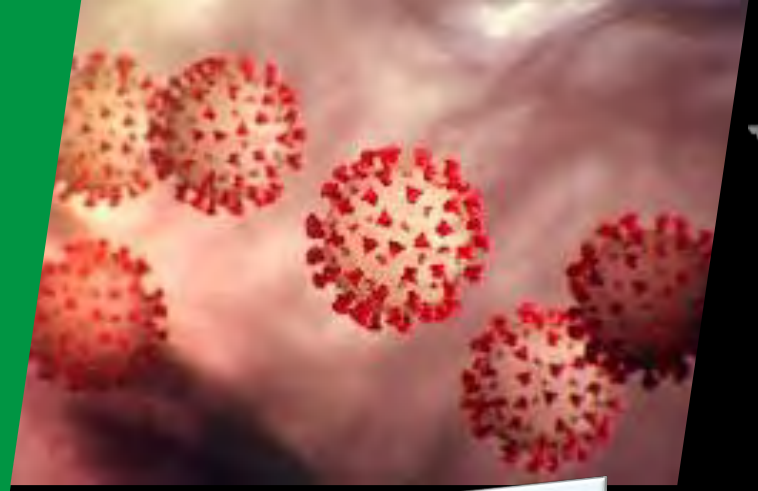

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NFPA 55 & NFPA 99

Medical Gas 2021 Code Updates

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The Gold Standard in Patient Safety

Presentation Outline

- NFPA 99 History
- NFPA 99 Code 2021 Update
- Responsible Facility Authority Update
- NFPA 55 Update
- Future Design Specifications
- Conclusions & Discussion

Regulatory Codes & Standards

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

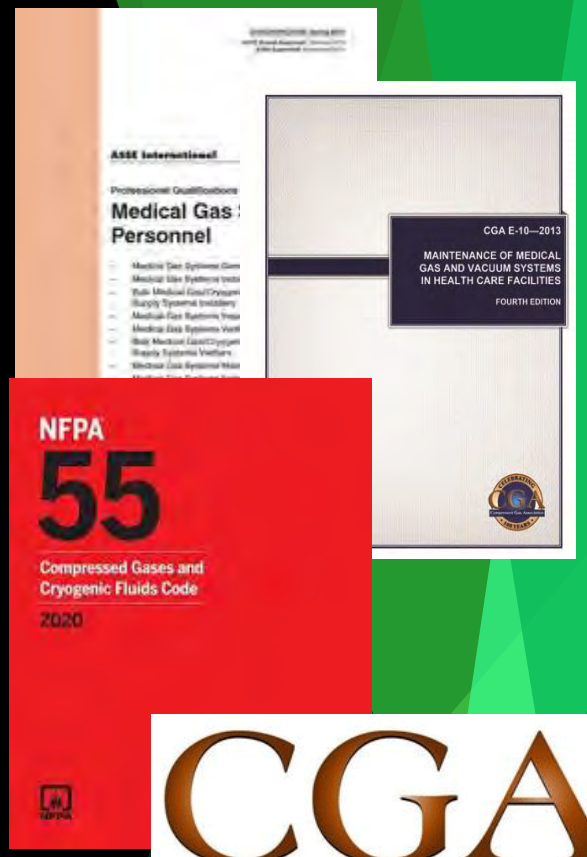
The scope of the NFPA 99: *Health Care Facilities Code* is to establish criteria to minimize the hazards of fire, explosion, and electricity in health care facilities providing services to human beings.

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



CGA
Compressed Gas Association
The Standard For Safety Since 1913

History of NFPA 99 Code

1986
- Medical Gas Board is established for the purpose of ensuring patient safety through standardization of practice.

1999
- NFPA updates code relevant to new industry standards.

2002/2005
- Minor edits completed for the purpose of staying current with evolving industry practices.

2012
- Major changes and reorganization of chapters.

2015
- NFPA 99 gets promoted from a "Standard" to a Code."

2018
- Category 3 Systems get assigned to Dental Chapter #15.

2021
- Responsible Facility Authority Permit to Work

2024
- Work in progress

NFPA® 99 2012 Edition

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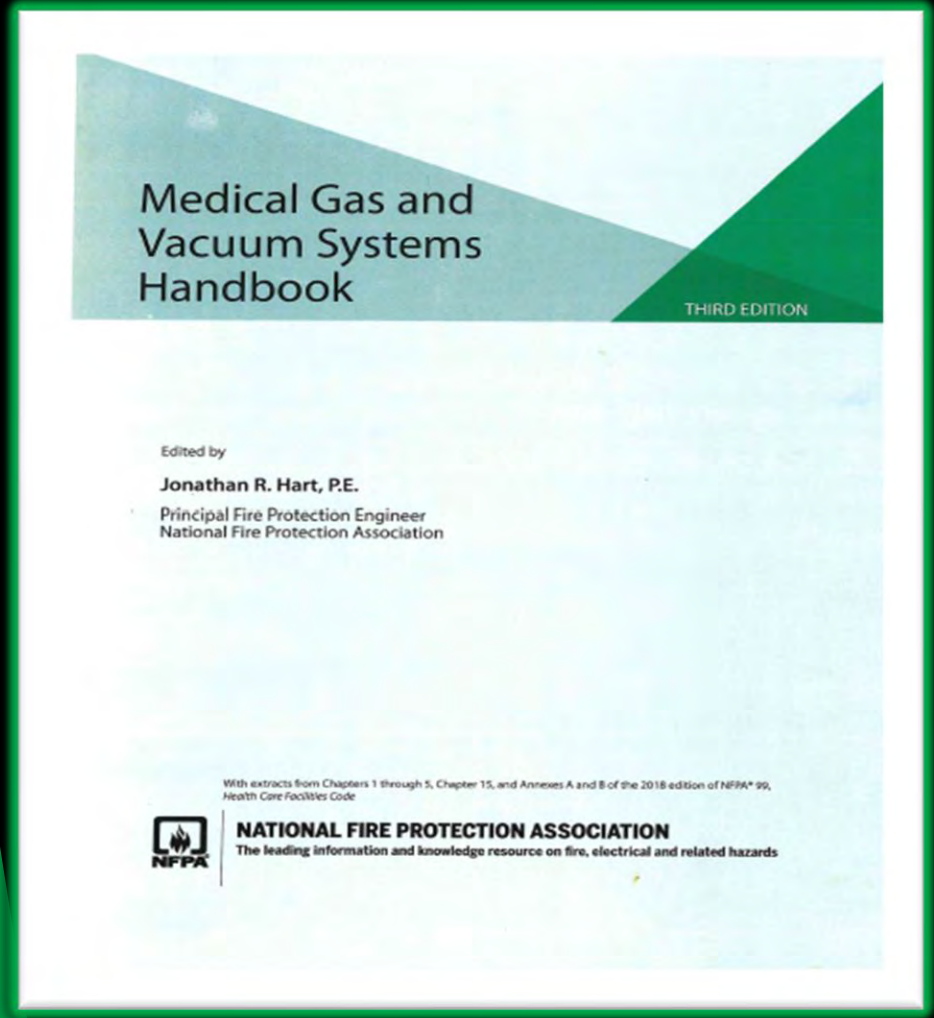
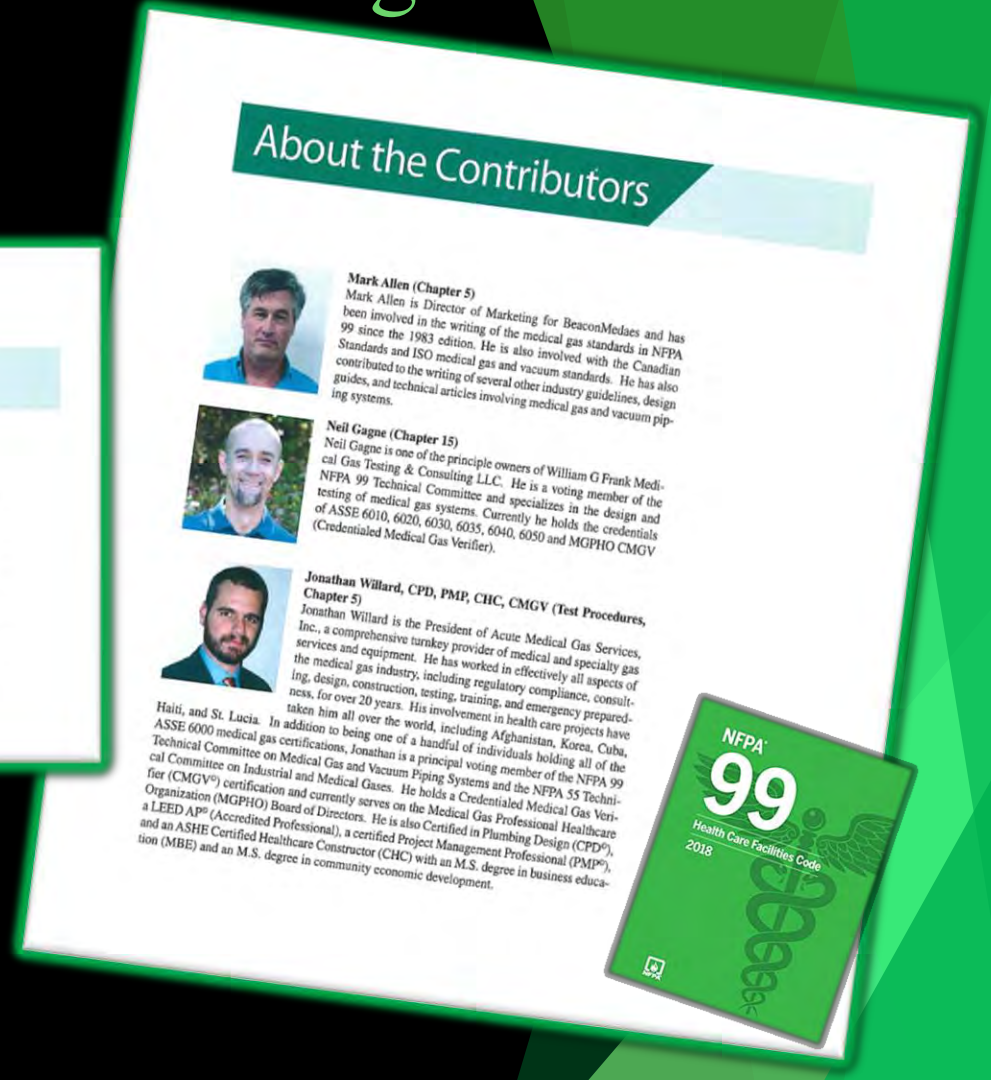
White Papers - Summary of Technical Changes 2018 - 2021





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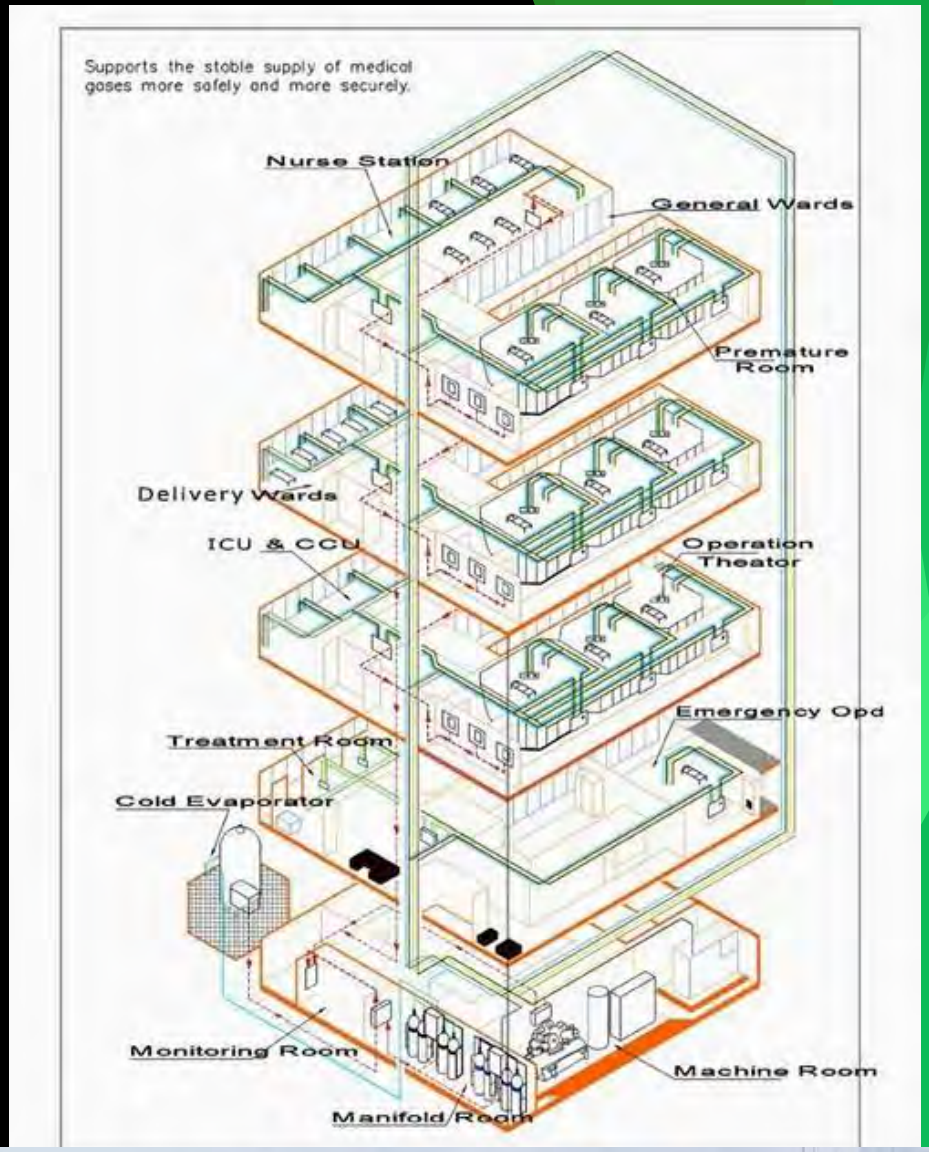
Typical Category 1 Medical Gas Systems

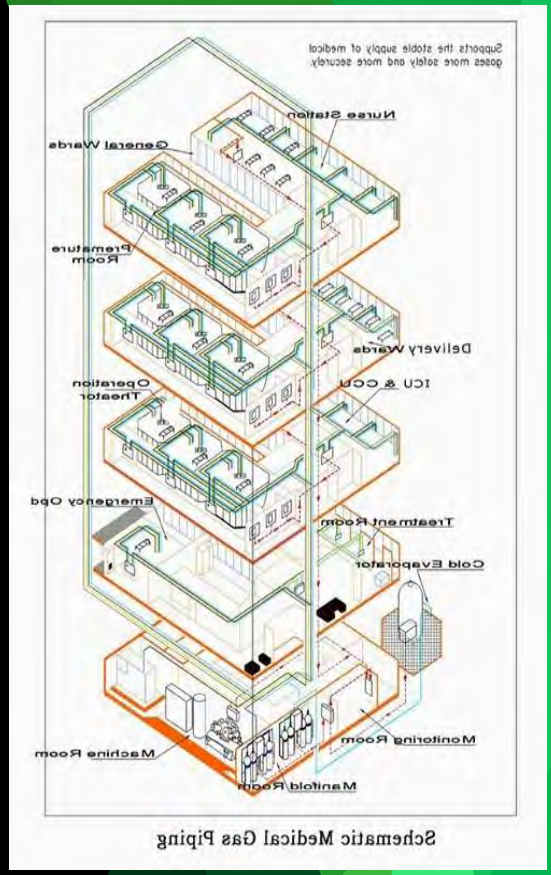


KNOWING YOUR FACILITY

Pandemic Response:
What We Learned from Medical Gas Overuse

- **Medical Gas System Capabilities**
- **Ventilator Usage**
- **Infrastructure (Can it Handle It)**
- **How your 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?



Schematic Medical Gas Piping

Risk Assessment

5.1.1.4 An existing system that is not in strict compliance with the provisions of this code shall be permitted to be continued in use, unless the Authority Having Jurisdiction (AHJ) has determined that such use constitutes a distinct hazard to life.

*The **Responsible Facility Authority (RFA)** should document a risk analysis on the specific requirements in question to determine if it's a distinct hazard to life.*

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.)

Following codes for existing buildings

5.1.1.5 The following sections of this chapter shall apply to operations, management and maintenance of Category 1 medical gas and vacuum systems in both new and existing facilities: 5.1.2, 5.1.3.1, 5.1.3.2, 5.1.3.3.4, 5.1.3.6.2, 5.1.3.6.3.10(A)(2), 5.1.3.7.6(A)(2), 5.1.8.4.1(2) & 5.1.14.

In Chapter 1.3 of this code, it is intended to apply to new healthcare facilities and altered, renovated or modernizations.

1.3.2.2 If the alterations, renovation, or modernization adversely impacts the existing performance requirements of a system or components, additional upgrading shall be required.

Following codes for existing buildings

5.1.1.6

Category 1 systems shall be permitted to serve spaces identified at Category 1, Category 2, or Category 3.

(This section has been modified to clarify that it is permitted for lower category spaces to be served by higher category systems. This was not explicitly stated in past editions. This section also clarifies the relationship between spaces and systems as they are used in this code.)

5.1.3 Category 1 Sources

Positive Pressure Gases
NO Smoking or Open Flame
Room May have Insufficient Oxygen
Open Door and Allow Room to Ventilate Before Entering

5.1.3.1.8.1

Existing signage that is not in strict compliance with the provisions of this code shall be permitted to be continued in use as long as the authority having jurisdiction has determined that such use does not constitute a distinct hazard to life.

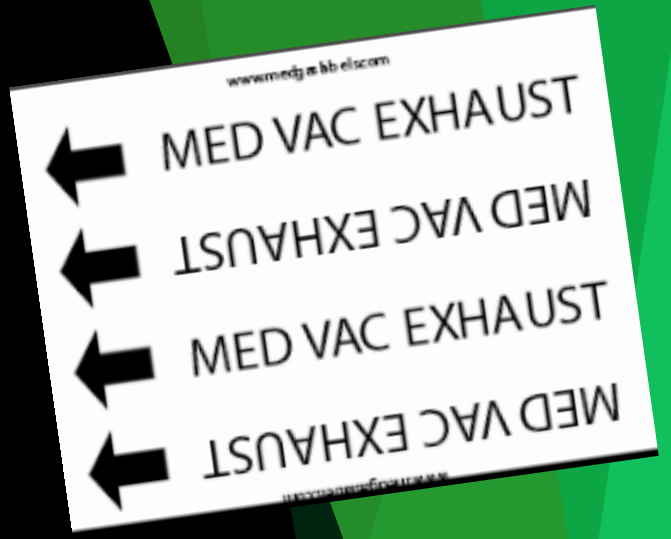
(This section is new to the 2021 edition of the NFPA 99 and is intended to alleviate the financial burden of having to replace all signage within an existing facility when there is a small change in the signage requirements. This has been written to allow the authority having jurisdiction to determine if continued use of existing signage could put lives in danger.)

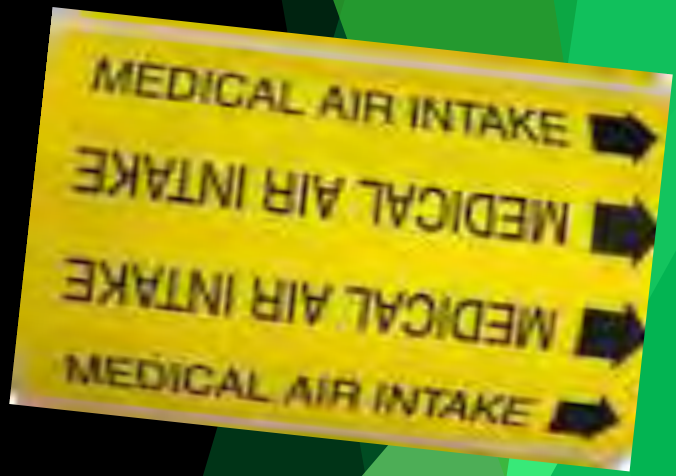
NFPA 99 2021: Summary of Changes
Chapter 5 Gas and Vacuum Systems

5.1.3.3.2.2
Design and construction of locations for cryogenic fluid central supply systems shall comply with 5.1.3.5.12***

****5.1.3.5.12Cryogenic Fluid Central Supply Systems. The storage, use and handling of cryogenic fluid central supply systems that deliver compressed medical gases (CMGs) to health care facilities shall be in accordance with 5.1.3.10***

NFPA 99 2021: Summary of Changes
Chapter 5 Gas and Vacuum Systems





5.1.3.6.3.11 Compressor Intake

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.

5.1.3.7.7.4 Vacuum Exhaust

Vacuum exhaust shall be labeled in accordance with 5.1.11.1 with any method that would distinguish it as a vacuum exhaust.

NFPA 99 2021: Summary of Changes
Chapter 5 Gas and Vacuum Systems

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.

5.1.11.5.2

Where vacuum systems are used to serve WAGD systems in accordance with 5.1.10.2.3.1, labeling for the medical-surgical vacuum source shall indicate that it serves both systems.

NFPA 99 2021: Summary of Changes
Chapter 5 Gas and Vacuum Systems

5.1.11.1.6

Labeling of piping for compressor intakes, vacuum exhausts, and relive valve vent lines shall meet the requirements of 5.1.11.1.1 and state the specific function to distinguish them from the patient supply piping.

NFPA 99 2021: Summary of Changes
Chapter 5 Gas and Vacuum Systems

5.1.11.4.3

Where medical gas systems operate at pressures other than the stand gauge pressure of 345 kPA to 380 kPA (50psi to 55psi), or a gauge pressure of 1100 kPA to 1275 kPA (160psi to 185psi) for nitrogen or instrument air, the area alarm panel identification shall include the nonstandard operating pressure in addition to the name of the gas.

NFPA 99 2021: Summary of Changes
Chapter 5 Gas and Vacuum Systems

5.1.11.4.4
Where vacuum systems are used to serve WAGD systems per 5.1.10.2.3.1, an area alarm panel(s) monitoring the area in which the WAGD system is used shall be labeled to indicate both systems.

5.1.11.5.1

Source equipment shall be labeled or tagged to identify the patient medical gas, the medical support gas, or the vacuum system and include the following information:

1) Name of the gas or vacuum system
2) Gas or vacuum system color code
3) Rooms, areas or buildings served.
4) Emergency contact information for the department or individual responsible for maintaining the equipment.

(Many other components are required to be labeled with critical information. The source equipment should also be labeled with minimum information so that those responding to an issue are able to quickly understand the potential impact on patient care.)

5.1.13.3.6 Nitrogen NF Central Supply Systems

Nitrogen NF central supply systems shall be permitted to consist of the following:

1) Manifolds for gas cylinders in accordance with 5.1.3.5.11
2) Manifolds for cryogenic liquid containers in accordance with 5.1.3.5.12
3) Cryogenic fluid central supply systems in accordance with 5.1.3.10.

5.1.13.3.6.1 General.

(A) Nitrogen NF central supply systems shall be obtained from a supplier or manufacturer familiar with their proper construction and use.

(B) Nitrogen NF central supply systems shall be installed in accordance with the manufacturer's instructions.

5.1.13.3.6.2 Medical Support Gases

Nitrogen NF central supply systems for medical support gases shall not be piped to or used for any purpose except medical support application.

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.

Operational Management Overview

Entering Stage Right:

The Responsible Facility Authority (RFA)

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.

Responsible Facility Authority

- The NFPA 99 2021 Edition introduces new requirement for a **designated** individual(s) to be responsible for the medical gas systems.

The term has been used for many years for inspections and testing and for the documentation/recordkeeping requirements.

Previous editions have stated that “reports” must be submitted to the RFA and that the RFA is responsible for ensuring that, before initial use of the systems, that those systems have been adequately tested and the test results demonstrate the systems are **acceptable and safe** for patient use.

Who is our Fearless Leader!

Responsible Facility Authority

- The NFPA 99 goes a long way to assist in providing guidance on how to implement this new requirement.
- This new program is modeled on other codes and standards that are widely accepted throughout the world including the British HTM Standard and the International ISO 7396-1 for Medical Gas Systems.

- The new requirements are meant to be flexible and adaptable to differing operational structures of facility management groups who are generally responsible for these systems.
- One of the primary responsibilities of the position is to implement the NFPA 99 code requirements for the Piped Medical Gas and Vacuum (PMGV) Systems that are in operation at any health care facility.

The Designated RFA

- An unplanned failure of a hospital's oxygen system can have a catastrophic effect on routine patient care.
- Managing the day-to-day operations and specific duties can are varied and diverse in nature. Therefore, the RFAs must be qualified and technically competent to fulfill these roles.

Ensuring Compliance and Properly Managing systems are essential to patient safety!

Who's at the Helm?

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.

RFA Qualifications

Education and Certifications Outlined in NFPA 99:

An educational program acceptable to the governing body of the health care facility and substantially equivalent or superior to below.

- **ASSE 6010**, *Medical Gas Systems **Installers***
- **ASSE 6020**, *Medical Gas Systems **Inspectors***
- **ASSE 6030**, *Medical Gas Systems **Verifiers***
- **ASSE 6040**, *Medical Gas **Maintenance Personnel***
- AND technical competence on the specific equipment and design of the health care facility

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*

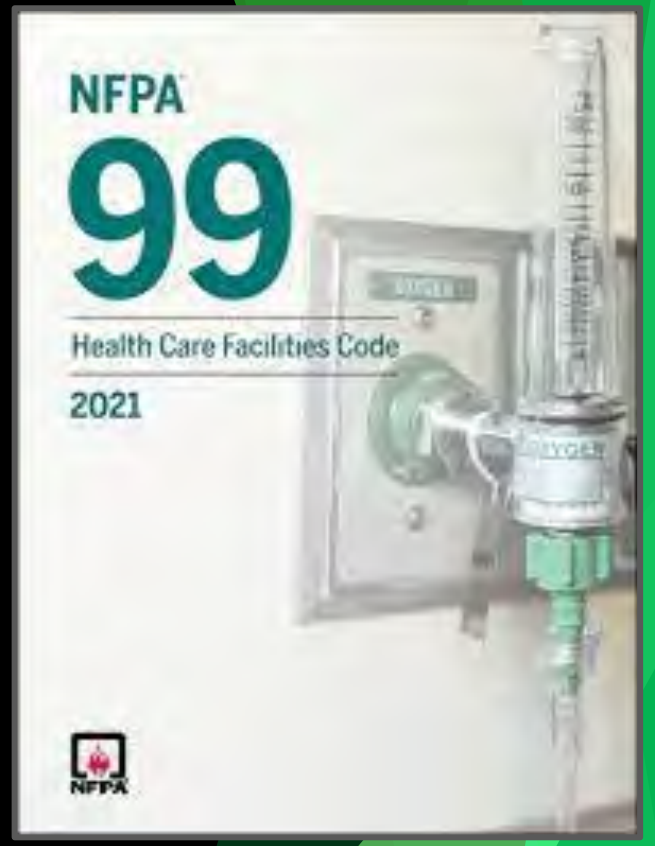
ASSE 6040, *Professional Qualifications Standard for Medical Gas Maintenance*

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

Name/Title: _____

Navigating the Regulatory Environment

- Code interpretation and ensuring compliance are usually in large part one of the primary responsibilities of the facilities management group.
- Compliance is the accepted **validation** that the systems being used in the hospitals are safe and reliable for patients.
- Accreditation is **confirmation** that the organization has organizational and management practices that demonstrate a continuously maintained quality health care environment.



However, code interpretation and compliance are only half the battle!

The RFA Program

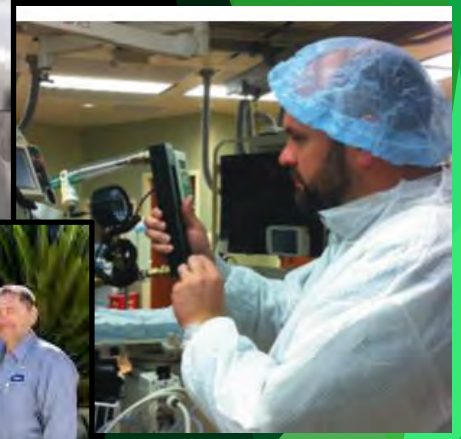
What are Some of the Other Responsibilities?

- Interpreting Regulatory Compliance Requirements
- Conducting Risk Assessments
- Developing and Enforcing a Permit-To-Work (PTW) System
- Evaluating and Accepting ITM Reports and Documentation
- Oversight of Critical Records
- Writing and Upkeep of:
  - Medical Gas Management Programs
  - Policies and Procedures
  - Emergency Management Programs
- Supervising Personnel Training and Licensing Programs

The RFA Program

Who's flying the Plane?

Who's helping to keep the plane in the air?



IT TAKES A VILLAGE!

The RFA Team

Is it practical for one RFA to do EVERYTHING?

Small organizations it may be possible for the RFA program to be overseen by a single individual.

Larger organizations it is likely to require a team of people to ensure that all the responsibilities outlined in the code are managed properly.

The “Designated RFA” may be shift specific. Consider a backup plan!

It might be useful to define additional roles based on individual expertise and qualifications. (i.e. Interpreting ITM Reports vs. Doc. Management)

These roles should be WELL defined through policies and procedures with final accountability resting with the Responsible Facility Authority (RFA).

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:

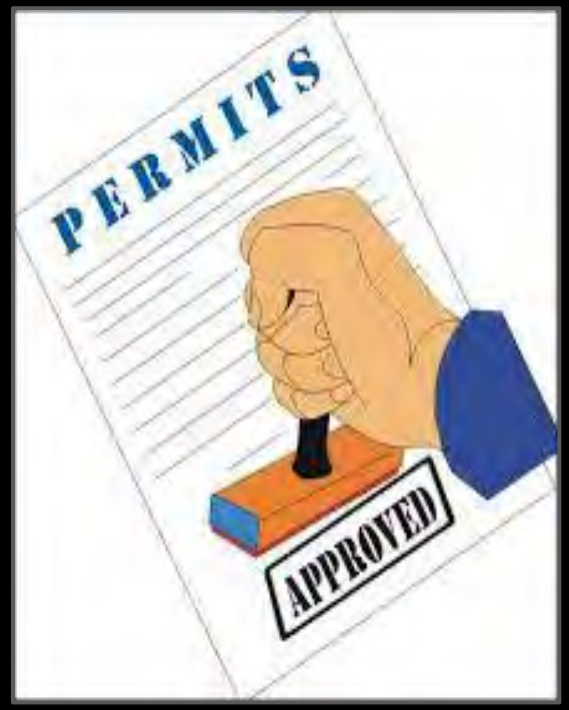
1. The effected clinical staff and administration is communicated with prior to work on piped medical gas and vacuum systems
2. Alternate supply or adjustments are in place
3. All work performed by competent and credentialed individual
4. Procedures of shutdown and restoration are communicated to all 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

Permit-To-Work System

- **Permit-To-Work (P-T-W)** refers to management systems used to ensure that work is done safely and efficiently. These are often used in hazardous industries or within hazardous operations. The P-T-W system involves procedures to request, review, authorize, document, and de-conflict specific tasks to be carried out during the permitted work.
- The new NFPA 99 permitting system is meant to formalize and codify a policy approach to managing routine work including maintenance, repairs, and construction activities as they relate to the active PMGV systems.
- The P-T-W system should include developing and enforcing applicable procedures to ensure the **uninterrupted continuity and quality** of the active medical gas systems.
  - A P-T-W is not a replacement for a robust risk assessment process but can help provide context for the types of risks associated with the work being performed.

The P-T-W Program

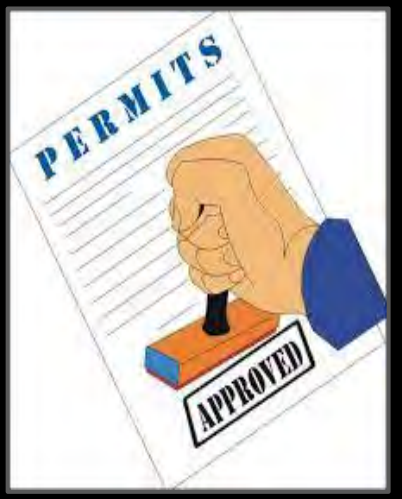
- **Similar to a Confined Space Entry Permit Program:**
  - * Multiple Layers of Review – Before Start of Work
  - * Clear Definition of the Scope of Work
  - * Duration and Scheduling of Work Tasks
  - * Chain of Command and Communication Protocols
  - * A Method for Clear Acceptance of the Plan and Signoff by All Involved
  - * System Monitoring During the Performance of Work
  - * Confirmation of the Closeout of Work



- This analogy helps to better understand some of the similar complexities involved in working on a critical medical gas system at a hospital.

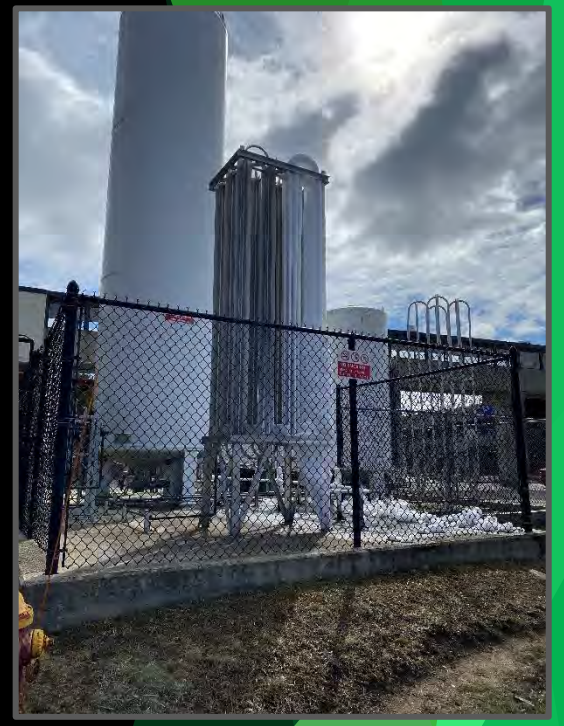
Permit-To-Work System

- **Policies and procedures should address the following:**
  - * Appropriate Communications Plan (Chain of Command)
  - * Shutdown and Restoration Procedures
  - * Standard Operating Procedures for Work Tasks
  - * Safety Protocols to Follow (i.e. ICRA)
  - * Alternative Supplies or Adjustments to Patient Care Arrangements
  - * Competency of Those Who Work on the PMGV Systems.
  - * Inspection, Testing, Maintenance, and Commissioning of Systems
  - * Procedures for Interruptions



High Hazard Permits

- **Should be used when the following exists:**
  - Anytime there is a chance for system contamination or cross connections
  - An isolation of any source of supply that is actively serving patient areas
  - A requirement for third-party testing and certification
  - The use of purging and/or brazing operations
  - Emergency repairs are required
- High-hazard permits will generally require testing by an ASSE 6030 certified verifier.



***Prior to system use, the permit process should include a verification by both the RFA and the verifier that all testing has been completed and that system integrity has been achieved or maintained. This is to confirm that the systems are ready for patient use as required by the code.

High Hazard Permits

- There should be process to address emergency work on the systems.
- If an emergency requires an immediate approval to proceed with work, there should be means to expedite the permit process for a quick authorization by the RFA or their designee to ensure any required emergency operations can be completed in a timely manner.

Low Hazard Permits

Should be used for routine tasks when:

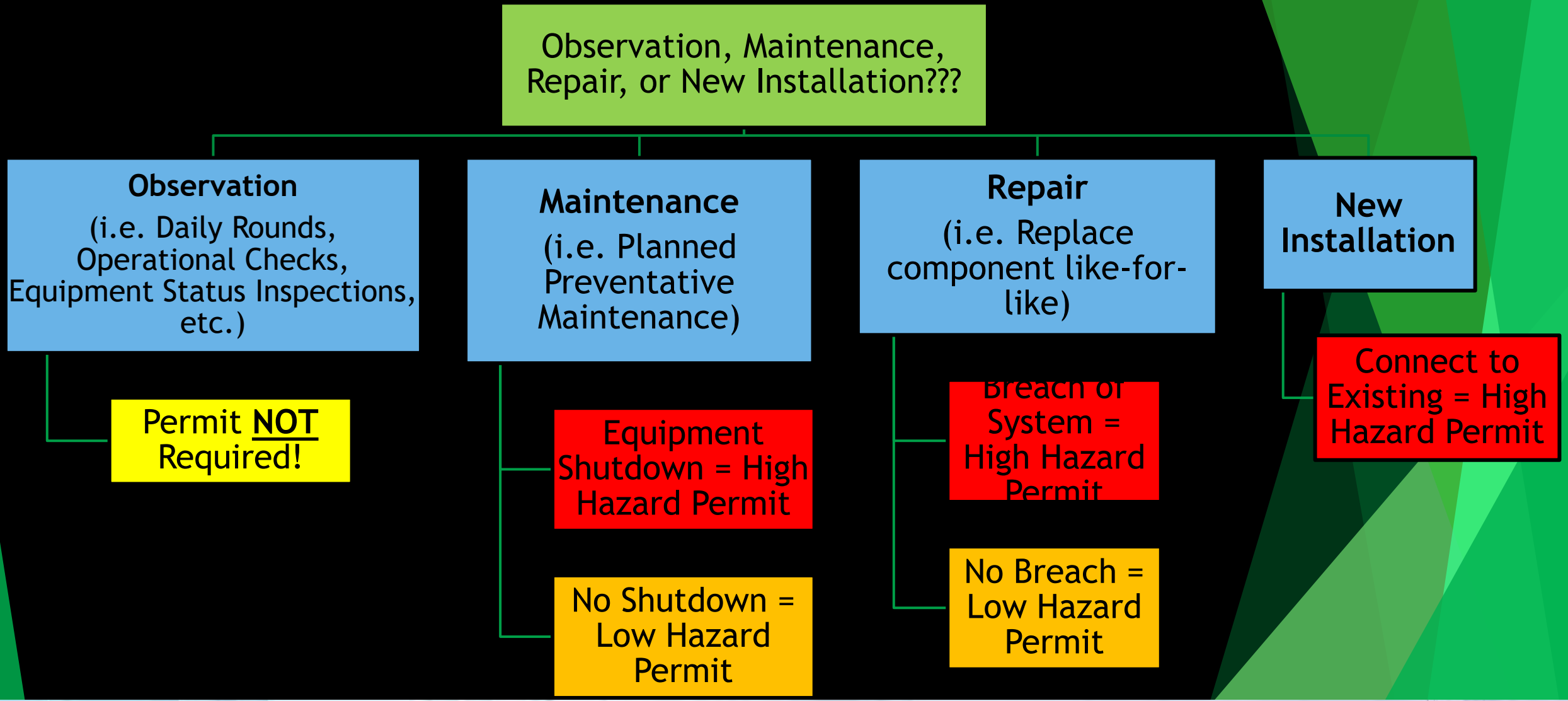
- Complicated planning and work hazard analyses are not required
- There is no interruption of patient services or the need for temporary services A risk assessment is not required
- Well established SOPs are used (customized procedures are not required) A third-party certification is not required

Good Example: Replacement of like-for-like components (i.e. pressure gauge) that can be isolated without affecting the systems being used for patient care.

The repair work and required functional testing should always be completed by technically competent and qualified individuals.

Low-hazard permits should not be required for typical maintenance rounds or system “observations” as they do not affect system operations.

PTW Decision Tree



Permit Forms

A permit to work form typically contains these items.

- The work to be done
- The equipment to be used
- The personnel involved
- Precautions to be taken when performing the work tasks
- Other workgroups to be informed of the work being performed in their area
- Authorization for the work to commence
- Duration that the permit is valid
- Method to extend the permit for an additional period
- Witness mechanism that all work has been completed and the worksite is restored to a clean, safe condition
- Actions to be taken in an emergency

NFPA 99 – ITM Requirements

- Inspection and testing shall be performed on all **NEW** piped medical gas and vacuum systems, additions, renovations, temporary installations, or **REPAIRED** systems to ensure system integrity has been achieved or maintained.
- The definition of a "breach" Definition is very broad in NFPA 99. It states that systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition.
- The responsible facility authority shall review these inspection and testing records prior to the use of systems.
- So, what testing is required?
  - Breaching involving separation of piping to atmosphere or conducting brazing operations requires a third-party verification by and ASSE 6030 verifier.
  - All other breaches require "functional testing" by a qualified individual.

New Requirements

- System inspections shall be performed prior to concealing piping systems in walls, ceilings, chases, trenches, underground, or otherwise hidden from view.
- Inspections must be by someone who is technically competent and experienced in the field of medical gas and vacuum inspections and testing and meeting:
  - ASSE 6020: Medical Gas Systems Inspectors; OR
  - ASSE 6030: Medical Gas Systems Verifiers
- Inspections shall be performed by a party other than the installing contractor.
- Inspections are permitted to be by in-house personnel of the organization who meet the requirements.

Required Inspections:

- Pressure testing performed by the installing contractor.
- Labeling and valve tagging for all concealed components and piping.

Medical Gas and Vacuum Systems are an Essential Utility and Require Proper Oversight

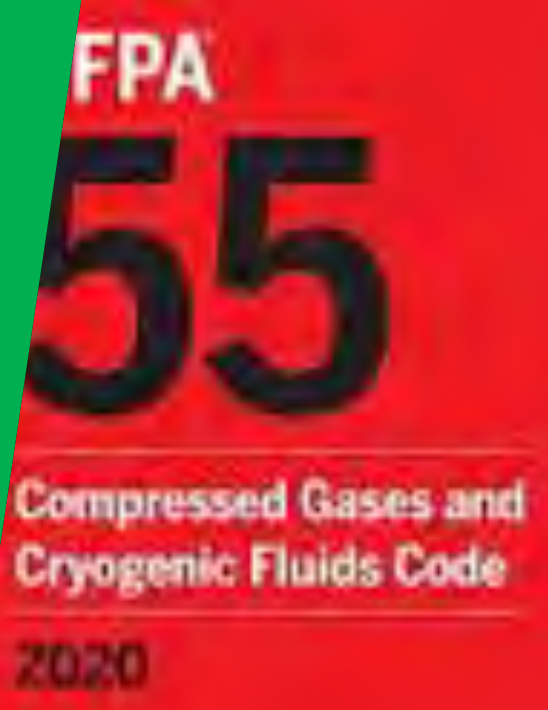
Reliable medical gas systems provide critical sources of life-supporting gases that are essential for the proper treatment of patients.

With the addition of the RFA and P-T-W systems into the operation requirements of the code, it is clear the goal is to continue to ensure these systems remain safe and reliable on an ongoing basis

RESPONSIBILITY IMPROVES RELIABILITY

WE THANK OUR COVID HEROES!

NFPA 55 Compressed Medical Gases (CMG)



NFPA 55 Update (2020 Edition)

- Applicability and Scope Clarifications between NFPA 99 & NFPA 55.
- What to worry about in NFPA 55?
- Important Definitions
- NFPA 55 Clarifications

NFPA 55 Charging Statements:

- **Applicability.** This code applies to the ***installation, storage, use, and handling*** of compressed gases and cryogenic fluids in portable and stationary cylinders, containers, equipment, and tanks ***in all occupancies***.
- **Specific Applications.** This code shall not apply to the following:

  Use and handling of medical compressed gases at health care facilities in accordance with NFPA 99, except as specified in Chapter 17.
- **Conflict w/ NFPA 99.** ***Storage, use, and handling***…of other gases???

The Purpose of NFPA 55

- **Purpose.** The purpose of this code shall be to provide fundamental safeguards for the ***installation, storage, use, and handling*** of compressed gases and cryogenic fluids in portable and stationary cylinders, containers, and tanks.

- **Application.** The requirements in this code shall apply to ***users***, producers, distributors, and others who are involved with the storage, use, or handling of compressed gases or cryogenic fluids.

NFPA 55 vs. NFPA 99

- **Applicability.**
  - **The source valve shall be the line separating the applicability between NFPA 55 and NFPA 99.**
  - **CFCSS installations up to, but not including, the source valve shall be covered by NFPA 55.**
  - **The source valve and all downstream piping and components, including wiring to storage system alarms, shall be covered by NFPA 99.**
- **Applicability.**

Definitions to Know

- **Compressed Medical Gases (CMG).** Any liquefied or vaporized gas alone or in combination with other gases that is classified as a drug.
- **Cryogenic Fluid Central Supply System (CFCSS).** An assembly of equipment for supplying compressed gases, including, but not limited to, a stationary tank(s)…, pressure regulators, PRDs, vaporizers, etc. that are designed to be filled at the facility and that terminates at the *source valve*.
- **BULK CFCSS.** A CFCSS with a storage capacity of more than 20,000 ft3 (scf). NFPA 55 is Primary Document.
- **Micro-Bulk (Non-Bulk) CFCSS.** A CFCSS with a storage capacity of up to 20,000 ft3 (scf). NFPA 99 is Primary Document.

Storage of Compressed Gas Cylinders

- **Which Codes Apply?** Building code, Life Safety Code, NFPA 55, NFPA 99, ASHRAE 170, OSHA?
  - All of them!
- **Navigating the Requirements.**
  - NFPA 55 when cylinder are NOT used for medical gas systems (i.e. Helium for MRIs and Carbon Dioxide in Laboratories) or for direct patient use (i.e. grab-n-go cylinder for patient transport)
  - NFPA 99 for storage, use, and handling of medical gases
  - ASHRAE 170 when air exchange calculation is less than 10 ACH AND must be mechanical exhaust

NFPA 55 Clarifications

- **If you're hearing terms like MAQs, Control Rooms, Control Areas, or Use Areas…Sir, Wrong Book!**
- **NFPA 55 Storage Requirements for Compressed Gases:**
  - *Indoor AND Exterior Storage* of compressed gases shall be in accordance with the material-specific provisions of Sections 7.4 through 7.10.
  - 7.4 states that medical gas systems for health care shall be in accordance with NFPA 99.

NFPA 55 Clarifications

Is a Concrete Spill Pad Required for the EOSC?

- The short answer is **NO**!

However, access and clearance are critical. The location for the EOSC is important for the intended use of the assembly.

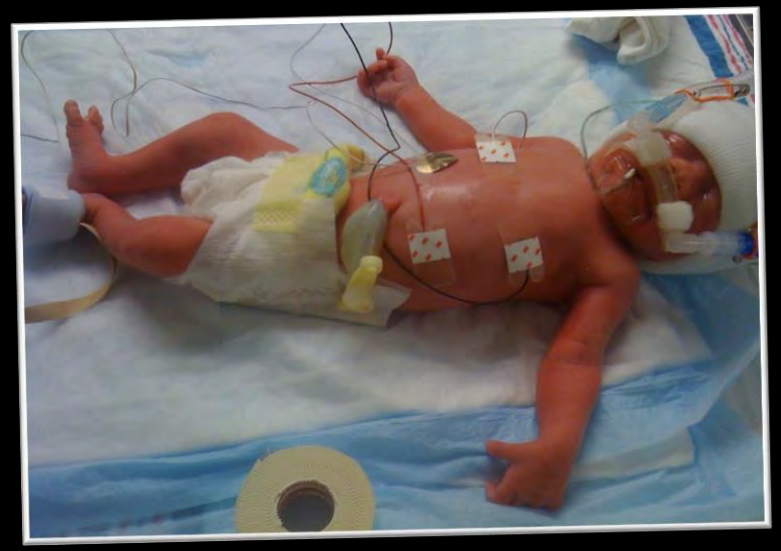
3 feet of clearance required for the EOSC.

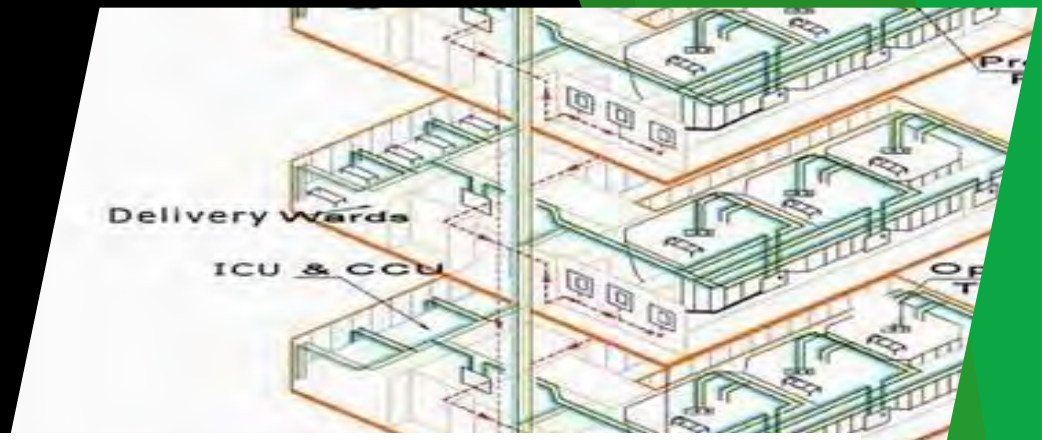
Alarms Connections!!!

NFPA 55 Clarifications:

- New Chapter 17: Cryogenic Fluid Central Supply Systems for Health Care Facilities
- Installation Qualifications
- Inspection and Testing Qualifications
- System Security & Physical Protection
- Separation from Exposure Hazards
- Portable Systems

Forward Thinking Designing Medical Gases for the Future





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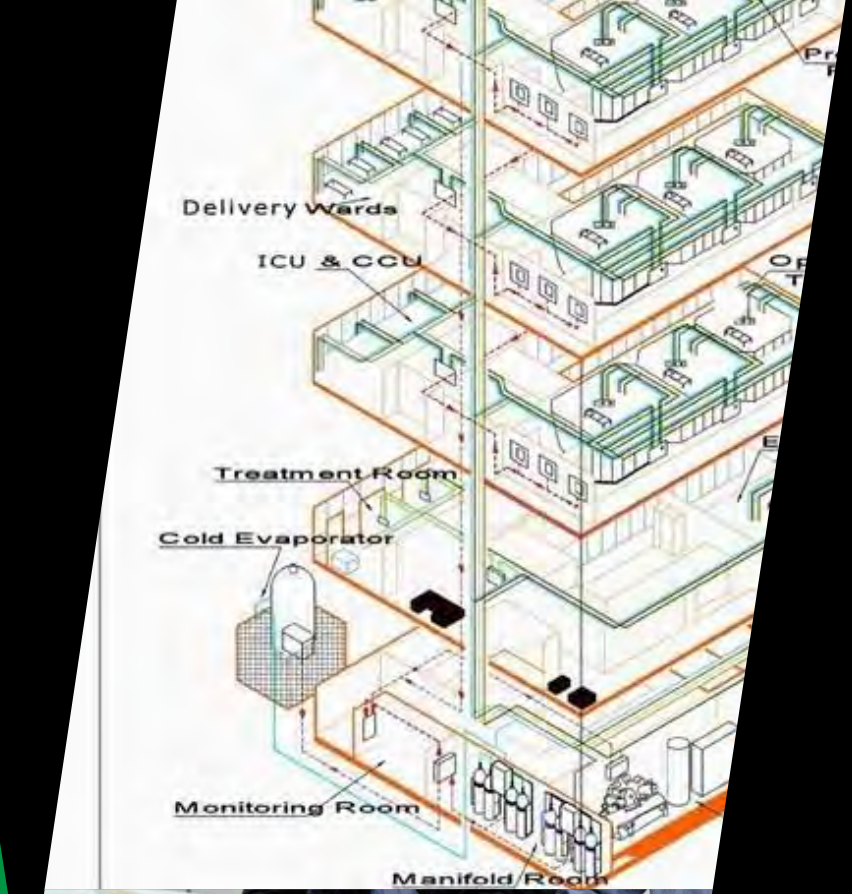

Future Design Specifications for Medical Gases

- 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

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


BMS

Medical Gas Related Disasters

Medical Gas Related Disasters

What happened?

Medical Gas Related Disasters

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

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

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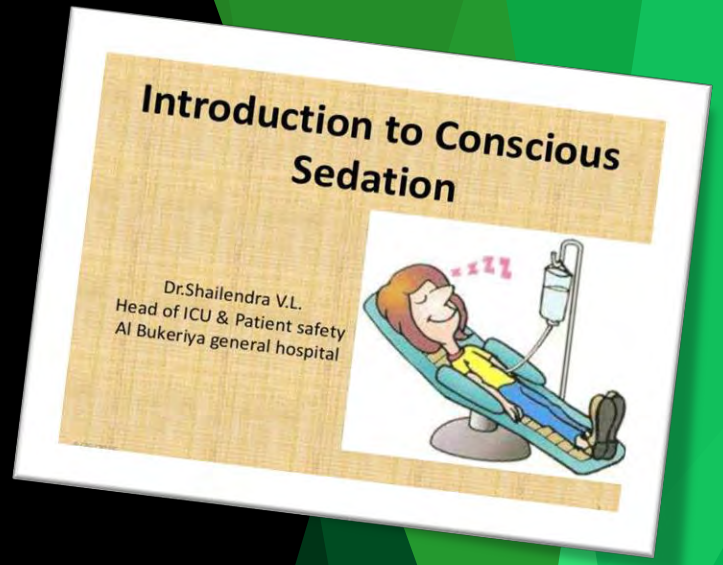
Two patients at Lanham, Md.-based Luminis Health Doctors Community Medical Center died after an oxygen valve was mistakenly turned off during maintenance Jan. 15, *FOX 5 DC* reported Jan. 28.

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."

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.

Risk Assessment

Because the level of risk in performing some tasks on the PMGV systems are far greater than others, it seems counterintuitive to have a one-size-fits-all approach.

Developing risk-based criteria for the P-T-W system is appropriate and the program may include multiple hazard levels for the permitting process.

For example, low-hazard permits may be issued for low-risk work tasks and could have a less restrictive process to determine staff involvement and approvals, and therefore, could generally be issued fairly quickly.

Whereas a high-hazard permit may require a more involved review and assessment by multiple departments, involving many layers in the planning and execution of the work with final authorization possibly coming from the executive level of the organization.

Risk Assessment

While the majority of work tasks will be easy to assess whether they are a low or high risk, some tasks may need to be evaluated for potential impacts on patient care.

Good Example: Isolation of a Supply Source (i.e. individual medical air compressor or vacuum pump) from the rest of the system for maintenance or repair.

This may or may not be high-hazard work.

NFPA 99 Design Standard:

Single Fault Failures are Not Allowed

Always a backup source in the "standby mode." Minimum of (2) Sources of Supply.

Source isolation during maintenance procedures not currently addressed.

Component failure could affect supply of medical gases to patients.

A risk-based assessment should be conducted to ensure a continuous supply during maintenance activities.

Threats

Guideline for Medical Gas Risk Assessment

(Ask Providers for Specific Documentation)

Important New Technologies Building System Categories

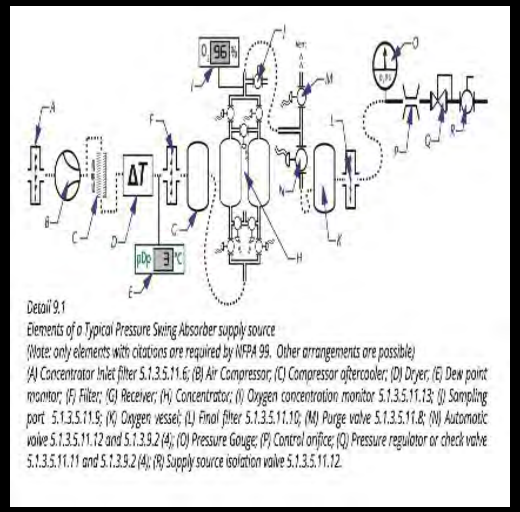
EZ Find" Technology

- 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

Vertical Zone Valves Box

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)

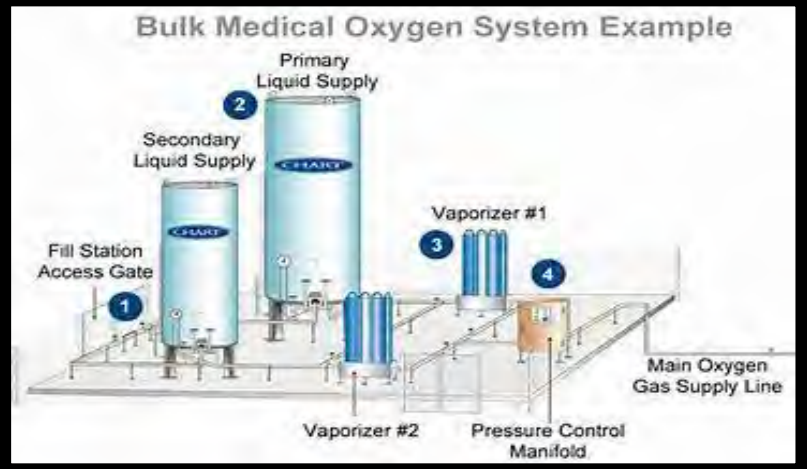


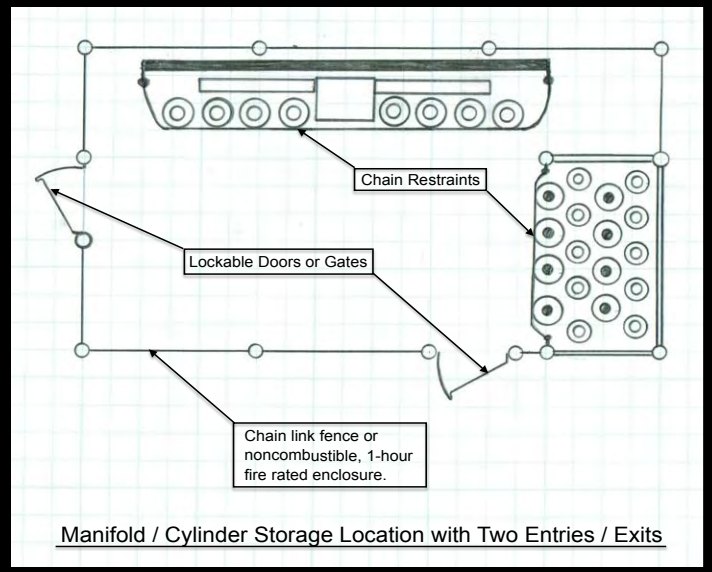
Detail 9.1
Elements of a Typical Pressure Swing Absorber supply source
(Note: only elements with citations are required by NFPA 99. Other arrangements are possible)
(A) Concentrator Inlet filter 5.1.3.5.11.6; (B) Air Compressor; (C) Compressor aftercooler; (D) Dryer; (E) Dew point monitor; (F) Filter; (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.

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

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

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.

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

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

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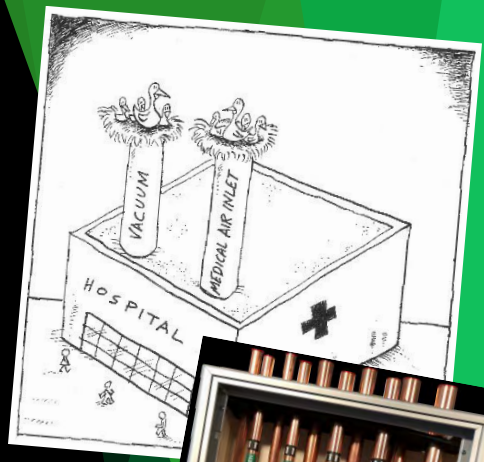
Compressor Intake & Vacuum Exhaust

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

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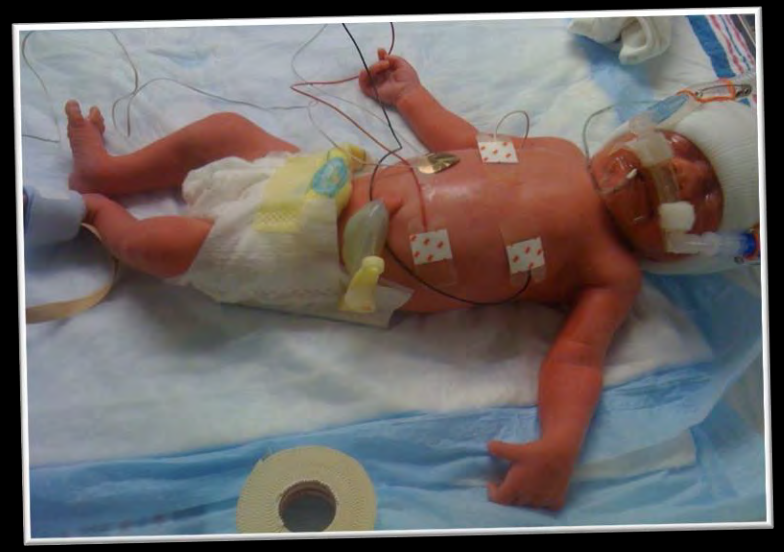
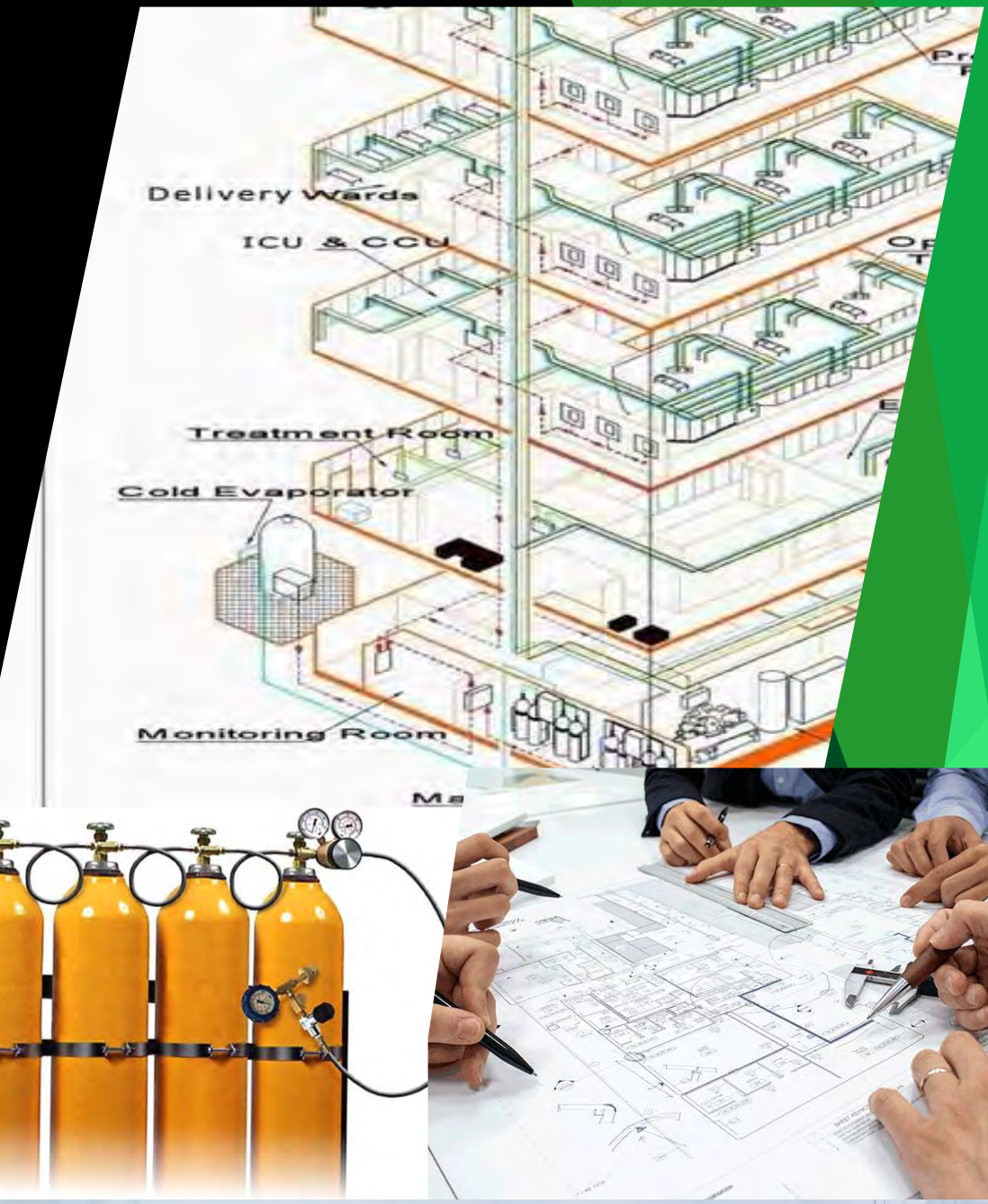
Summary

Forward thinking Designing Medical gases for the future





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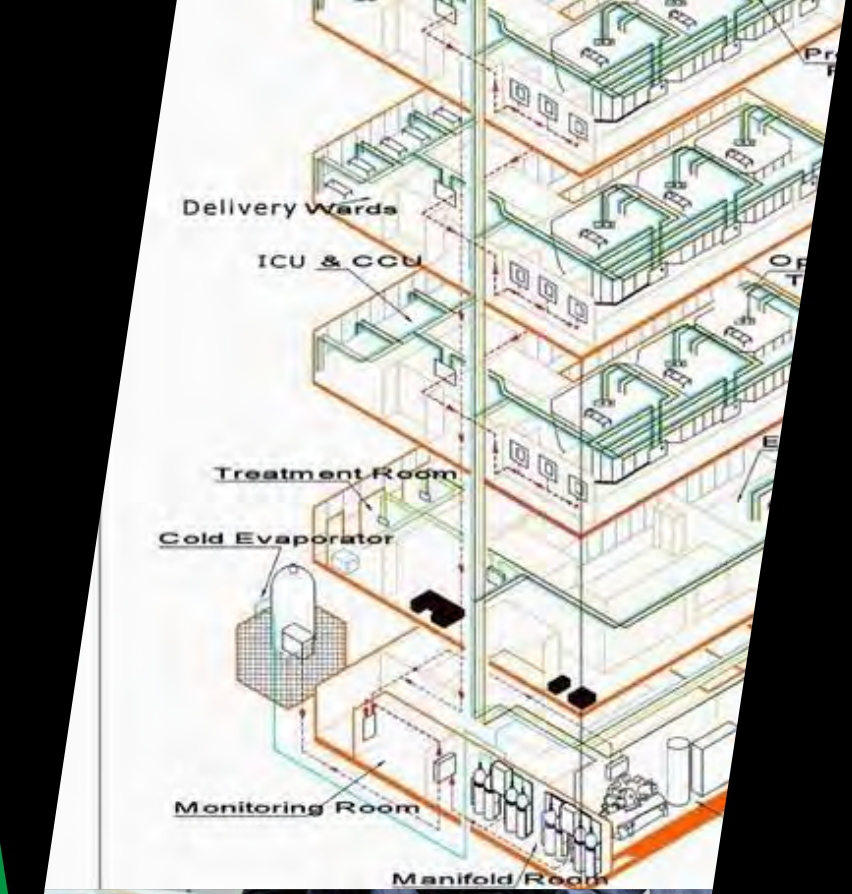

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Qualifications and Permit to Work Systems

THANK YOU SO MUCH FOR YOUR TIME!!!

Please contact us for additional information.

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