



SECTION 3-13: PIPED MEDICAL GAS AND VACUUM SYSTEM MANAGEMENT

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3-13-00 POLICY

The purpose of this section is to define the roles and responsibilities of Office of Research Facilities (ORF) and the administration of the Clinical Center (CC) in managing the design, construction, commissioning, maintenance, and testing of all new and existing piped medical gas and vacuum systems (MGV) in the hospital environment. The goal is to design and maintain MGV that meet the research and clinical needs of the CC, comply with the National Fire Protection Association (NFPA) 99, and ensure safe and reliable systems consistent with The Joint Commission (TJC) Environment of Care (EC) Standard and related industry standards.

ORF will collaborate with CC leadership to institute the following measures during installation, modification, testing, and maintenance of all critical components of the MGV in the Clinical Center Complex (CCC):

- Design MGV systems to meet clinical and research requirements and applicable codes and standards.
- Have qualified workers perform installation, labeling, repair, inspection, and certification per NFPA99 and industry standards.
- Have installation, labeling, repair, inspection, and certification work reviewed for compliance with NFPA99 and industry standards.
- Complete inspection, testing, and maintenance activities at the frequencies listed in Exhibit X3-13-A. Complete the respective tasks within timeframes approved by the Hospital Safety Committee (i.e., within ± 45 days of the prior task for semiannual and within ± 60 days of the prior task for annual tasks).
- Document all inspection, testing, and maintenance activities, including description of work performed, deficiencies found, completion date, and name of individual performing the work.
- Communicate to the Office of Hospital Physical Environment (OHPE) and to the CC leaders prior to leaving the work site for the day all deficiencies that represent a risk to hospital occupants to ensure health care workers are aware of deficiencies in a timely manner. Health care workers assess the risk to patients for deficiencies identified and implement temporary alternate measures, including clinical interventions, as warranted.
- Collaborate with the CC staff to identify areas where life-support-level care is provided to identify items in the MGV inventory for urgent response.
- Use measurement, evaluation, and reporting of performance (e.g., completion rates for scheduled maintenance) to monitor compliance with this Policy.



A. APPLICABILITY

This policy and procedure applies to all design, construction, commissioning, maintenance, and testing of all new and existing MGV in the hospital environment.

B. RESPONSIBILITIES

The CC assesses the needs of its patients and clinical stakeholders determine the types, locations, and criticality levels of MGV within the hospital. Consistent with these determinations, ORF, in collaboration with CC, works to ensure the following:

- MGV design begins with a Program of Requirements (POR) document to meet the specific need of the hospital.
- MGV is designed by qualified A/E contractors per applicable code requirements and reviewed according to established ORF review process.
- Installation, inspection, testing, and maintenance of its MGV are properly managed.
- CC and ORF staffs are properly trained.
- MGV operate safely, reliably, and as designed and meet the needs of the hospital.

ORF manages the MGV program with support from CC Safety Office, CC Office of Space and Facility Management (CC-OSFM), Biomedical Engineering and Personal Property Management Section (BIOMED) and Storage and Distribution Section of the CC Materials Management Department (MMD), the DFM, and guidance from the medical staff and health care workers. Responsibilities of the various organizations are described below:

- **Division of Technical Resources (DTR), ORF** – provides planning and reviews MGV design performed by A/E firms for the compliance with applicable standards and codes.
- **Division of Property Management (DPM), ORF** – oversees the operations, maintenance, repair, and renovation of MGV. Within DPM, the Capital Projects West Branch and Construction Management Branch (CMB) provide planning, design, acquisition, construction, commissioning and quality assurance. DPM/FSB will review design specifications and drawings to ensure MGV system being installed or replaced to avoid issues during construction and operation and maintenance.
- **Office of Hospital Physical Environment (OHPE), ORF** – provides overall review and oversight for The Joint Commission (TJC) compliance of design, commissioning, inventory management, labeling of components, maintenance, testing, and system breach activities. In conjunction with CC Office of Space and Facility Management (CC- OSFM) and Division of Fire Marshal (DFM), the OHPE verifies documentation of work performed in order to meet provisions for occupancy certification of areas to be used for patients after renovation or installation.
- **Real Property Management Organization (RPMO), ORF** – provides management of utilities, inspection, testing, operation, maintenance, and emergency response for all MGV throughout the CCC. The Joint Commission Engineering Team (JCET) provides quality control for TJC compliance of installation, testing and maintenance activities.
- **CC Office of Space and Facility Management (CCOSFM)** – monitors and arranges for replenishment of the supply for the CC bulk central Oxygen tank system and Nitrogen manifold systems for the surgery area. Works with ORF and other CC staff to ensure all work on the MGV is coordinated with the health care manager for the respective area to reduce risk of unscheduled disruption of service and scope of work matches the needs of the users.

- **CC Biomedical Engineering and Personal Property Management Section (BIOMED), Materials Management Department (MMD)** – maintains and monitors service contracts for the maintenance and inspection of flexible connections located on the rooms in surgery and the intensive care unit.
- **CC Storage and Distribution Section, MMD** – manages the purchase and delivery of all portable medical gas cylinders that are used for patient care at the bedside and for manifold systems.
- **Division of Fire Marshal (DFM)** – provides design review and approval, as requested, to ensure all aspects of design and installation are in compliance with the applicable codes as described in NIH Policy Manual Chapter: 1370- Fire Protection and Life Safety Building Permit Process.
- **CC Office of Hospital Safety** – facilitates communications between ORF and hospital workers and reviews summary documentation of activities via the Safety Committee to ensure the MGVP Program meets the needs for patient care and TJC standards and, when applicable, clinical interventions are implemented for patient safety. These communications involve risk assessments to identify areas within the hospital that are dependent on MGVP for life support and critical services.
- **Deputy Director for Clinical Care** – provides oversight for all clinical activities associated with the use of MGVP as well as identifying priorities and resources to support the stakeholders’ needs for patient care. The Deputy Director for Clinical Care is also responsible for working with the medical and nursing staff to develop appropriate emergency clinical procedures to manage the consequences of a failure or disruption of any MGVP system supporting life-critical patient care areas.
- **Leadership: The Directors for CC and ORF co-chair the Environment of Care Committee** – The EOC Committee meets regularly to review and direct resources and staff necessary to maintain an effective and compliant program for the hospital physical environment. In addition to the Directors, the EOC membership includes representatives from facility, safety, engineering, medical staff, and administration. The Chief of OHPE is the ORF liaison on the Committee.

3-13-10 PROCEDURES

The MGVP Program encompasses design, construction, commissioning, maintenance program design, maintenance, quality control, and quality assurance. Program procedures are discussed below. A graphical overview of the Program is provided in Exhibit X3-13-B: MGVP Program Flowchart.

A. PLANNING AND DESIGN

The NIH Facilities Development Manual (FDM) outlines specific roles; responsibilities of staff; and procedures that are to be followed in facilities planning, acquisition through construction, commissioning, and occupancy of all facilities at NIH; including specific requirements outlined for the hospital. The policies and procedures outlined in the manuals



specifically address guidelines and mandatory requirements for „Who, When, and How?“ involving all life cycle phases of a facility (i.e., managing design, reviews, submittal, approval, permitting, quality control and assurance, inspection, testing, acceptance, document distribution, retention and updates, and evaluation and compliance for Construction Risk Assessment (CRA) and Interim Life Safety Measures (ILSM)).

Planning, design, and upgrade services are accomplished through contracted professional architect/engineering firms with healthcare facility experience. Review and approval of those design documents for construction are accomplished by experienced and qualified individuals in DPM, DTR, OHPE, CC-OSFM, and DFM.

B. CONSTRUCTION AND COMMISSIONING

All projects are constructed and commissioned per industry standards by DPM’s Capital Projects Branches and Construction Management Branch. All materials, equipment, installation, testing, and certification are provided in accordance with NFPA99, NIH Policies and American Society of Sanitary Engineering (ASSE) Series 6000 Standards for MGV.

The FDM includes the CRA/ILSM Policy (Section 3-10) which dictates the requirements to ensure safety and reliability. To ensure compliance with TJC and CC policies, all contractors and staff are trained by DTR on CC construction practices and CRA/ILSM requirements.

At various construction and repair phases, the ORF Project Officer (PO) delivers submittals and shop drawings to the project notification team as outlined in the Section 3-1 of the FDM. The Team is comprised of assigned staff from DFM, DTR, OHPE, Division of Occupational Health and Safety, and CC-OSFM and is responsible for completing the risk assessments and defining measures to compensate for disruptions of utility services or code deficiencies during the repair or construction phase.

ORF is responsible for ensuring all new MGV installation meets NFPA99 and ASSE Series 6000 codes and standards for installation, testing, inspection, and certification by qualified contractors. At least 4 weeks prior to start of work, PO is required to submit the documentation listed below to OHPE for their review and approval of work plan. In addition, at least 2 weeks prior to all shutdowns of the existing system PO is required to submit shutdown notification and scope of work/drawings to RPMO for field coordination and shutdown approval. RPMO manages an automated Utility Shutdown system to facilitate the necessary review and approval process for MGV shutdowns prior to start of work.

Submittals for approval include:

- Scope of work to be performed
- Drawings indicating existing piping, new work, and point of connection.
- Qualification of installing, testing, and inspection contractor/personnel performing the work, including applicable American National Standards Institute (ANSI)/ASSE certifications.
- Valid brazing certificates by industry-recognized testing and certification agency for all installers as per NFPA99/ANSI/ASSE, certifying that all brazers have been thoroughly trained and tested in the complete installation of MGV.



- Independent third-party certification agency qualifications and sample report indicating location, outlet identification, flow, pressure, and particulate (purge) test and purity test results per NFPA99. Example documentation from the independent laboratory verifying the particulate and purity test results shall also be included.

Per NFPA99 the following actions constitute a breach of the system:

- **Sect 5.1.12.1.4** Systems shall be deemed breached at the point of pipeline intrusion by physical separation or by system component removal, replacement, or addition.
- **Sect 5.1.12.1.12** The removal of components within a source system for repair and re-installation, or the replacement of components like for like shall be treated as new work for the purposes of testing whenever such work involves cutting and/or brazing new piping.

Field inspections, testing, and approvals are carried out per ORF policies and procedures outlined in the FDM, the RPMO guidelines, and are adhered to by the designers, qualified contractors, trained operations and maintenance staff. Occupancy certification is issued by OHPE and CC-OSFM based on evidence of satisfactory inspection, testing, and certification of installation of MGV.

C. INVENTORY, DRAWINGS, AND CERTIFICATION DOCUMENTATION

All critical equipment/components pertaining to MGV are inventoried and labeled in existing MS2000™ (which is the ORF current computerized maintenance management system (CMMS)) or any other new CMMS system installed in future. OHPE reviews and provides quality assurance of inventory, labeling, and assignment of respective preventative maintenance (PM) guide codes for all critical equipment.

At project conclusion, the Project Officer provides As-Built documentation to the JCET and OHPE per RPMO policy 455-13-02: *MGV Testing and Certification Performance Requirements*. OHPE updates the drawings and provides updated inventory and PM guides to RPMO for input to MS2000.

MGV outlets are documented on system drawings and are updated by the JCET and OHPE whenever renovation or alterations to the MGV occur in the hospital area.

Hard copies of inspection, testing, and certification/recertification are maintained by the JCET and OHPE.

D. INSPECTION, TESTING, MAINTENANCE, AND EMERGENCY RESPONSE

All critical components of the MGV in the CC are tested and maintained at the frequencies described in Exhibit X3-13-A and as required through trouble/service calls generated by the users. Unless otherwise stated in Exhibit X3-13-A, RPMO is responsible for completing PM inspection and maintenance checks and responding to emergencies.



The inspection and testing tasks are managed through MS2000 and are reviewed for TJC compliance by OHPE. ORF document *RPMO-455-12-00: Piped Medical Gas and Vacuum Systems Management Program* and the supporting procedures documents describe the systems and locations and outline the procedures for trouble calls and emergency response.

In the event of an MGV failure, the CC and ORF implement emergency response procedures in accordance with CC Policy *S-005: Emergency Response Procedures for Hospital Utility Failures*. These procedures include clinical interventions that CC staff must implement during an MGV disruption. All problems, failures, or user errors are investigated by ORF. When a failure is deemed a significant event, the CC and ORF activate the emergency command center to manage the recovery to normal operations. As needed, the CC and ORF use the “NIH Alert” system to mobilize designated staff and/or communicate to the hospital leadership and emergency management staff. In the event of an overt failure of the medical oxygen distribution system, the CC and ORF implement emergency procedures in accordance with CC Policy *S-011: Emergency Procedures for Failure of Medical Oxygen*.

E. MONITORING, VERIFICATION, AND IMPROVEMENT PROCESS

RPMO and OHPE track and monitor completion dates of all inspection, testing, and maintenance; document, compile, and retain current documentation on file to meet the EC standard’s documentation requirements; support periodic performance reviews; and provide Life Safety surveys. OHPE develops, recommends, and initiates short-term and long-term resolution and implementation plans in consultation with CC and ORF leadership.

OHPE is responsible for upkeep and monitoring of inventory, alarm, and testing history to verify timely completion of PM documentation per TJC requirements. The JCET and OHPE review reports from contractors on testing, service, and repairs for completeness and deficiency correction.

RPMO and OHPE compile reports for compliance with EC standards and report deficiencies to responsible ORF groups for corrective action. Deficiencies are tracked to ensure satisfactory resolution within the TJC-specified time intervals.

F. TRAINING AND EDUCATION

No person operates or works on any part of an MGV unless adequately trained or supervised. The CC and ORF collaborate to ensure that staff is properly trained and also that staff orientations include key MGV safety information. In addition, to ensure compliance with TJC and CC policies, all contractors and staff are trained by DTR on CC construction practices and CRA/ILSM requirements.

The policy regarding training responsibilities is as follows:

- CC provides MGV end-user training and training on CC emergency response procedures for unscheduled interruption of service.
- ORF provides MGV maintenance and operations training and training on ORF emergency response procedures for unscheduled interruption of service.
- Contractors provide qualified personnel to perform MGV work.

3.13.20 GUIDANCE AND INFORMATION

The CC has multiple separate MGV serving patient-care areas. Medical gas by definition includes any gas that is regulated by the Food and Drug Administration, and that requires medical orders for its use on patients. Examples include nitrous-oxide, nitrogen, and bulk oxygen systems serving patient-care areas. Medical air systems are used in surgery, intensive care unit, patient-care, and dental clinic. Medical vacuum, including waste anesthesia gas disposal system, is also used in clinical areas.

All MGV system are designed, installed, commissioned, and maintained by ORF per the following standards and guidelines, as applicable:

- Guidelines for Design and Construction of Health Care Facilities, Facilities Guidelines Institute, 2010 edition.
- NFPA 99: Standard for Health Care Facilities, National Fire Protection Association, 2002 edition.
- ASSE 6000: Professional Qualifications Standards for Medical Gas Systems Personnel, American Society of Sanitary Engineering, revised February 2006.
- NIH Design Requirements Manual for Biomedical Laboratories and Animal Research Facilities (DRM), 2008.
- NIH Facilities Development Manual (FDM), 2009.
- Meeting Minutes [approving revised TJC timeframes to complete semiannual and annual tasks], Clinical Center Safety Committee, March 10, 2010.

This policy and procedure establishes the ORF program requirements for management of MGV in the hospital. The MGV Program is described in greater detail in *RPMO-455-12-00: Piped Medical Gas and Vacuum Systems Management Program*. Additional supporting documents include the following:

- CC policies *S-005: Emergency Response Procedures for Hospital Utility Failures* and *S- 011: Emergency Procedures for Failure of Medical Oxygen*
- System drawings such as zoning diagrams and plumbing critical disconnect plans.
- Standard operating procedures such as MGV Procedures for the ORF Project Officer, MGV Testing and Certification Performance Requirements, MGV Emergency Response Procedures, MGV Education and Training Manual, and MGV Utility Shutdown Procedures.
- Record documents such as current list of MGV personnel, emergency telephone numbers, and training records.

3-13-30 REPORTING REQUIREMENTS

Consistent with similar information collection and evaluation activities for hospital utility systems, ORF presents summary reports and recommendations for the MGV Program to the Hospital Safety Committee and EOC leaders. These data include completion rates for scheduled maintenance, critique of response calls for service from the users, and assessments of the condition of equipment or performance of staff.

MGV-related incidents are recorded by the CC in the CC Occurrence Reporting System and by ORF in MS2000. These records serve as part of the critique of the event and to support development of measures to mitigate event risks.



Equipment Type	Service	Location	Responsibility	PM/testing Frequency			semi- annually	annually	Tri-Annually
				daily	monthly	quarterly			
Outlets & Valves	Critical areas Surgery 3SW, 3NW, 5SE, 7SW-N, DRD (SP, CT, MRI), OP7, OP11	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO					X	
	Noncritical areas	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO						X
Flexible Connectors	Source Equipment	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO						
Shut Off Valves	All Areas	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO						X
Automatic Pressure Switches	10/CRC	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO						
Area Alarms	Critical areas 3SW, 3NW, 5SE, 7SW-N, DRD (SP, CT, MRI), OP7, OP11	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO		X			X	
	Noncritical areas	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO		X				X
Master Alarms	BMU, Security South Entry, CRC Security	10/CRC	Owner-ORF PM-RPMO Emerg-RPMO					X	

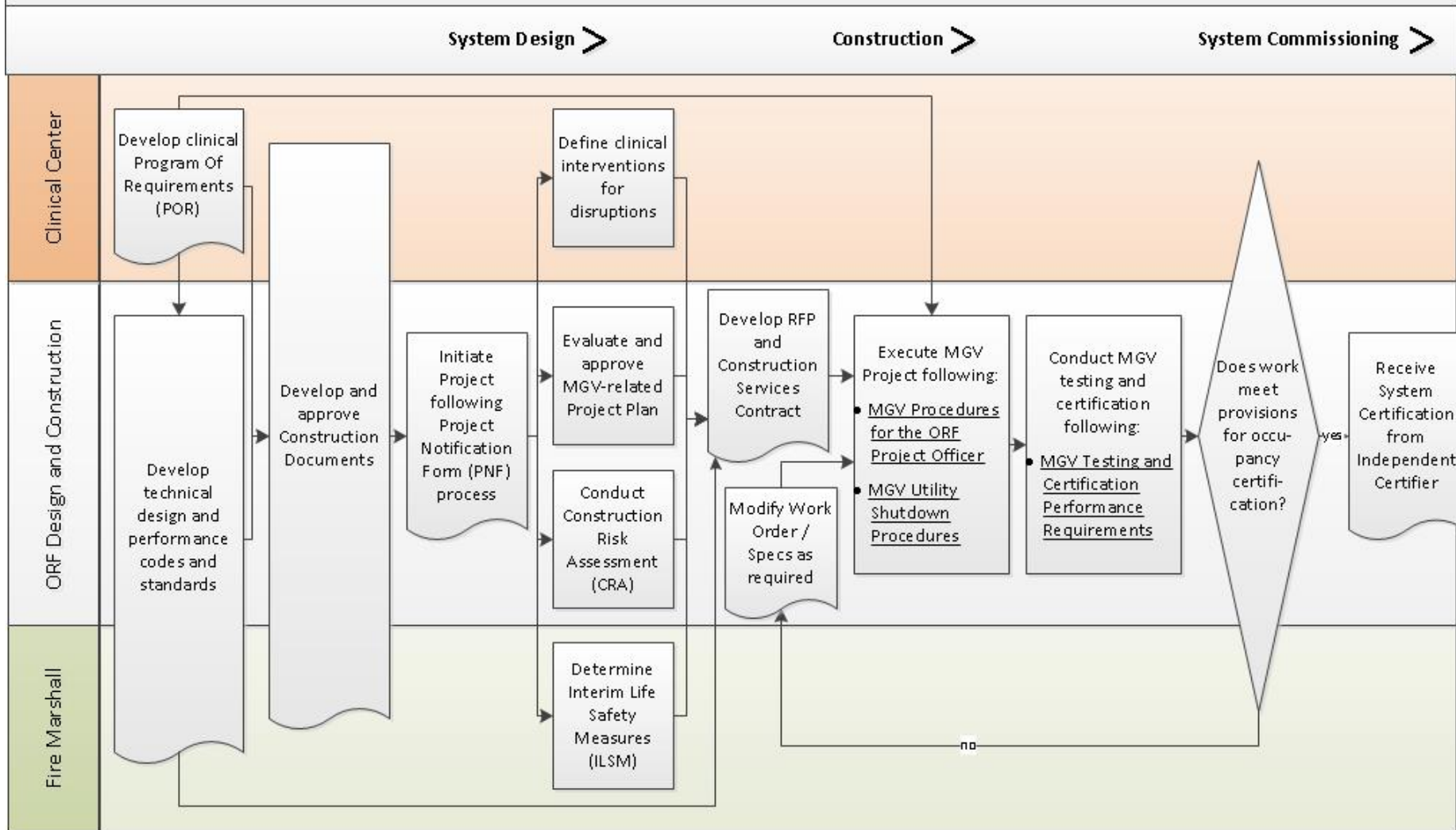


Equipment Type	Service	Location	Responsibility	daily	monthly	quarterly	PM/testing Frequency		
							semi-annually	annually	Tri-Annually
Source Equipment	CRC Medical Air Intake	B2- 2461	Owner-ORF PM-RPMO Emerg-RPMO			X			
	CRC Medical Air Compressor & Dryer	B2- 2461	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Surgery Medical Air Intake	3C726 A	Owner-ORF PM-RPMO Emerg-RPMO			X			
	Surgery Medical Air Compressor & Dryer	3C726 A	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Dental Medical Intake	B1B01 A	Owner-ORF PM-RPMO Emerg-RPMO			X			
	Dental Medical Air Compressor & Dryer (level 3)	B1B01 A	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	In Vivo Medical Air Intake	B1D48	Owner-ORF PM-RPMO Emerg-RPMO			X			
	In Vivo Medical Air Compressor & Dryer	B1D48	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Surgery N2 Manifold	2C541	Owner-CCOFM PM-CCOFM Emerg-RPMO	3 (X)					X
	Surgery Nitrous Oxide Manifold	B2C13 5	Owner-CCOFM PM-CCOFM Emerg-RPMO	3 (X)					X
	CRC Medical WAGD and Vacuum Pump	B2- 2461	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Surgery Medical WAGD Pump	3C581	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Surgery Medical WAGD Pump	3C726 A	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Surgery Medical Vacuum Pump	3C581	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	B10 (2J) Medical Vacuum Pump	B2S233	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	B3 MIL medical Vacuum Pump	B4B100	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	ACRF Medical Vacuum Pump	B1C22 8	Owner-ORF PM-RPMO Emerg-RPMO				X		X
	Dental Medical Vacuum (level 3)	B1B10	Owner-ORF PM-RPMO Emerg-RPMO				X		X

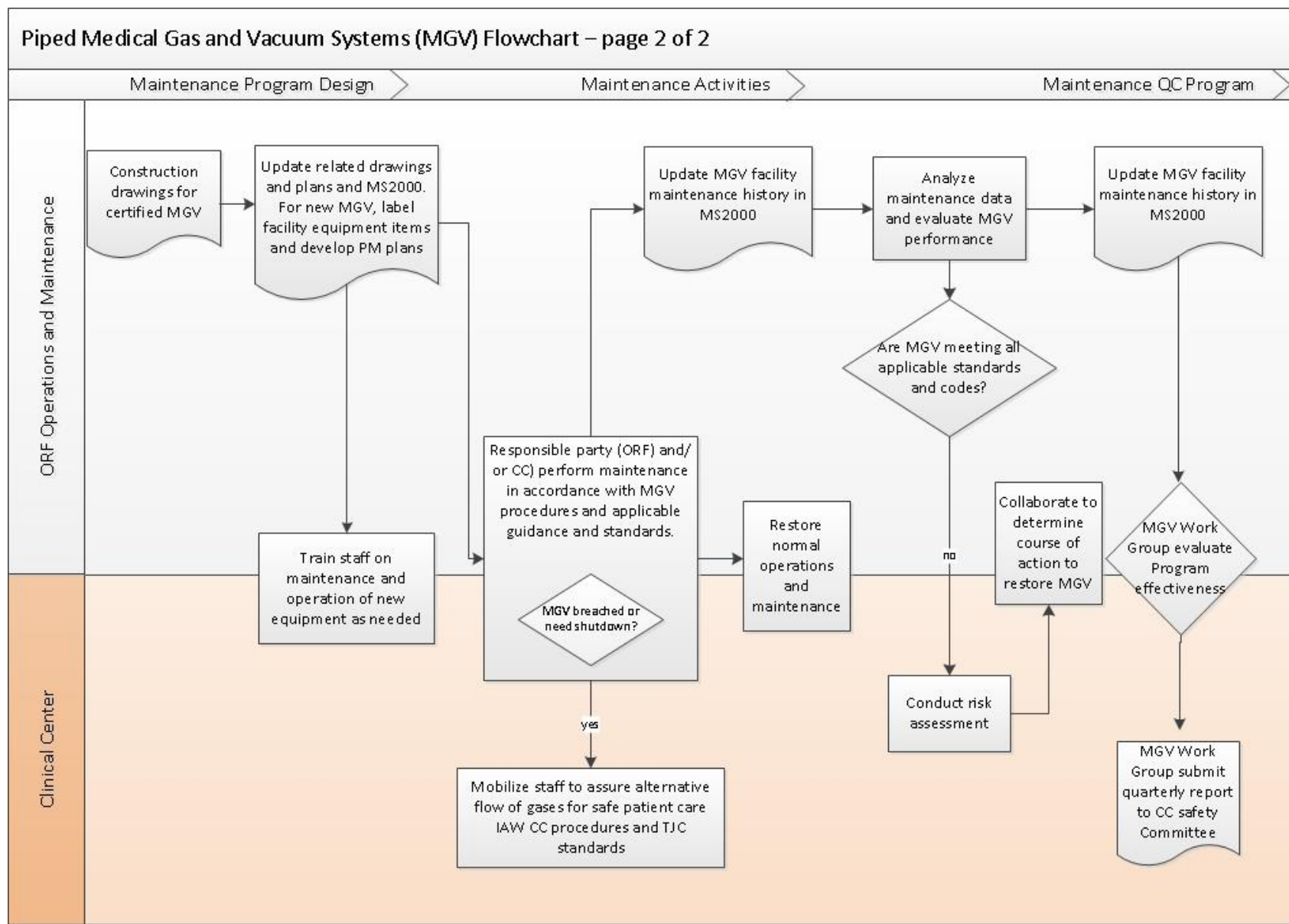


	In-Vivo (NMR) Medical Vacuum (level 3)	B1D41 1	Owner-ORF PM-RPMO Emerg-RPMO				X	X	
	CCC O2 Tank (bulk system – Primary & Secondary)	tank farm B10	Owner-CCOFM PM-CCOFM Emerg-RPMO	3 (X)				X	
	CCC O2 Tank (bulk system - Emergency)	tank farm B13	Owner-CCOFM PM-CCOFM Emerg-RPMO	3 (X)				X	

Piped Medical Gas and Vacuum Systems (MGV) Flowchart – page 1 of 2



Piped Medical Gas and Vacuum Systems (MGV) Flowchart – page 2 of 2





Office of Research Facilities
Development and Operations

Division of Property Management

Real Property Management Office

Subject: Piped Medical Gas and Vacuum Systems Management Program

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Approved by:

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In Collaboration With:

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Division of the Fire Marshal, ORS

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PROGRAM STATEMENT

The National Institutes of Health (NIH) Clinical Center Piped Medical Gas and Vacuum Systems (MGV) Program is based on standards and codes promulgated by the Joint Commission, the Government, and other applicable regulatory agencies and associations. The program is jointly managed by the Office of Research Facilities (ORF) and the administration of the Clinical Center (CC). Described in this Program are our organizational structures with their respective responsibilities and authorities; fundamentals and objectives of the Program; and processes used to develop, implement, and maintain compliant and reliable hospital MGV for patients and staff.

It is the policy of the NIH to provide a safe and healthy environment for all its patients, staff, and visitors. ORF serves all NIH campus operations including the CC. As ORF staff is often assigned or requested to design, maintain, or service one of the many MGV systems serving patients of the CC they are required to observe CC policies and procedures for patient safety. Each ORF staff member is aware at all times that he or she has an individual responsibility for the maintenance of safe systems of work and that it is through compliance with this MGV Program that the NIH CC can provide safe and effective patient care services.

1. SCOPE

The MGV Program encompasses the management and maintenance of Clinical Center Complex (CCC) facility equipment items for the medical supply by pipeline and equipment testing of the following:

1. medical air
2. medical oxygen
3. medical vacuum
4. waste anesthesia gas disposal
5. nitrous oxide
6. medical-grade nitrogen

For the purposes of this Document, the MGV Program also includes the safe management, use, handling, and storage of compressed medical gas cylinders and cryogenic liquid nitrogen used for medical treatments.

This Program document is used by all ORF staff, and as applicable CC staff, involved in the use, management, and maintenance of the above systems and associated equipment. This Program document is supported by a group of Tier 3 documents that detail MGV procedures and related performance requirements for work performed or managed by ORF staff. The MGV Program is further supported by other procedures and manuals specific to the respective responsible organizations of the NIH.



2. APPLICABLE DOCUMENTS

Standards and guidelines, as applicable, include the following:

1. 2011 Hospital Accreditation Standards: Accreditation Policies, Standards, Elements of Performance, Scoring, Joint Commission on Accreditation of Healthcare Organizations.
2. ASSE 6000: Professional Qualifications Standards for Medical Gas Systems Personnel, American Society of Sanitary Engineering, Revised February 2006.
3. Guidelines for Design and Construction of Health Care Facilities, Facilities Guidelines Institute, 2010 edition.
4. NFPA 99: Standard for Health Care Facilities, National Fire Protection Association, 2002 Edition.
5. NIH Design Requirements Manual for Biomedical Laboratories and Animal Research Facilities (DRM), 2008 (pending development in 2011 of Design Requirements Manual for Clinical Research Facilities).
6. NIH Facilities Development Manual, 2009.

In March 2010, the CC Safety Committee approved changes to some of the recommended time intervals outlined in the 2010 Hospital Accreditation Standards Environment of Care (EC) chapter under *Issues for Consideration*. The Committee determined that the changes do not represent a higher risk to occupants, property or equipment in the hospital. As a result, the following intervals apply to activities conducted to meet Evidence of Performance for standards outlined in the EC chapter:

1. Quarterly = 4 times a year, once in each quarter (remains unchanged).
2. Semiannually = every 6 months from the date of the last event, ± 45 days.
3. Annually/every 12 months/once a year = 1 year from the date of the last event, ± 60 days.
4. Triennially/every 36 months/every 3 years= 36 months from the date of the last event, ± 45 days (remains unchanged)

ORF procedures and manuals applicable to MGVS include the following:

1. *MGV Procedures for the ORF Project Officer, RPMO-455-13-01*
2. *MGV Testing and Certification Performance Requirements, RPMO-455-13-02*
3. *MGV Training Manual, RPMO-455-13-03*
4. *MGV Emergency Response Procedures, RPMO-455-13-04*
5. *MGV Utility Shutdown Procedures, RPMO-455-13-05*

4. PROGRAM ORGANIZATION CHART

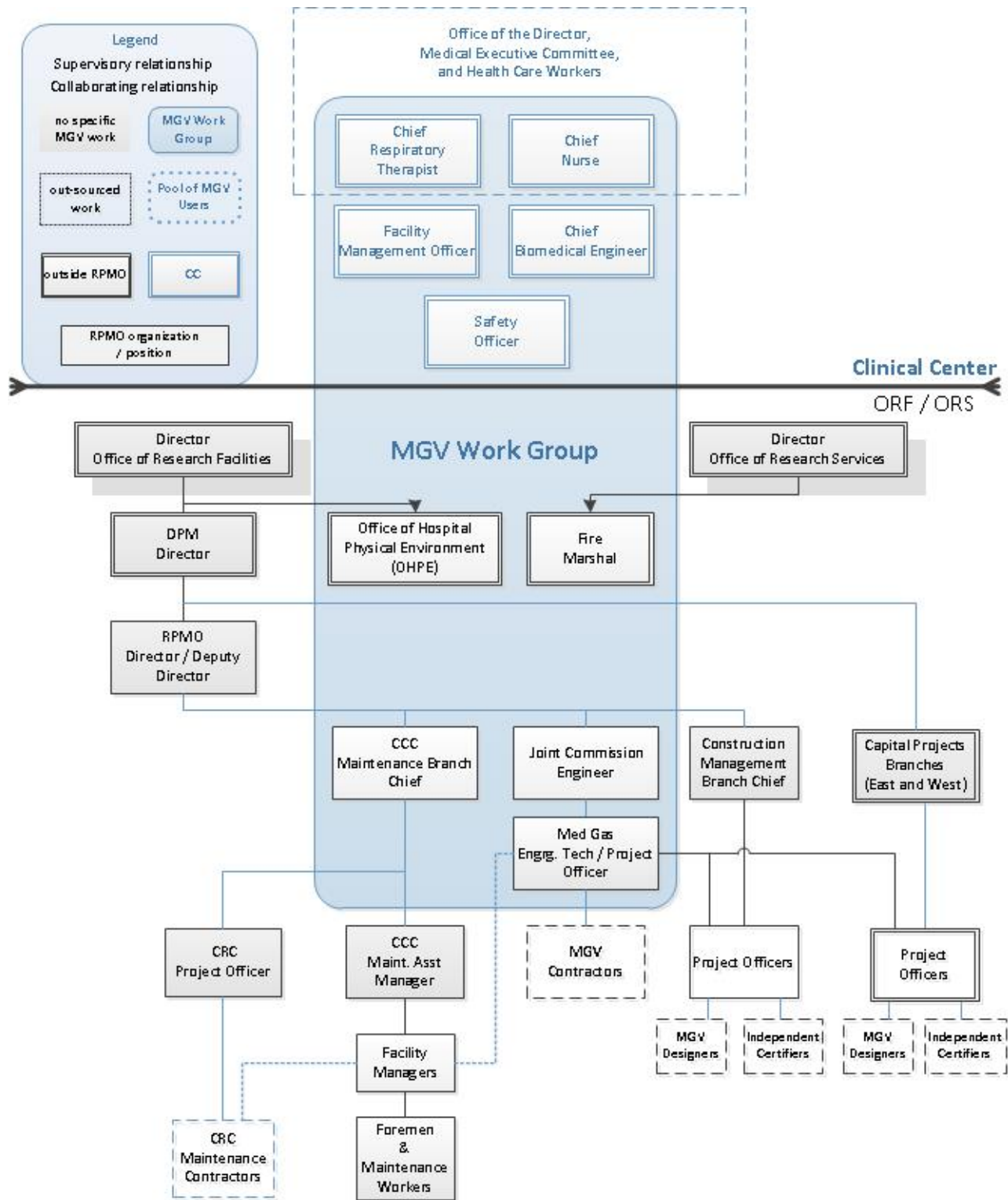


Figure 1: MGV Program Organization



5. ROLES AND RESPONSIBILITIES

The hierarchy of MGV Program roles and responsibilities includes the following (which are discussed in more detail in the remainder of this section):

1. Program Management. A joint effort by:
 - a. Office of Hospital Safety, CC.
 - b. MGV Work Group, which is a committee of representatives from CC, ORF, and the Office of Research Services (ORS).
 - c. Joint Commission Engineering Team (JCET), RPMO, ORF.
2. Program Support. Functions such as quality assurance, system acceptance, and contract-related support are provided by a variety of CC, ORF, and ORS organizations:
 - a. Office of Hospital Physical Environment (OHPE), ORF
 - b. CC Office of Space and Facility Management (CC-OSFM)
 - c. CC Biomedical Engineering Section (BIOMED), Materials Management Department (MMD)
 - d. CC Storage and Distribution Section, MMD
 - e. Division of the Fire Marshal (DFM), ORS
 - f. RPMO, ORF
3. Project Management. MGV projects, from inception to certification, are managed by ORF Project Officers.
4. Maintenance. Certified MGV is maintained by RPMO. This includes contract administration and the collection of maintenance and service information for contractor-performed MGV work.

Program Management

5.1 Office of Hospital Safety

- a. Orients ORF staff that designs, constructs, commissions, maintains and repairs MGV systems in the CC to the administrative and safety policies of the CC including but not limited to:
 - 1) Infection control practices
 - 2) System shutdown procedures
 - 3) Work safety practices in patient care areas including special practices required in sensitive areas such as OR's, behavioral health units, pediatric units, and isolation rooms.
 - 4) The CC procedure for reporting a utility system disruption
- b. Facilitates communications between ORF technicians assigned to work on the MGV and hospital administration, clinical staff, and CC- OSFM. These communications include but are not limited to:
 - 1) Risk assessments to identify areas in the hospital where patients are dependent on MGV for life support;
 - 2) Developing Interim Life Safety Measures ® (ILSM) and proactive



- construction risk management plans to manage risks during demolition, modification, installation, or repair of MGVS; and
- 3) Managing emergency responses when MGVS are disrupted or fail.
- c. Reviews summary documentation of activities via the Hospital Safety Committee to ensure the MGVS Program meets the Joint Commission standards and works with the members of the MGVS Work Group to develop recommendations for improvement when issues are identified.
- d. When applicable, coordinates the implementation of clinical interventions for patient safety.

5.2 MGVS Work Group

5.2.1 Membership and Meetings

The MGVS Work Group consists of the following representatives:

- a. Joint Commission Engineer (JCE), JCET, ORF
- b. Medical Gas Engineering Technician (MGET), JCET, ORF
- c. Hospital Safety Officer, CC
- d. Chief of Respiratory Therapy (or designee), CC
- e. Chief Nurse (or designee), CC
- f. Chief of Biomedical Engineering (or designee), CC-BIOMED
- g. Facility Management Officer (or designee), CC-OSFM
- h. Fire Marshal (or designee), ORS
- i. Office of Hospital Physical Environment, ORF
- j. CCC Maintenance Branch Chief, RPMO, ORF

Others are invited to join the Work Group when appropriate.

The Work Group meets at the following time intervals:

- a. Quarterly to review Program implementation.
- b. Annually to review the MGVS Program document.
- c. On an ad hoc basis if any MGVS hazards arise requiring hospital-wide actions, or on the introduction of new technologies or guidance which may affect MGVS across the hospital.

5.2.2 Charter

The Work Group is chartered as follows:

- a. Review and monitor the MGVS Program content, staff, and system compliance (via survey/audit) and its implementation with regard to the required standards and with particular reference to:
 - 1) Planning, design, construction, commissioning and documentation.
 - 2) Control and maintenance of MGVS supply systems within the hospital.
 - 3) Operation of the MGVS Permit-to-Work process.
 - 4) Emergency response and maintenance staff reporting mechanisms.



- 5) Gas storage cylinder management (including audit of usage at patient care unit (PCU) level).
 - 6) The training of all maintenance staff groups working with medical gases either in cylinders or from piped supply systems. This includes maintenance staff responsibilities/actions related to piped medical gas systems and alarms, the use and management of medical gas cylinders at PCU level, assessment of available training courses, and mechanisms for assessing the effectiveness of training provided.
- b. Ratify and monitor implementation of health and safety measures associated with medical gas usage (especially at the PCU level). This includes:
 - 1) storage of medical gas cylinders
 - 2) provision of warning signs and instructional safety information for maintenance staff for patients receiving medical gas therapy
 - 3) assessment of compliance with health and safety issues relating to medical gases and their usage
 - c. Work as an MGV advisory committee to the incident commander during any emergency events.
 - d. Act as a forum for all other medical-gas-related matters.
 - e. Contribute content to the Hospital Safety Committee's quarterly meetings.

5.3 Joint Commission Engineering Team

The JCET has overall responsibility for the day-to-day management and quality control of the MGV. As such, the JCE and the MGET:

- a. Conduct life-cycle assessments.
- b. Maintain the content of ORF MGV procedures and controls documentation.
- c. Manage the ORF education and training program on MGV procedures and controls.
- d. Participate in review and approval of MGV design, installation, and commissioning.
- e. Issue permits and control the MGV Permit-to-Work process.
- f. Manage implementation of the MGV maintenance and replacement programs. Manage the collection of maintenance and service information.
- g. Coordinate all MGV utility shutdowns and ensure that only authorized maintenance staff performs the shutdown of MGV. Ensure that contractors and subcontractors do not commence any MGV work or operate on MGV until it has been secured by the maintenance staff.
- h. Manage ORF MGV emergency responses.



- i. Implement a plan to measure and evaluate MGTV performance.
- j. Collaborate with the Office of Hospital Safety to ensure the MGTV Program meets the Joint Commission standards and work with the members of the MGTV Work Group to develop recommendations for improvement when issues are identified.

Project Management

5.4 ORF Project Officers

- a. Provide project management of MGTV projects (or projects impacting MGTV) from inception to certification.
- b. Coordinate with the MGET to ensure MGTV projects (or projects impacting MGTV) comply with this MGTV Program document and associated MGTV SOPs.

Project Support

5.5 Office of Hospital Physical Environment

- a. Provides quality assurance in the form of program monitoring and making certain that program quality and Joint Commission accreditation compliance requirements are fulfilled in design, commissioning, inventory management, component labeling, periodic testing, and system breach activities.
- b. In conjunction with CC-OSFM and DFM [as appropriate], verifies documentation of work performed in order to meet provisions for occupancy certification of areas to be used for patients after renovation or installation.
- c. Reviews and provides ORF PO with written approval of MGTV-related Project Plan.

5.6 CC Office of Space and Facilities Management

- a. Maintains and monitors supply and maintenance contracts for (1) the bulk central oxygen tank system and (2) the nitrous oxide and nitrogen manifold systems for the anesthetizing areas.
- b. Interfaces with ORF and hospital workers to ensure all work on the MGTV is coordinated with the health care manager for the respective area to reduce risk of unscheduled disruption of service and scope of work matches the needs of the users.
- c. Receives necessary project documents in order to submit to the PO all CC _use and occupancy' acceptance documents.

5.7 CC Biomedical Engineering Section

Maintains and monitors service contracts for the mechanical and electrical maintenance and inspection of the booms in surgery and the intensive care unit (ICU). [Note: This Section does not provide



maintenance and inspection of hoses and outlets. This service is provided by RPMO.]

5.8 CC Material Distribution Section

Manages the purchase and delivery of all portable medical gas cylinders that are used for patient care at the bedside and for manifold systems.

5.9 Division of Fire Marshal

- a. Verifies that MGCV design and installation is in compliance with the life safety code requirements stipulated by NFPA99.
- b. As appropriate, may work in conjunction with OHPE and CC-OSFM to verify documentation of work performed to meet provisions for occupancy certification.

Maintenance

5.10 Real Property Management Organization

Provides operation, maintenance, and emergency response repair services for all MGCV. RPMO Project Officers formally appoint contractors, in writing and on the advice provided by the MGET, as authorized persons to work on the NIH MGCV. RPMO Facility Managers:

- a. Take overall responsibility for the distribution and coordination of MGCV work to authorized persons.
- b. Ensure that authorized persons are available to cover any instances of sickness or holiday.
- c. Share project officer duties with the MGET for —replace in kind|| MGCV work.

5.11 Authorized MGCV Workers (RPMO or Contractor)

Only qualified and approved contractors or NIH employees are authorized to perform MGCV work. All authorized MGCV workers are listed in the Tier 4 document: *List of MGCV Personnel*. The MGET may challenge the competency of any authorized worker at any time as deemed fit, and may require evidence of their competency as deemed appropriate. The duties and responsibilities of authorized MGCV workers are:

- a. Serve as the first responder to an emergency and follow RPMO-455- 13-04: MGCV Emergency Response Procedures.
- b. Perform work on the MGCV in accordance with the NIH maintenance specification.
- c. Perform repair, alteration, or extension work as directed by the MGET in accordance with the Permit-to-Work process.
- d. Perform engineering tests appropriate to all work carried out and inform the MGET of all test results.
- e. Perform all work in accordance with NIH health and safety policies.



6. PROGRAM PROCESS AND PROCEDURES

The MGVS Program encompasses design, construction, commissioning, maintenance, and quality control. The processes associated with this Program are discussed below, and the processes are shown in a flowchart in Appendix B.

6.1 Design Process

ORF has an established project execution process that addresses design. Refer to the NIH Facilities Development Manual for information on the design process.

When a facility design directly impacts MGVS, the MGET is included as a project stakeholder to ensure all MGVS requirements are defined and incorporated into the project documentation and budget. As a project stakeholder, the MGET collaborates with the CC to develop the Program Of Requirements (POR) and is a member of the ORF Project Notification Team (PNT).

Also when a facility design directly impacts MGVS, CC defines the clinical interventions for disruptions to existing MGVS that may occur during project execution.

When a facility design introduces new MGVS technologies, the MGVS Work Group is also included as a project stakeholder and included in the design process as appropriate.

6.2 Construction and Commissioning Process

The ORF project execution process also addresses construction and commissioning. Refer to the NIH Facilities Development Manual for information on the construction and commissioning process. Specifics for projects impacting MGVS are included below:

6.2.1 Construction

After OHPE has approved the Project Plan, the Project Officer initiates **Phase 1** of the MGVS Permit-to-Work process following the *RMPO-455-13-01: MGVS Procedures for the ORF Project Officer*. Phase 1 of the Permit-to-Work process concludes with JCE/MGET review and authorization.

MGVS work commences only after review and approval of all MGVS-related project documents and receipt of an authorized Phase 1 of the —PERMIT TO WORK.¶

6.2.2 Commissioning

All MGVS construction must be tested and certified per NFPA99. Parties participating in the commissioning process include the clinical users; ORF design and construction groups; OHPE; CC-OSMF; the DFM (as requested by a stakeholder); and an independent, credentialed Medical Gas System Certifier.



Prior to final tie-in, OHPE reviews and approves the initial certification for the new work (i.e., source equipment, piping, valves, and alarms) or any breach to the system. Then the Project Officer initiates **Phase 2** of the MGV Permit-to-Work process. Phase 2 of the Permit-to-Work process concludes with JCE/MGET review and authorization of Phase 2.

Final MGV tie-in may commence only after the following:

- a. Review and approval of Phase 1 MGV-related project documents.
- b. PO issuance to the construction team of a JCE-authorized Phase 2 of the —PERMIT TO WORK.¶

After final tie-in and final testing, the independent certifier issues the MGV certification. And lastly, the Government stakeholders verify that the MGV work meets the provisions for occupancy.

If the MGV work does not meet the provisions for occupancy, Project work resumes for the purpose of correcting deficiencies or discrepancies. Then the above testing and certification process is repeated.

The MGV commissioning process is closed out when the PO ensures that the following are completed:

- a. If there is a change in use, MGV orientation and education is provided to the CC users.
- b. Maintenance orientation and training is provided to the ORF maintenance staff.
- c. As-built drawings are submitted to the ORF maintenance group and OHPE.

6.3 Maintenance

6.3.1 System Documentation

- a. Plans, specifications, and commissioning data for all new MGV systems are maintained by the MGET.
- b. All MGV critical control points are identified on Plumbing Critical Disconnect Plans. The ORF maintenance group follows an established drawing maintenance process in order to update engineering drawings and Plumbing Critical Disconnect Plans.
- c. All MGV equipment is labeled and identified as an inventory item in the MS2000 system. An ORF facility equipment labeling process is followed to ensure MGV equipment items are labeled and also incorporated into the MS2000 system.
- d. Appropriate calibration, inspection, testing, and maintenance procedures and schedules are documented in the MS2000 system for each type of



MGV system equipment or component included in the inventory.

6.3.2 Maintenance and Repair

- a. **Scheduled Maintenance.** Scheduled maintenance, including all inspections, tests, and preventive maintenance, is performed and documented by RPMO in accordance with the MS2000 system and the established process for scheduled work.
- b. **Unscheduled Maintenance.** Unscheduled maintenance is performed and documented by RPMO in accordance with the service-call-related SOPs.
- c. **System Shutdown.** If MGVS require a shutdown for maintenance, the SOP,
- d. **RPMO-455-13-05: MGVS Utility Shutdown Procedures**, is followed.
- e. **Maintenance Records.** Maintenance effort culminates with recording the work in the MS2000 system and notifying the MGVS Work Group and the clinical users of the maintenance results.
- f. **System Breach.** Maintenance work that involves a breach in MGVS requires testing and certification. RPMO-455-13-01: MGVS Procedures for the ORF Project Officer is followed.

1) Phase 1

If MGVS is breached during scheduled maintenance, the Project Officer notifies OHPE of the breach and prepares a Project Plan for OHPE approval. The Project Officer initiates Phase 1 of the MGVS Permit-to-Work process. MGVS maintenance commences only after review and approval of all MGVS-related project documents and receipt of an authorized Phase 1 of the —PERMIT TO WORK.

If the MGVS was breached during the performance of maintenance, then the MGVS components and branches must be tested. Parties participating in the testing include the clinical users, the ORF maintenance group, OHPE, and an independent certifier.

Prior to final tie-in, OHPE reviews and approves the initial certification for the new work (i.e., piping, valves, and alarms) that is pending tie-in and the certification plan for final tie-in.

2) Phase 2

Then the Project Officer initiates Phase 2 of the MGVS Permit-to-Work process. Phase 2 of the Permit-to-Work process concludes with JCE/MGET review and authorization of Phase 2.

Final tie-in of any MGVS work may commence only after review and approval of all MGVS-related project documents and receipt of an



authorized Phase 2 of the —PERMIT TO WORK.¶

After final tie-in and final testing, the independent certifier issues the MGV certification. And lastly, the Government stakeholders verify that the MGV work meets the provisions for occupancy.

However, if MGV work does not meet the provisions for occupancy, Project work resumes for the purpose of correcting deficiencies or discrepancies. Then the above testing and certification process is repeated.

6.4 Quality Control

The review and approval requirements within the aforementioned established processes address much of the quality control throughout the life cycle of the MGV. Additional measures specifically to address MGV performance at the system level and the program level include the following:

6.4.1 System Performance

- a. The MGET, liaison with CC staff, monitors day-to-day MGV performance. Untoward incidents, accidents, or policy breaches are reported via the Clinical Center incident reporting procedure using the Clinical Center Occurrence Reporting System.
- b. When ORF determines that an MGV is no longer capable of meeting applicable codes, the MGET notifies the CC Safety Officer with a recommendation that the system be taken out of service until system capability can be restored. CC staff may conduct a risk assessment to determine if the degraded level of performance presents a risk to patient safety until repairs can be performed. CC staff and ORF collaborate to determine the best course of action to restore the MGV.

6.4.2 Program-level Quality Control

- a. The MGET surveys CC users in life support care areas to determine if MGV in those areas continue to meet their requirements.
- b. ORF, CC, and DFM conduct semi-annual Environment of Care tours. During these tours, the quality and effectiveness of the MGV Program is evaluated.



7. RECORDKEEPING

RPMO maintains all MGV facility history and maintenance records in MS2000. The MGET maintains copies of the following:

1. NIH Piped Medical Gas and Vacuum Systems Descriptions
2. MGV Zoning Diagrams
3. CRC Plumbing Critical Disconnect Plan
4. ACRF and Magnuson Center Plumbing Critical Disconnect Plan
5. MGV insurance/statutory documentation
6. New and completed—PERMIT TO WORK forms
7. Manufacturers technical data sheets/manuals for all MGV components
8. Site-specific technician manuals
9. MGV contractor service contracts and ASSE certificates, contractor training records, equipment calibration certificates
10. List of MGV Personnel (especially in the Permit-to-Work system)
11. Emergency and other useful telephone numbers
12. MGV employee training records
13. Calibration certificates of NIH-owned test equipment
14. MGV Certification Reports
15. Piped Medical Gas and Vacuum Systems Program Binder (which includes all associated SOPs)

8. TRAINING

No person operates or works on any part of MGV unless adequately trained and supervised. Training responsibilities are as follows:

1. CC provides and documents training of CC engineering staff, safety staff, clinical staff, and contractors in:
 - a. Use of the MGV
 - b. Reporting problems
 - c. How to respond to unexpected disruptions or failures of any MGV
2. ORF provides and documents training of maintenance and operations employees. RPMO managers ensure that maintenance workers whose work may affect MGV are appropriately trained in:
 - a. Maintenance of the MGV
 - b. Reporting problems
 - c. How to respond to unexpected disruptions or failures of any MGV
3. Project Officers request training records of contractors' staff. Contractors provide trained personnel.
4. The MGET provides and documents training of the ORF Project Officers, RPMO Facility Managers, and RPMO maintenance workers on the MGV Program and SOPs.



5. The MGET administers and maintains records of MGV training for all key personnel (including NIH employees and contractors).

The ORF, CC, and DFM collaborate on the following training elements:

1. Training programs are coordinated to ensure that content, presentation of content, credentials, and evaluation of credentials are consistent.
2. Semi-annual Environment of Care tours are conducted to identify areas to emphasize during the scheduled training sessions.
3. MGV emergency response drills.

9. MANAGEMENT CONTROL

The MGV Work Group conducts an annual review of the MGV Program scope, objectives, performance, and effectiveness. The word of the MGV Work Group is final on all amendments.

1. Within one week of the review meeting, the MGET writes and distributes the minutes of the meeting to all interested parties.
2. Within six weeks of the review, the JCET updates the MGV Program documentation and provides electronic copy of the revised documentation to all interested parties. Individuals receiving the electronic copy immediately update their personal hard copies.
3. A least one month before an MGV revision is to be released, the JCET provides a report of the MGV Work Group's review to the Director of ORF, the Environment of Care Committee, and the Hospital Safety Committee.

Between the annual Program reviews, the MGET updates the MGV Program documentation with respect to any of the changes listed below. Within one month (or sooner, as appropriate), the MGET notifies all MGV Work Group members and ORF staff involved with MGV of the following:

1. Change of nominated personnel
2. Changes in limits of authorization
3. Change of contractors
4. Change of telephone numbers
5. Additional plant or equipment purchases requiring special operating procedures
6. Changes in normal operating/reporting procedures
7. Changes in legislation



APPENDIX A: ACRONYMS AND DEFINITIONS

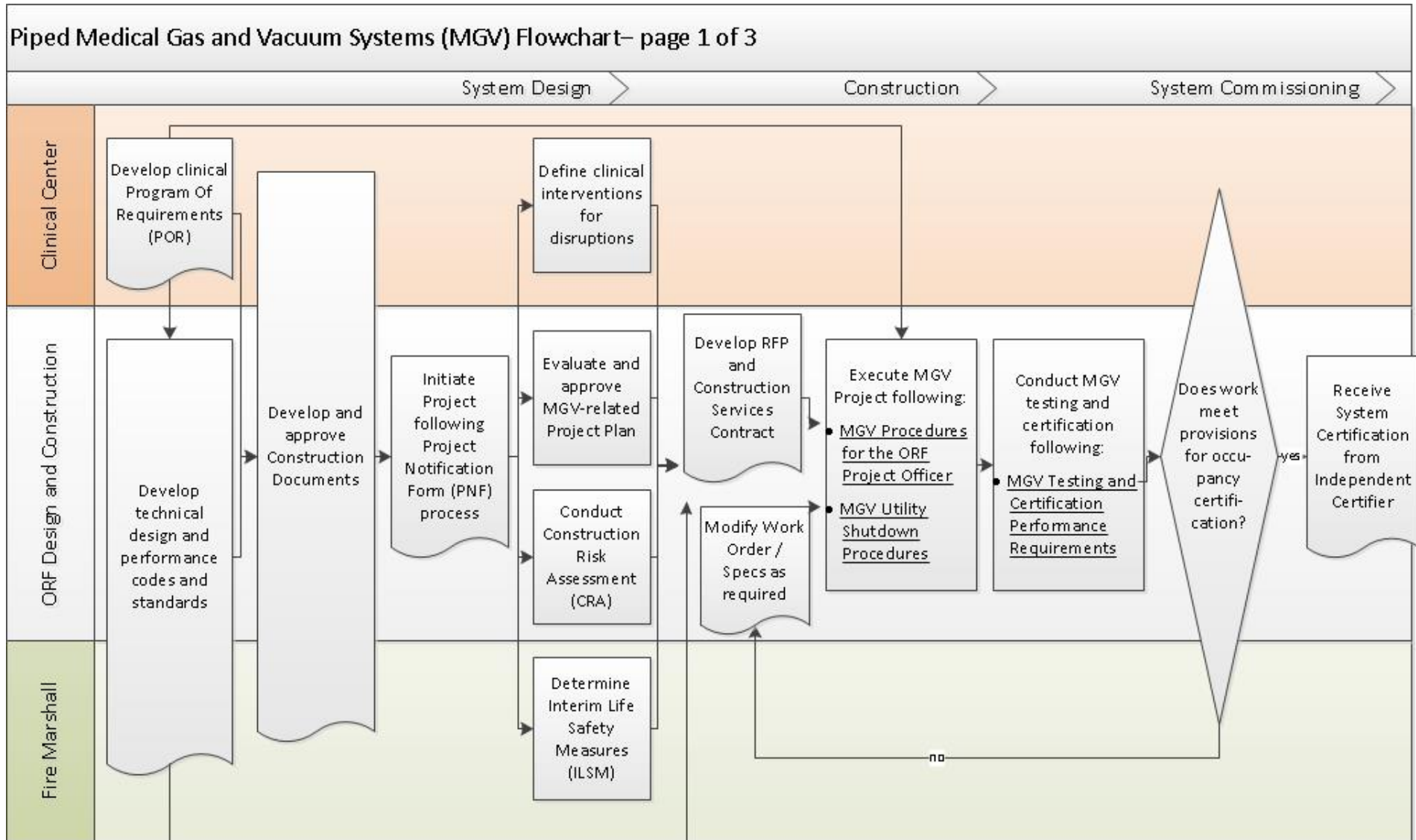
Acronym or Phrase	Definition
ACRF	Ambulatory Care Research Facility
ASSE	American Society of Sanitary Engineering
BIOMED	Biomedical Engineering Section
CC	Clinical Center
CCC	Clinical Center Complex
DFM	Division of the Fire Marshal
DPM	Division of Property Management
DRM	NIH Design Requirements Manual for Biomedical Laboratories and Animal Research Facilities
ICU	Intensive care unit
JCE	Joint Commission Engineer
JCET	Joint Commission Engineering Team
MGET	Medical Gas Engineering Technician
MGV	Piped Medical Gas and Vacuum Systems
MMD	Material Management Department
N/A	Not applicable
NFPA	National Fire Protection Association
NIH	National Institutes of Health
OHPE	Office of Hospital Physical Environment
ORF	Office of Research Facilities
ORF design and construction groups	RPMO Construction Management Branch, the DPM Capital Projects East Branch, and the DPM Capital Projects West Branch
ORF maintenance group	RPMO Maintenance Services Branch
ORS	Office of Research Services
OSFM	Office of Space and Facility Management
Out of service	Not operational because it needs maintenance, cleaning, or repair. [Such items are marked with "Out of Service" tags to prevent accidental operation.]
PCU	Patient care unit



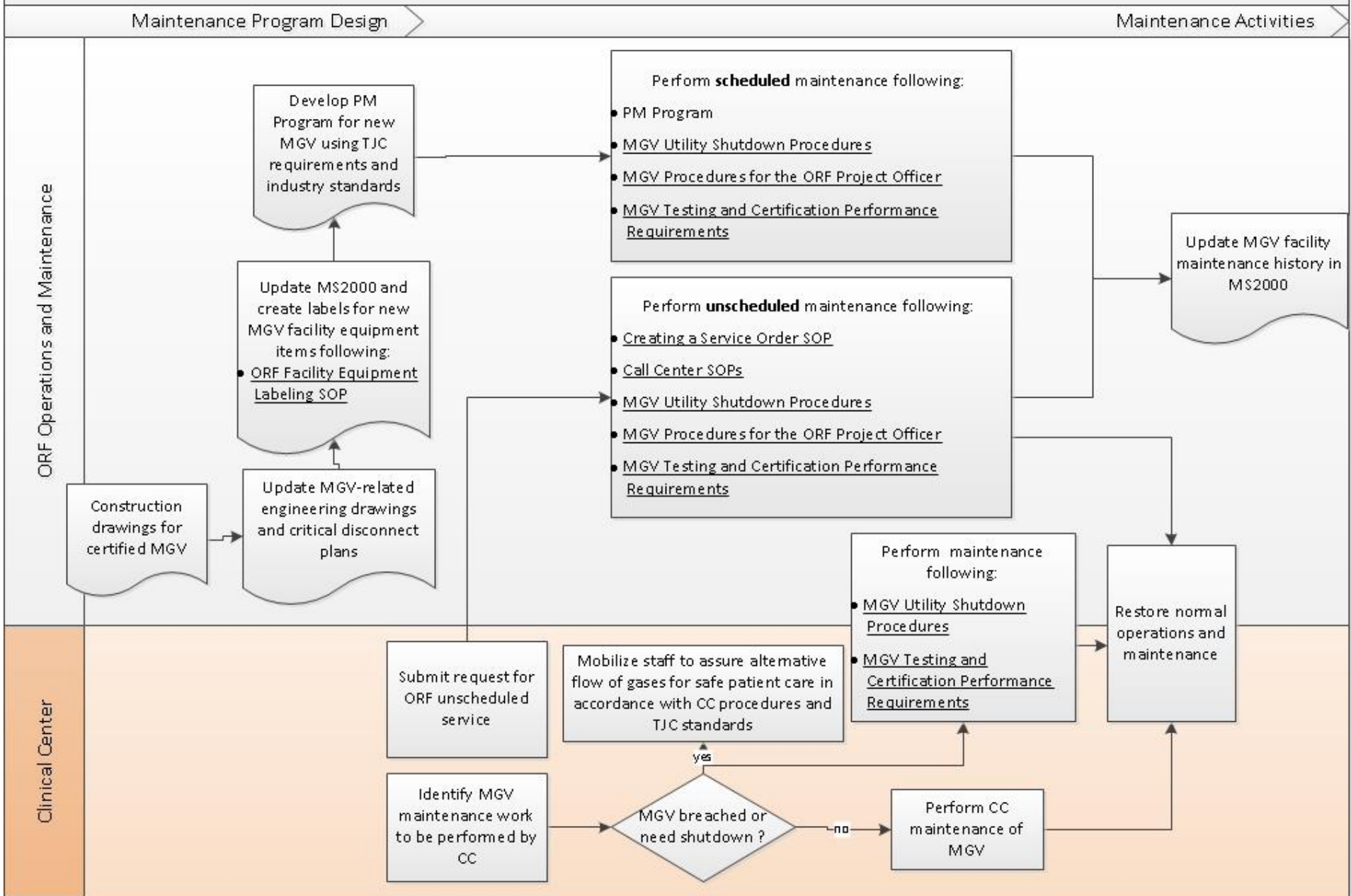
NIH Exhibit X3-13-C
NIH Facilities Development Manual

Acronym or Phrase	Definition
PO	Project Officer
RPMO	Real Property Management Office
SOP	Standard Operating Procedure

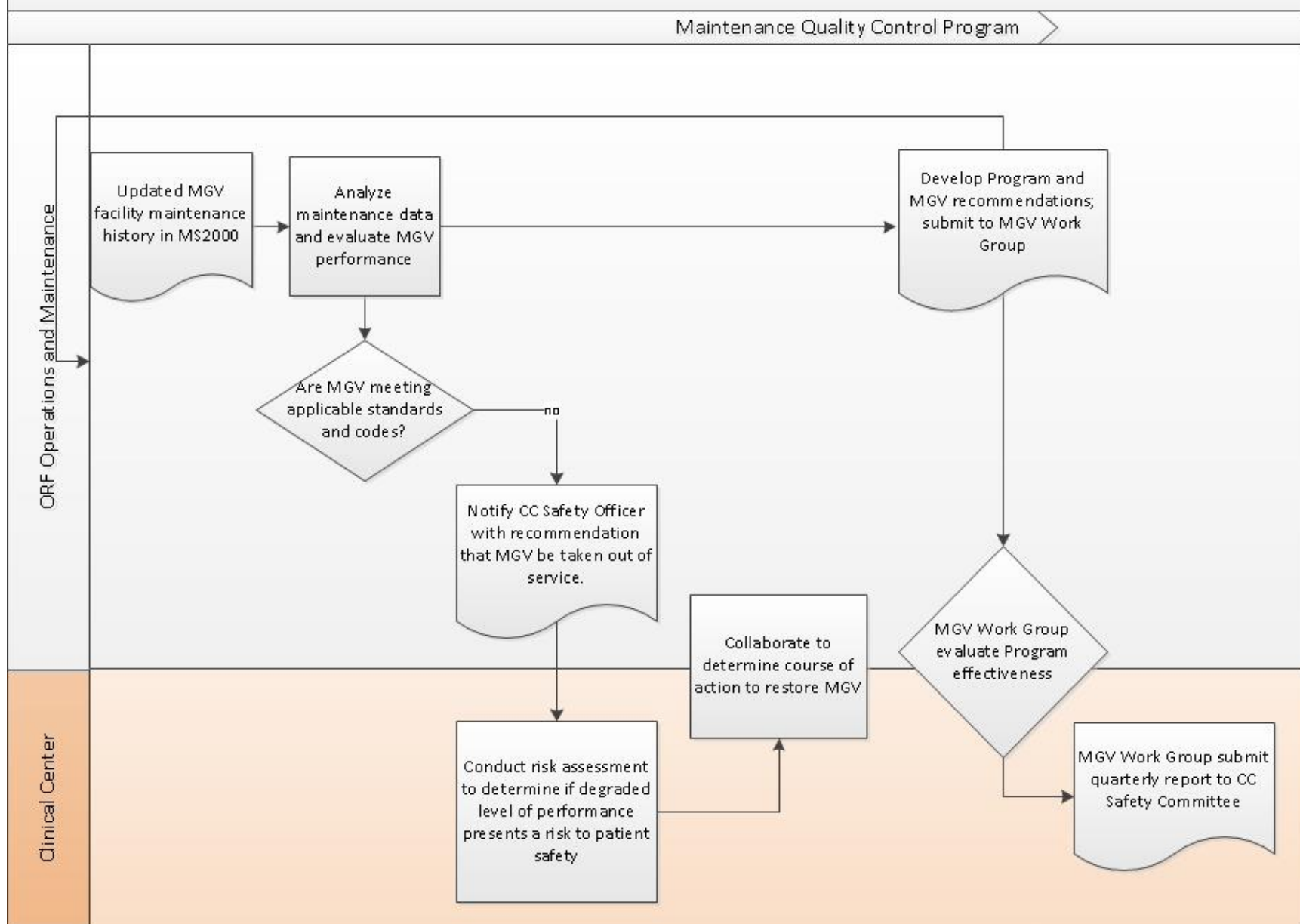
APPENDIX B: MGVS PROGRAM FLOWCHART



Piped Medical Gas and Vacuum Systems (MGV) Flowchart – page 2 of 3



Piped Medical Gas and Vacuum Systems (MGV) Flowchart – page 3 of 3





APPENDIX C: MGV DESCRIPTION

1. MGV IN THE CLINICAL RESEARCH CENTER

1.1 Medical Air, Vacuum, and Oxygen

The CRC MGV is comprised of three primary systems: medical air, medical vacuum, and medical oxygen. The medical air system is supplied by three compressors arranged in a lead/lag/standby arrangement with refrigerant dryers. The medical vacuum system is supplied by three vacuum pumps arranged in a lead/lag/standby grouping with a receiver tank for system stability. The medical oxygen system is fed from a tank farm outside of the building (this tank farm also feeds the Magnuson Center from a different connection at the manifold).

The CRC medical air and medical vacuum pipeline systems serve the entire CRC space and **ONLY** the CRC space. These systems are **NOT** connected in any way to any other CCC spaces.

The CRC medical oxygen system consists of a single-point source fed through the Magnuson Center, which is fed from a tank farm. No source equipment or system tanks are located within the CRC space. If the source equipment (Magnuson Center tank farm or manifold) fails, then the CRC medical oxygen system will also fail.

The CRC does not have a central utility nitrogen system or a central utility nitrous oxide system.

The CRC MGV consists of the equipment items listed and described in the following table:

NIH Exhibit X3-13-C
NIH Facilities Development Manual

Table 1: CRC MGV Equipment Items

Air	Vac	O ₂	Qty	Equipment Item	Location / Description
x			3	Compressors	Compressors, surge tank, pumps, and receiver tank are all located on one skid on the B2 level in room B2-2461. Air compressors are redundant and oil-less. Pumps are redundant, rotary vane, oil pumps.
x			1	Surge tank	
	x		3	Pumps	
	x		1	Receiver tank	
Air	Vac	O ₂	Qty	Equipment Item	Location / Description
x			4	Risers	Each riser feeds one of the four main clinical wings. The risers tap off into the interstitial mechanical space above the patient care unit (PCU) that the particular line is serving and pass through shutoff valves within each PCU before being distributed individually at each room.
	x		4	Risers	<i>Refer to drawings.</i>
		x	4	Risers	<i>Refer to drawings.</i>
x			4	Riser shutoff valves	Riser shutoff valves are located in the two-story B2-level —super corridorl space; except for the northeast riser, which is located in room B2-2460.
	x		4	Riser shutoff valves	
		x	1	Main shutoff valve	Main shutoff valve is located on the B2 level in the hallway outside of room B2- 5340. Main shutoff valve serving the entire CRC.
x			1	Radiation oncology shutoff valve	
	x		1	Radiation oncology shutoff valve	
x	x		TBD	Zone valve-in-box	Located at nurses stations. For medical staff use for emergency shutoff of patient rooms.
x			2	Refrigerant dryers	
x	x		TBD	Wing and corridor shutoff valves	Located in the interstitial spaces above each PCU.
x			TBD	In-line filters	



1.2 Monitoring

The CRC MGV is monitored from the following locations:

- a. Clinical Center Maintenance Unit (CCMU) office in room B1N108
- b. Security station in the CRC room B1-6522
- c. Individual nursing stations
- d. Local gauges at the system source in room B2-2461

1.3 Drawings

The CRC MGV drawing information is available on the CRC Plumbing Critical Disconnect Plan.

1.3.1 Source equipment

The Plan indicates the location of the source equipment on the B2 level.

1.3.2 Risers

The physical location of the risers is internal to all mechanical/electrical shafts. In order to allow for readable drawings, the locations of the risers are shown in the same general area, but not necessarily shown in the shafts.

1.3.3 Shutoff valves

The floor plans indicate runs of piping that show shutoff valves for the different areas of the building being served. On the interstitial floor, isolation of an entire wing is possible as well as isolation for just the north half of the wing or the south half of the wing.

2. MGV IN THE ACRF AND THE MAGNUSON CENTER

The ACRF and Magnuson Center MGV are comprised of three primary systems: medical air, medical vacuum, and medical oxygen, and also systems for nitrous oxide and nitrogen, which are described separately.

2.1 Medical Air, Vacuum, and Oxygen

The Magnuson Center medical air pipeline system has been decommissioned and is scheduled to be replaced. The new medical air pipeline system is in the process of design and review. The ACRP is fed by a triplex compressor system.

The ACRF and Magnuson Center medical vacuum system is configured to provide service as follows:

- a. The ACRF medical vacuum system consists of six air-cooled vacuum pumps for operating suites—two for medical vacuum and four dedicated for use with waste anesthesia. Each two pumps has a corresponding receiver tank.
- b. The Magnuson Center medical vacuum system consists primarily of vertical transmission lines supplied by two air-cooled vacuum pumps and with a receiver tank for system stability.

The ACRF and Magnuson Center medical oxygen is supplied by a large distribution system with four sources: primary tank, secondary tank, emergency tank, and an



external portable oxygen supply by either tanker truck or removable oxygen banks that will connect via a supply header to the manifold and feed into the Magnuson Center distribution room located in B1.

The ACRF and Magnuson Center medical air, vacuum, and oxygen systems consist of the equipment items listed and described in the following table:

Table 2: ACRF and Magnuson Center Medical Air, Vacuum, and O2 Equipment Items

Air	Vac	WAGD	O ₂	Qty	Equipment Item	Location / Description
x					Compressors	No compressors or surge tank at this time. A replacement pipeline system is currently in the design and review process.
x					Surge tank	
	x			2	ACRF air- cooled pumps	3C581 (serving ORs 1 – 12)
	x			1	Receiver tank	3C581 (serving ORs 1 – 12)
		x		2	ACRF air- cooled pumps	3C581 (serving ORs 1 – 9)
		x		1	Receiver tank	3C581 (serving ORs 1 – 9)
		x		2	ACRF air- cooled pumps	3C726
		x		1	Receiver tank	3C726
	x			2	CC air-cooled pumps	B2S233
	x			1	Receiver tank	B2S233
			x	3	Tanks	6000 gal. primary tank, located at the southeast corner of B10. 1500 gal. secondary tank, located on pad with primary tank. 1089 gal. emergency tank, located on the north side of B13. Interconnection of these three tanks is in Room B1C101.
			x	1	Manifold	Located in B1C101.



Air	Vac	WAGD	O ₂	Qty	Equipment Item	Location / Description
			x	1	External portable oxygen supply	Utilizes a manifold for oxygen delivered by truck. Located at B1 loading dock, behind B1C11.
			x	2	Header supply systems	
			x	2	Flow-rate meters	Located in B1N108 and B1C101
x					Risers	No medical air risers at this time.
	x				Risers	Each vacuum/oxygen riser feeds one of the four main clinical wings. The risers tap off into the space above the patient care area ceiling that the particular line is serving and pass through shutoff valves within each nurses station before being distributed individually.
			x		Risers	<i>Refer to drawings.</i>
x					Riser valves shutoff	Not applicable at this time.
	x				Riser valves shutoff	Located on the B1 level at alternate PCU, starting with Room S207 and ending with Room 5263.
			x		Main Valve Shut-off	B1
x	x			TBD	Zone valve-in- box	Located at nurses stations. For medical staff use for emergency shutoff of patient rooms. Not currently applicable for medical air.
x					Refrigerant dryers	Not applicable at this time.
x	x			TBD	Wing and corridor shutoff valves	Located in the hallways outside the patient care areas, hanging in the spaces above the ceilings. Not currently applicable for medical air.
x				TBD	In-line filters	Not applicable at this time.

2.2 Nitrous Oxide and Nitrogen

The ACRF and Magnuson Center nitrogen supply system services the first floor Dental Clinic. A supply header exists that is capable of servicing the operating suite in Room 2C525; to date this part of the system has never been in service.

The ACRF and Magnuson Center nitrous oxide system serves the first floor Dental Clinic and the operating suite in Room 2C525. It is also capable of providing supply to Transfusion Medicine.

The ACRF and Magnuson Center nitrous oxide and nitrogen systems consist of the equipment items listed and described in the following table:

Table 3: ACRF and Magnuson Center Nitrous Oxide and Nitrogen Equipment Items

N2	N2O	Qty	Equipment Item	Location / Description
x		5	Cylinders	One bank of five cylinders is on-line with the spare tanks in standby status. Located in Room B1N108.
x		5	Spare tanks	
	x	5	Cylinders	One bank of five cylinders is on-line with the spare tanks in standby status. Located in Room B1N108.
	x	5	Spare tanks	
	x	1	Manifold	Located in Room B2C135
	x	1	Nitrous Oxide supply system	Separate series of tanks for the B3B North operating suite, located in an adjacent space.

2.3 Monitoring

The ACRF and Magnuson Center medical air, oxygen, and vacuum systems are monitored from the following locations:

- a. Clinical Center Maintenance Unit (CCMU) office in room B1N108
- b. South entry badging station in room 1C47
- c. Individual nursing stations
- d. Local gauges at the system sources

Alarms for the ACRF and Magnuson Center nitrogen and nitrous oxide systems are located in Room B1N108. Monitoring is accomplished by two-bottle scales for each system in Room B2C135.

The nitrous oxide system that supplies the B3B operating suite has no alarm system and is monitored by operating room personnel.

2.4 Drawings

The ACRF and Magnuson Center MGW drawing information is currently being surveyed and updated. An ACRF and Magnuson Center Plumbing Critical Disconnect Plan is currently being drafted.



Office of Research Facilities
Development and Operations

Division of Property Management

Real Property Management Office

Subject:	MGV Testing and Certification Performance Requirements
Document No.:	RPMO-455-13-02
Effective Date:	September 1, 2010
Next Review Date:	September 1, 2011
Review Responsibility:	MGV Work Group
Approved by:	_____ Lawrence Manfredi, Director, RPMO

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1. PURPOSE

The purpose of these performance requirements is to provide supplemental guidance and clarification for the performance of piped medical gas and vacuum systems (MGV) testing and certification at the National Institutes of Health (NIH) hospital. All MGV testing and certification shall be performed in accordance with NFPA 99 standards and as specified herein.

2. SCOPE

These performance requirements apply to the testing and certification process for Building 10 MGV before and after completion of MGV construction, addition, alteration, renovation, maintenance, replacement, or demolition.

3. APPLICABLE DOCUMENTS

Document #	Title	Issued by	Document Location
	NFPA 99: Standard for Health Care Facilities, 2002 Edition.	National Fire Protection Association	
	ASSE Series 6000: Professional Qualifications Standard for Medical Gas Systems Personnel, Revised February 2006.	American Society of Sanitary Engineering	
RPMO-455-12-00	ORF Piped Medical Gas and Vacuum Systems Management Program	ORF	
RPMO-455-13-01	MGV Procedures for the ORF Project Officer	ORF	
RPMO-455-13-05	MGV Utility Shutdown Procedures	ORF	
RPMO-300-03-01	ORF Facility Equipment Labeling Procedures	ORF	



4. DEFINITIONS

Phrase	Definition
Facility Equipment	Encompasses building-type equipment; built-in equipment; and large, substantially affixed equipment/property and is normally acquired and installed as part of a facility project. Facility equipment items are the maintainable items for which facility data records are created and maintained.
Inspectors [<i>specific to the ORF MGV Program</i>]	Those NIH individuals designated by the Real Property Management Office (RPMO) Joint Commission Engineer, to be the onsite reviewers where identified by the standard in ASSE Series 6000, Annex A – Item A.15.2.3.
New Work [<i>specific to the ORF MGV Program</i>]	The installation or modification of facility equipment items at the job site by the contractor. Simple “cut and cap” work does not qualify as new work.
Source (also known as „breach“) [<i>specific to the ORF MGV Program</i>]	The „point of intrusion.“ Intrusion is cutting or tapping into a line, opening a line to atmospheric conditions, etc.

5. PERFORMANCE REQUIREMENTS

5.1 Overall Testing and Certification Process

Table 1: Performance Requirements Overall

Requirement	Responsibility	Performance	Control Points
Testing and Certification	Project Officer (PO)	Provide an independent, credentialed Medical Gas System Certifier to verify and submit test results, including certified results by an independent testing laboratory, as required by	Independent certifiers shall have ASSE 6030 certificates, as defined in NFPA 99C and ASSE Series 6000.

5.2 Prior to Final Tie-in

Testing performed prior to final tie-in is authorized under Phase 1 of the MGCV “PERMIT TO WORK” and must be satisfactorily completed by an independent certifier in order to obtain authorization of Phase 2 of the “PERMIT TO WORK,” which permits final tie-in. Authorization of Phase 2 will constitute compliance of standards as reviewed by the RPMO, Clinical Center Office of Space and Facilities Management (CCOSFM), and Office of Hospital Physical Environment (OHPE) groups.

Testing of new work prior to final tie-in shall be performed in accordance with the following NFPA 99 standards:

1. Standing Pressure Test (5.1.12.3.2)
2. Cross-Connection Test (5.1.12.3.3)
3. Valve Test (5.1.12.3.4)
4. Alarm Test (5.1.12.3.5)
5. Piping Purge Test (5.1.12.3.6)
6. Piping Particulate Test (5.1.12.3.7)
7. Piping Purity Test (5.1.12.3.8)



Table 2: Performance Requirements Prior to Final Tie-in

Requirement	Responsibility	Performance Requirements	Control Points
Standing Pressure Test	PO	Ensure that an independent party (if possible, the potential independent Certifier)	
Piping Purge Test	RPMO Joint Commission Engineer (JCE) and/or Medical Gas Engineering Technician (MGET)	Determine the primary outlets/areas to which the piping purge test shall apply.	
	Independent Certifier	0.45 micron filters shall be used for the visual inspection of particulate on outlets/areas. There will be no requirement to send these samples to	
	PO	If the piping purges fail to produce clean samples, immediately notify the following groups: JCE/MGET OHPE CCOSFM	



Requirement	Responsibility	Performance Requirements	Control Points
	<p>JCE / MGET OHPE CCOSFM Construction Team (i.e., NIH PO, primary contractor, and the independent certifier)</p>	<p>If notified that the piping purges failed to produce clean samples, determine a plan of action.</p>	<p>Must have an agreed-upon plan of action.</p>
<p>Piping Particulate Test and Piping Purity Test</p>	<p>JCE / MGET</p>	<p>Determine the outlet(s) to be tested and inform the project team accordingly.</p>	<p>A Piping Particulate Test will be required for the most remote outlet for each positive pressure gas in</p>
	<p>Independent Certifier</p>	<p>Send test samples to a certified laboratory for analysis. Submit the resulting lab reports, including explicit laboratory results, as testing documentation (refer to testing documentation</p>	
<p>Test Documentation</p>	<p>PO</p>	<p>Submit documented test results to the JCE/MGET, OHPE, and the CCOSFM for review. Test documentation shall include the following: Standing Pressure Test Results Cross Connection Test Results Valve Test Results Alarm Test Results Piping Purge Test Results Piping Particulate Test Results (from Certified Laboratory) Piping Purity Test Results (from Certified Laboratory)</p>	<p>This is required in order to receive authorization of Phase 2 of the “PERMIT TO WORK.”</p>



5.3 During and After Final Tie-in

Testing and certification performed during and after final tie-in is authorized under Phase 2 of the “PERMIT TO WORK.”

The following NFPA 99 standards apply to the testing and certification of all work during and after final tie-in:



1. Final Tie In Test (5.1.12.3.9)
2. Operational Pressure Test (5.1.12.3.10)
3. Medical Gas Concentration Test (5.1.12.3.11)

Table 3: Performance Requirements During and After Final Tie-in

Requirement	Responsibility	Performance Requirements	Control Points
Final Tie-in Test	All	Adhere to the requirements of <i>RPMO-455-13- 05: MGV Utility Shutdown</i>	
	Independent Certifier	<p>Be on site during final tie-in.</p> <p>Ensure all testing and certification requirements are met.</p> <p>Conduct testing and produce a final report indicating all standards have been met.</p> <p>Provide a report indicating acceptance of each joint in the final connection. This report may be a standard copy of the floor plan layout of the piping with appropriate initials asserting acceptance of each joint. Similar concepts for approval can be</p>	Final report indicates all standards have been met.
	Authorized maintenance staff	Activate shut down of MGV as directed.	<p>The MGET maintains a list of maintenance staff permitted to shutdown MGV and posts the list in the shift maintenance control room.</p> <p>The Government personnel to</p>
Operational Pressure Test and Medical Gas Concentration Test	Independent Certifier	<p>Actual pressure reading numbers shall be provided. “Pass” or “Fail” are not acceptable designations for test results.</p> <p>All testing components shall be uniquely identified in the test report using either (1) the facility number for each facility equipment item or (2) the construction drawing labels. References to rooms or generalized areas are not acceptable.</p>	



Requirement	Responsibility	Performance Requirements	Control Points
Test and As- Built Documentation	PO	<p>Submit final documented test results and as- built documentation to the JCE/MGET, OHPE, and the CC-OSFM as proof of completion. Required documentation includes the following:</p> <ul style="list-style-type: none"> • Final Tie-in Test Results • Operational Pressure Test Results • Medical Gas Concentration Test Results • Final report from an independent certifier. Report shall include verification of the following: <ul style="list-style-type: none"> • testing and certification requirements are met • new facility equipment items are appropriately labeled • alarm devices are correctly applied • Facility documents including the following: <ul style="list-style-type: none"> • as-built drawings indicating all field changes/corrections • approval records from appropriate stakeholders • floor plan drawings showing location of all new facility equipment items • operating and maintenance manuals for new MGV • contractor warranty and contact information for new MGV • Confirmation that an inventory of new facility equipment items has been provided to the JCE/MGET for inclusion in the Real Property Management Office (RPMO) 	<p>All required documentation is necessary to receive acceptance of the new work as COMPLETE.</p>