Section 8.10 Natural Gas/Fuel Gas Systems

8.10.0. General Requirements:

1. Natural gas shall be utilized as the primary fuel gas source in NIH facilities. Propane may be used for remote buildings when life-cycle costing justifies its installation over natural gas.

RATIONALE
The use of natural gas over LPG is preferable for safety reasons (primarily related to hazards associated with storage of liquefied gas containers and gas density as compared to air) as well as economy of use of available centralized systems.

2. Natural gas systems shall be designed per NFPA Standard 54/ANSI Z-223.1, National Fuel Gas Code and Washington Gas requirements. Propane/LPG systems shall be designed in accordance with NFPA-58 and NIH DFM requirements. For additional design, construction and testing guidelines.

3. The natural gas piping system shall be designed to provide 0.03 to 0.04 L/s (4 to 5 CFH) at each laboratory outlet at a pressure of 1750 Pa (7-inch w.g.) Fuel gas piping distribution systems that serve laboratories shall be low-pressure systems, operating at 1750 Pa (7-inch w.g.). For fixed laboratory equipment, the volume flow rate required shall be determined from the manufacturer’s input ratings. Diversity may be applied for laboratory turret outlets if the diversity is safely established, however equipment shall be considered at 100% use factor. Primary building equipment loads (such as for building mechanical or food service equipment) shall not be diversified unless a control means is provided to preclude simultaneous operation and prior approval of NIH is obtained.

RATIONALE
The design criteria for flow and pressure is established to promote flexibility of the gas system to support a range of burners and equipment without excessive needs for gas pressure regulators. Diversification of primary equipment loads is not permitted where such equipment could potentially be operated simultaneously. Even where separate distribution systems are provided, it is necessary that each distribution system be sized to accommodate peak equipment loads that could be in simultaneous operation without causing unsafe drop of pressure to lab areas.

4. Gas distribution for food service, supporting mechanical equipment, and other functions which are not directly part of the lab program shall be separated from the laboratory gas distribution system starting at the service entrance.

RATIONALE
Interconnections of lab systems with food service and mechanical areas can result in excessive disruptions to laboratory and building services as renovations, repair, and modifications are required, including disruptions associated with purging of system air. In addition, the use of higher pressure gas distribution to serve mechanical equipment and food service areas is common and often preferable for economy, though such practice is inappropriate for lab areas.
where gas regulators throughout the building and the relatively low gas demands would make such practice less unwarranted.

5. The design pressure loss in the gas piping system shall be such that the supply pressure at any piece of equipment is greater than the minimum pressure required for proper equipment operation. A pressure drop of 75 Pa (0.3 inches of water gauge) during periods of maximum design flow is to be used for sizing low-pressure gas installations. Pressure drop in medium pressure systems shall not exceed 10% of the design distribution pressure.

**RATIONALE**

These requirements are to ensure required operating pressures are provided consistently and safely during peak operating conditions.

6. Shutoff valves shall be specifically listed for the appropriate fuel gas application and for use at the system operating pressure. All interior gas valves shall be actuated without requiring the use of tools. Each laboratory floor shall have an isolation valve that is quickly accessible for emergency shutoff, located through consultation with the DFM, to permit emergency isolation of an individual floor of each building wing. If the emergency shut-off valve is of actuated type, it shall be of a stored energy type to preclude inadvertent shut-down due to unintended loss of power source or air supply, and shall require manual operation to re-open.

**RATIONALE**

These requirements are to clarify the need and location for valving in fuel gas systems and to obtain consistency in design practices. Additional user operable gas valves are not required outside of each individual laboratory for daily shut-off of gas supply. Gas system valves must be selected and listed for the pressure range of the actual fuel gas application. Emergency shut-off gas valves that automatically reopen could be hazardous in the facility if they were to reopen prior to safe conditions (all valves closed) having been verified. Nuisance tripping of a gas valve could similarly cause unsafe conditions.

7. A user accessible shut-off valve is required for each piece of fixed equipment. Additional shutoffs are not required for lab turrets (with the exception of those provided in equipment such as fume hoods) as these may be served by the shut-off valve serving the laboratory.

8. Whenever equipment is on wheels or intended to be movable for regular cleaning or usage, the gas connection shall be made with a UL/AGA listed epoxy-coated stainless steel commercial type gas connectors that is especially designed for movable equipment applications and includes a quick disconnect with integral shut-off and a properly assembled restraining device. A user accessible shut-off valve shall also be provided. All connectors shall be properly sized for the required flow rate based on equipment input requirements and maximum allowable pressure drop.

**RATIONALE**

These requirements are intended to provide a safe means of accommodating movable equipment without elevated risk of gas leakage.
9. Gas connections to laboratory equipment and fixed equipment shall be hard-piped, and unions shall not be permitted in concealed, unventilated spaces, including above ceilings. The final gas connection below the ceiling to laboratory fume hoods may be made with ASTM A539 welded steel tubing specifically designed for fuel gas lines. Compression fittings shall not be utilized at any point in a fuel gas system, and joints shall be permitted only at each end. Couplings used in fuel gas systems shall include appropriate thread stops and proper NPT pipe thread taper. Factory-furnished couplings at the end of threaded steel pipes that protect pipe threads shall not be used in the piping system in lieu of proper fittings.

RATIONALE
This installation and joint connections requirement is intended to reduce high incidence of leakage at these joints. Compression fittings are not designed for fuel gas applications but have often been found in the field and are subject to leakage.

10. Services to each floor of a building wing shall be connected to respective supply risers, independent of other floors. Gas piping shall not route through electrical rooms or other potential sources of combustion, hazardous or critical spaces, or where subject to potential mechanical damage. Horizontal gas piping shall be graded to slope to drain towards the service entrance and risers at a slope of not less than 5 mm (3/16 in.) per 5 m (16 ft.).

RATIONALE
These requirements are intended to preclude potential disruptions and maintain continuity of service. Disruptions in fuel gas systems can create safety hazards as there is risk of terminal outlets being left open in depressurized systems as users attempt to operate outlets. Sloping of piping towards main risers and service entrance is to minimize potential for moisture, oils, and contaminants to induce premature wear or unsafe conditions at terminal outlets, controls, and equipment.

11. Gas pressure regulators shall be vented to the outside at locations as approved by code turned down and located to preclude blockage. Pressure regulators without external vents shall not be utilized with the exception of low pressure appliance regulators at terminal outlets that are approved by the serving gas supplier (Washington Gas at NIH) and in conformance with applicable codes and standards.

RATIONALE
Venting of fuel gas regulators inside building can pose safety hazards. Vent regulators must be approved by the serving gas supplier, and should be of reliable, low-maintenance design.

12. Fuel gas shall not be piped to biosafety cabinets.

RATIONALE
Pressurized gas and flames may disrupt air currents, disrupt sterile fields, result in potentially explosive gas build-up in recirculated cabinets, damage HEPA filters and thereby compromise the safe and effective operation of biosafety cabinets. Variances shall be subject to approval of NIH DOHS and where granted, shall require provision of a user-accessible emergency fuel gas
shut-off. In most cases, alternatives may be applied which negate the need for flames within cabinets.

13. Gas cocks and turret outlets shall have ¼-turn lever handles.

**RATIONALE**

1/4-turn turret levers promote a quick visual confirmation of the shut-off position of turrets and valves.

### 8.10.1. Testing Requirements

1. Fuel gas piping shall be tested in accordance with NFPA-54 (or NFPA-58 as applicable) based on the total piping system volume, except that in no case shall the test pressure be less than 420 kPa for an 8 hour test period. Every connection shall be tested, and appropriate procedures to isolate equipment from test pressure shall be strictly followed. Only final connections to equipment (downstream of any appliance regulators) may be tested with non-corrosive manufactured gas leak detection solution or sensitive electronic leak detectors. For additional design, construction and testing guidelines see.

2. Post installation and system modification gas system purging practices shall be specified to conform to current edition of NFPA-54/ANSI Z223.1.

**RATIONALE**

Extent of gas system testing varies by codes, standards, and local ordinances; however for NIH projects all gas connections shall be tested to preclude leakage. Safe purge procedures are not routinely defined by all codes and can result in significant safety hazards. ANSI Z223.1/ NFPA-54 2012 edition identifies acceptable procedures to address these concerns however conformance must be mandated in design documents.