Guideline D.02 – Firefighter Breathing Air Replenishment Systems

D.01.1 PURPOSE

The purpose of this guideline is to provide information and minimum requirements for the installation of Firefighter Breathing Air Replenishment Systems in accordance with Appendix F of the California Plumbing Code. Breathing Air Replenishment Systems provide firefighters the ability to refill **S**elf-**C**ontained **B**reathing **A**pparatus (SCBA) cylinders onsite.

D.01.2 SCOPE

This guideline shall apply to all high-rise buildings, underground structures, large area structures and underground transportation or pedestrian tunnels.

D01.3 DEFINITIONS

For the purpose of this guideline, the following shall be defined as:

Firefighters Breathing Air Replenishment System – The Firefighters Breathing Air Replenishment System is a complete, self-contained breathing air replenishment system permanently installed within a structure, consisting of exterior fire department connection panels, interior air fill stations and an interconnected piping distribution system.

High-Rise Building - Buildings greater than 55 feet in height where the building height is measured from the lowest level of fire department access to the floor of the highest occupiable story.

Large Area Structure - Large area structures with an area greater than 200,000 square feet and where the travel distance from the centerline to the closest exit is greater than 500 feet, such as warehouses, manufacturing complexes, malls, or convention centers.

Underground Structure – Underground structures that are three (3) or more floors below grade with an aggregate area greater than 20,000 square feet.

Underground Transportation and Pedestrian Tunnels - Underground transportation and pedestrian tunnels exceeding 500 feet in length.

D.01.4 PERMITS REQUIRED

Permits and Plans

A Building Department permit is required to install, repair or modify any Firefighter Breathing Air Replenishment System. All permits are required prior to starting any work.

Installation plans shall be submitted to the Building Department for review. The plans shall be prepared by a registered Professional Engineer and shall include the design, details and specifications for the components.

Design Professional and Contractor Responsibilities:

- Plans, specifications, product data sheets, system calculations and equipment.
- Calculations for the firefighters air replenishment system shall be reviewed and stamped by a California licensed mechanical engineer knowledgeable in high pressure (6,000+ psi) firefighter breathing air replenishment systems.
- The installation contractor shall be licensed by the State of California – Class C-36.

D.01.5 PROCEDURE

Firefighter breathing air replenishment systems and all pressurized components shall be listed and accredited by a nationally recognized testing agency: NFPA, ANSI, U.L or equal as established by the fire department.

Exterior Fire Department Connection Panel

- Each building shall have a minimum of two (2) panels.
- The panels shall contain all of the necessary gauges, isolation valves, pressure-relief valves, pressure regulating valves, check

valves, tubing, fittings, supports, connectors, adapters, air analyzer, display modules, tamper switches and other necessary components as may be required to allow the Fire Department's mobile air unit to connect and supply the system with a constant source of breathing air.

- The connections must be compatible with the Newport Beach Fire Department's mobile air unit.
- Each Fire Department connection panel shall contain at least two (2) inlet air connections.
- The panels shall be constructed of minimum 18 gauge, corrosion resistant carbon steel or equivalent.
- The panels shall be attached to the building or on a remote monument at the exterior of the building. A minimum of six (6) feet of clear unobstructed access to the front of the panel is required.
- The panels shall be weather resistant or secured inside a weather-resistant enclosure.
- The panels shall be located on opposite sides of the building within fifty (50) feet of an approved roadway or driveway, or other locations approved by the Newport Beach Fire Department.
- The panel enclosure shall be marked "FIREFIGHTER AIR SYSTEM". The lettering shall be in a color contrasting to the color of the cabinet with a minimum 3/8-inch brush stroke 2 inches high.
- Impact protection in accordance with California Fire Code Section 312.2 shall be provided where the panel is subject to vehicular traffic.
- An approved means of locking the enclosure shall be provided.

Interior Fire Department Air Fill Station

- The location of the closet or room for each air fill station shall be approved by the Newport Beach Fire Department. When approved, the space may be utilized for other firefighting purposes.

- The door to each room enclosing the air filling station enclosure shall be readily accessible at all times. A minimum of six (6) foot radius and 180-degree clear unobstructed access to the front of the air filling station shall be provided.

- The enclosure shall have emergency lighting installed in accordance with NFPA 70 and CALIFORNIA ELECTRICAL CODE article 700.16.

- The air fill station shall contain all of the gauges, isolation valves, pressure-relief valves, pressure-regulating valves, check valves, tubing, fittings, supports, connecting hoses, adapters, Class II rupture containment, and other components to refill SCBA cylinders.

Interconnected Piping Distribution System

- All pressurized components shall be compatible for use with high-pressure breathing air equipment and self-contained breathing air apparatus.

- All pressurized breathing air components of the system shall be rated to operate at a MINIMUM working pressure of 6,000-psig. at 70 degrees F with a MINIMUM safety factor of four (4).

- Tubing shall be stainless steel complying with ASTM A269, or other approved materials that are compatible with breathing air at the system pressure.

- Routing of tubing and bends shall be such as to protect the tubing from mechanical damage.

- Fittings shall be constructed of stainless steel complying with ASTM A479, or other approved materials that are compatible with breathing air at the system pressure.

- The use of nonmetallic materials, carbon steel, iron pipe, malleable iron, high-strength gray iron, or alloy steel shall be prohibited for breathing air pipe and tubing materials.

Air Monitoring System

The air monitoring system shall transmit a supervisory signal when the air pressure and or levels of moisture or carbon monoxide exceed acceptable set levels. The supervisory signals shall be transmitted from the air analyzers and display modules to the building's fire alarm panel. The air monitoring system shall consist of a minimum:

- One (1) Electric pressure monitoring switch rated for a maximum working pressure of 7500-psig. The switch shall have contacts that are adjustable to close at 3,000-psig. +/- 100 psig descending. The pressure switch shall be connected to the building's fire alarm system and shall transmit a supervisory signal to the central alarm monitoring station when the pressure of the breathing air system is less than 80 percent of the system operating pressure. Activation of the pressure switch shall also activate an audible alarm and visual signal located at the building's fire alarm annunciator panel.

- One (1) electric moisture and carbon monoxide analyzer located at the uppermost (or lowermost air replenishment room if below grade) and one (1) at ground level. Additional electric moisture and carbon monoxide analyzers may be required at other locations if required by the fire code official. The analyzers shall be connected to the building's fire alarm system. The fire alarm system shall transmit an alarm to the building's central alarm monitoring station as a supervisory alarm.

- Three (3) electric moisture and carbon monoxide display modules; one each located within the exterior panels and one located within the lowest floor air cylinder fill station. Each unit shall be connected to the building's fire alarm system. The fire alarm system shall transmit an alarm to the building's central alarm monitoring station as a supervisory alarm.

- If the building is not equipped with a fire alarm system, activation of the pressure switch shall activate an audible alarm located at the building's main entrance. A weather-resistant sign shall be provided in conjunction with the audible alarm stating "FIREFIGHTER AIR SYSTEM – LOW PRESSURE ALARM" the lettering shall be in a contrasting color and the letters shall be 2 inches high with a 3/8-inch brush stroke.

Isolation Valve

- A lockable system isolation valve shall be installed downstream of each air fill station and shall be located in the panel or within three (3) feet of the station.

- The isolation valve shall be marked with its function in letters that are a minimum of 3/16 – inches high with a 1/16 – inch brush stroke.

Pressure Relief Valve

- Pressure-relief valves shall be installed downstream of the pressure regulator unit. The relief valve shall meet the requirements of the CGA S-1.3 and shall not be field adjustable. The relief valve shall have a set-to-open pressure not exceeding 1.1 times the design pressure of the system. Pressure-relief valve discharge shall terminate so that the exhaust air stream cannot

impinge upon personnel in the area. Valves, plugs or caps shall not be installed in the discharge of a pressure-relief valve. Where discharge piping is used, the end shall not be threaded.

Class II Rupture Containment

- A Class II rupture containment system is required at all cylinder fill stations. Class II rupture containment systems must comply with NFPA Standard 1901.

Protection

- All components of the Firefighter Breathing Air Replenishment System installed in a building or structure shall be protected by a minimum two (2) hour fire-resistive construction. All components shall be protected from physical damage.

System Demand

- The system shall be designed to fill, at the most remote fill station, a minimum of two (2) 66 standard cubic foot compressed breathing air cylinders to a maximum pressure of 4,500 PSIG simultaneously in three (3) minutes or less. Where greater capacity is required, the Fire Code Official shall specify the required system capacity.

Fill Station Location

Cylinder fill stations shall be installed in the interior of buildings as follows:

- **High-rise Buildings.** An interior cylinder fill station shall be installed commencing on the third floor and every third floor thereafter above grade. For underground floors in buildings with more than three underground floors, an interior cylinder fill station shall be installed commencing on the third floor below grade and

every three floors below grade thereafter, except for the bottom-most floor.

- **Underground Structures.** For underground floors in buildings with more than three underground floors, an interior cylinder station shall be installed commencing on the third floor below grade and every three floors below grade thereafter, except for the bottom-most floor.

- **Large Area Structure.** As required by the fire code official.

- **Underground Transportation and Pedestrian Tunnels.** As required by the fire code official.

System Assembly Requirements

- The system shall be an all-welded system except where the tubing joints are readily accessible and at the individual air fill stations. When mechanical high-pressure tube fittings are used, they shall be approved for the type of materials to be joined and rated for the maximum pressure of the system.

Welding Requirements

- Welding procedures shall meet ASME B31.1, Part 4 and Chapter V. Prior to and during the welding of sections of tubing, a continuous, regulated dry nitrogen or argon purge at three PSIG shall be maintained to eliminate contamination with products of the oxidation or welding flux. The purge shall commence a minimum of two (2) minutes prior to welding operations and continue until the welded joint is at ambient temperature.

Prevention of Contamination

- The system components shall not be exposed to contaminants, including but not limited to, oils, solvents, dirt, and construction materials. When contamination of system components has occurred, the affected component shall not be installed in the system.

System Acceptance, Testing and Certification

- **Static Pressure Testing.** Following fabrication, assembly, and installation of the piping distribution system, exterior connection panel, interior cylinder fill stations and the air monitoring system, the fire code official shall witness the pneumatic testing of the complete system at a minimum test pressure of 7500 PSI using oil-free dry air, nitrogen, or argon. A minimum twenty-four (24) hour pneumatic test shall be performed. During the test, all fittings, joints and system components shall be inspected for leaks. A solution compatible with the system component materials shall be used on each joint and fitting. All defects in the system or leaks detected shall be documented on an inspection report, repaired or replaced. As an alternate, a pressure-decay test in accordance with ASME B31.3 shall be permitted.

- **Low Pressure Switch Test.** Upon successful completion of the twenty four (24) hour static pressure test, the system's low-pressure monitoring switch shall be calibrated to not less than 3,000 PSI, descending, and tested to verify that the signal is annunciated at the building's main fire alarm panel and by means of an audible alarm and visual strobe located in a visible location.

- **Compatibility Check.** Each air fill station and each exterior fire department connection panel shall be tested for compatibility with the fire department's SCBA fill fittings.

- **Material Certifications.** The pipe or tubing material certifications shall be provided to the Fire Code Official.

- **Air Sampling.** Before the system is placed into service, a minimum of two (2) samples shall be taken from separate air fill stations and submitted to an independent certified gas analysis

laboratory to verify the system's cleanliness and that the air complies with the requirements for breathing air in accordance with NFPA 1989, section 5.3. The written report of the analysis shall be submitted to the fire code official, documenting that the breathing air complies with this section. During the period of air quality analysis, the air fill panel inlet shall be secured so that no air can be introduced into the system and each air fill panel shall be provided with a sign stating "AIR QUALITY ANALYSIS IN PROGRESS, DO NOT FILL OR USE ANY AIR FROM THIS SYSTEM." This sign shall be a minimum of 8-1/2 inches by 11 inches with minimum of 1 inch lettering.

- **Annual Air Sampling.** The breathing air within the system shall be sampled and certified annually and in accordance with the procedure outlined above.

- **Final Proof Test.** The fire code official shall witness the filling of two (2) empty sixty six (66) cubic foot capacity SCBA cylinders in three (3) minutes or less using compressed air supplied by the fire department equipment connected to the exterior fire department connection panel. Following this, a minimum of two (2) air samples shall then be taken from separate air filling stations and submitted to an independent certified gas analyst laboratory to verify the system's cleanliness and that the air meets the requirements of NFPA 1989. The written report shall be provided to the fire code official certifying that the air analysis complies with the above requirements.