Seattle Fire Department, Standard Operating Guideline

Natural Gas

This Standard Operating Guideline (SOG) provides guidance for operating at natural gas emergencies.

1. OVERVIEW

1.1. A natural gas incident can vary depending upon location of the leak (i.e., inside or outside), the size of the supply line (i.e., less or greater than 2 inches), and the pressure being supplied (i.e., ¼ to 2 psi on the consumer side of the meter vs. 35psi or greater on the supply side of the meter).

1.2. Natural gas has a low vapor density that causes it to rise in air. This can be beneficial when exterior, but needs to be taken into account when interior or near a structure. Do not rely only upon ground level air monitor readings. Areas at ceiling level, void spaces in dropped ceilings, elevator shafts, upper floors, and stairwells should be checked.

1.3. In an underground or confined release, natural gas may migrate to remote locations, creating an explosive atmosphere in adjacent structures, interconnected utility systems, or even up through the street or open ground. If the gas seeps up through the ground the Mercaptan may be 'scrubbed out' and an odor may not be detectible.

1.4. Due to the enormous potential associated with a natural gas emergency, it is vital that a hazard recognition/identification process begin at a safe distance and slowly advance inward based upon gathered information and the Risk Benefit Analysis (RBA). Many 911 callers lack accurate information, therefore responding personnel should use a systematic approach regardless of the reported leak size. Collect and verify information before determining a deployment strategy.

2. DEFINITIONS

2.1. Natural Gas – A colorless, odorless gas composed of approximately 94% methane. It has a vapor density of 0.6 (lighter than air) with a flammable range of 4%-14%. Mercaptan, which contains sulfur, is added before it reaches the consumer creating a distinct rotten egg odor detectable at extremely low levels. However, extended exposure to Mercaptan can cause olfactory fatigue and create unreliable sensory indication. As required by DOT, the odor threshold for Mercaptan in natural gas is .8% which is 20% of the Lower Explosive Limit (LEL).

2.1.1. Supply Pressure on the consumer side of the meter is regulated down to between ¼ psi (residential) to 2 psi (multi-family or commercial). On the supply side of the meter (intermediate line) pressures range from 35 to 60 psi. High-pressure distribution lines may be up to 200 psi.

2.2. Type Codes for Natural Gas Responses. One of these codes will be selected by the FAC.

2.2.1. Natural Gas Odor (NGO) – Involves a report of an odor of natural gas. A single Ladder will be sent to investigate.

2.2.2. Minor leak (NGL) – Involves a broken gas line with a diameter less than two inches (2"). A single Engine, Ladder, and Chief will be sent. FAC will notify Puget Sound Energy (PSE).

2.2.3. Major leak (NGLMJ) – Involves a broken gas line with a diameter of two inches (2") or greater. 5 Engines, 2 Ladders, 2 Chiefs, DEP1, SAFT2, a Medic, Aid Car, AIR9, and the Hazardous Materials Response Team will be sent. FAC will notify PSE.
NOTE: A PSE Supervisor will be sent on NGLMJ.

3. STRATEGY

3.1. The initial strategy at a natural gas response should be offensive, starting from the periphery and working inwards, as the RBA allows. The first arriving Officer is responsible for performing a RBA that confirms or changes the deployment strategy or operational mode.

3.2. Information gathering is critical to a safe operation and effective strategy and should be an initial priority. It can include location and size of release, wind direction, responsible party, air monitor readings, structures involved, civilians, witness reports, audible and olfactory clues.

3.3. Protect responders by staging appropriately. Minimize the number of responders in the hazard zone to accomplish essential tasks. Do not approach the area of the release without proper PPE. Proactively use air monitor readings and other available information to locate and evaluate the leak.

3.4. Protect life through a combination of appropriate actions that may include isolation and/or evacuation.

3.5. It should be a top priority of SFD personnel to shut natural gas off at the lowest acceptable risk (e.g., stop the leak by shutting the valve at the appliance, meter, or meter riser).

3.6. Protect exposures during a fire fueled by a natural gas leak.

3.7. Unless protecting life, do not extinguish a natural gas leak that is on fire except by eliminating the leak at the source.

3.8. Consult with PSE prior to SFD demobilization.

4. RESPONDING

4.1. Evaluate dispatch info, wind direction, and topography. Upon approach, stay up wind.

4.2. Turn on the air monitor(s) (i.e., Altair 5-gas, and CD100A, Gas-Trac if available) en-route to assist in establishing the Initial Isolation Perimeter.

4.3. Scene recognition:

4.3.1. Occupancy type and size (e.g., construction, dimensions, compartmentation) and how it may affect concentration levels (e.g., SFR, warehouse, apartment).

4.3.2. Internal or external leak (proximity to structure).

4.3.2.1. Supply and pressure possibilities based upon location and occupancy:

4.3.2.1.1. Small leak possibility: <2″ residential line on the consumer side of meter with ¼ psi.

4.3.2.1.2. Medium leak possibility: <2″ multi-family/commercial line on the consumer side of meter with up to 2 psi.

4.3.2.1.3. Large leak possibility: >2″ supply line with 35 psi or greater.

4.3.3. Estimate leak duration and possible saturated area(s) with high concentration levels.

5. <u>ARRIVAL</u>

5.1. Stop 300′ away establishing the Initial Isolation Perimeter. Do not park over utility access openings/covers.

5.2. The Officer should initiate Command responsibilities, perform a 360 (when possible) and conduct an RBA. Within the descriptive size-up the term "Natural Gas" should be stated, establishing that this SOG is in effect.

5.3. A Base location should be identified and incoming companies directed accordingly.

5.4. Evaluate audible and/or olfactory clues.

5.4.1. If odor is present, increase the Initial Isolation Perimeter to a point of no odor in incremental steps of 100′. If no odor is present – continue gathering information to establish the Hot Zone.

5.4.2. The Hot Zone will be established based upon an odor and/or a 20% of the LEL reading.

5.5. Gather information by interrogating reporting/responsible party(s) for known information:

5.5.1. Location, size, and duration of leak (i.e., large/small; exterior/interior… or both).

5.5.2. Number of structures involved and types (for multiple reports).

5.5.3. Structure proximity to external leak; evaluate possibility of migration (e.g., crawl space vents, gable vents, HVAC, open windows/doors, soffits, etc.).

5.5.4. Adjust the Initial Isolation Perimeter as appropriate.

5.6. Verify and/or request appropriate resources (i.e., PSE, City Light, SPD, "NGLMJ" - HazMat Team, Technical Rescue Team). Establish a Unified Command if appropriate.

5.7. Ongoing life safety concerns (e.g., number of occupants, if any; what evacuations have been completed; special need civilians; reliability of the reporting parties), based upon their location to the hazard and/or estimated possible saturated areas with high concentrations levels.

5.8. Identify and minimize ignition sources (e.g., utilities/systems/appliances using electricity, spark producing machines/equipment/tools, HVAC).

5.9. Obtain a water supply and assign Unit(s) to stage for hose deployment. Hose should not immediately be deployed and staffed within the Hot Zone due to explosion potential.

6. APPROACH – "Hot Zone Assessment"

6.1. Do not approach odorous atmosphere without air monitoring equipment and proper PPE.

6.1.1. Full structural PPE and SCBA are donned and covered when operating in the Hot Zone.

6.1.2. During Hot Zone evaluation, it is critical to understand crew location, concentration levels, and take actions based upon an ongoing RBA.

7. ACTIONS

7.1. Determine action thresholds (i.e., Go/No-Go) based upon the RBA's life profile and then property profile.

7.1.1. Crews must be aware that gas migration may have varying levels of interior concentration in relation to their current location and the point of origin.

7.1.2. Evacuation should be a priority when it is assumed there is an elevated saturation level or confirmed LEL reading is at or above 20% of the LEL within the structure.

7.1.3. Interior mitigation and/or evacuation actions can be conducted up to a threshold of 50% of the LEL unless additional risk is supported by the RBA (see examples).

7.1.4. It is imperative that readings are constantly monitored for changes and that gathered information from the exterior or interior be used to project and estimate the downrange/forward concentration levels. Crews must use judgment and incorporate all RBA factors when determining the associated level of engagement.

7.1.4.1. Example 1 – A severed pipe after a visible exterior meter shutoff may allow a crew to quickly enter the Hot Zone with concentration levels above 50% of the LEL while shutting the quarter turn valve.

7.1.4.2. Example 2 – With readings rising to 20% of the LEL outside an apartment door and upon entering rising to 50% of the LEL within feet of a known leak source (i.e., gas appliance) it would be allowable to close the valve mitigating the interior hazard.

7.1.4.3. Example 3 – After initial entry, a saturated apartment hallway nearing 50% of the LEL with an unknown leak source, firefighters should notify Command. Command should implement a defensive strategy, order withdrawal, and develop an evacuation plan.

7.1.4.4. Example 4 – If, while evaluating the outside perimeter of an unoccupied single family residence, air monitor readings approach 40% of the LEL, then it is likely interior conditions may be within the explosive range. This indicates a defensive strategy should be employed.

7.1.4.5. Example 5 – Upon entering a 100 ft x 200 ft warehouse with 30 ft ceilings, crews have consistent ground level air readings of 35% of the LEL. A reasonable RBA projection may estimate ceiling concentration levels approaching the explosive range requiring a change in deployment strategy.

7.2. When air monitoring, evaluate entry points, open windows, crawl space vents, gable vents, HVAC, etc., as appropriate, remembering that natural gas can accumulate in elevated areas. In addition to the use of the Altair 5-gas, consider the use of combustible gas detectors (i.e., CD100A and/or Gas-Trac) when available due to their sensitivity in sensing a combustible gas.

7.3. Carbon monoxide readings result from incomplete combustion and indicate there is likely an ignition source.

7.4. Consider forcible entry only after monitoring door jambs. Do not use spark-producing equipment if readings are at or above 20% of the LEL (e.g., irons).

7.5. Consider natural gas migration and check adjacent structures, connected underground utility vaults and passageways.

7.6. A failure in the natural gas distribution system at one point may cause a release elsewhere in the system, especially in cases of mechanical or accidental damage. Confer with PSE.

7.7. Shutting off natural gas.

7.7.1. Shutting the gas off at the valve in the street should only be done by qualified PSE personnel.

7.7.2. It should be a top priority of SFD personnel to shut natural gas off at the lowest acceptable risk (e.g., at the meter or appliance).

7.7.2.1. Once a natural gas valve is closed it should only be opened by PSE.

7.7.2.2. SFD personnel should not perform crimping or plugging actions.

7.8. With a high suspicion of gas saturation and high concentrations, evaluate requesting City Light to eliminate ignition sources by cutting the power at the pole. Decision will be made via a Unified Command.

7.8.1. Confirm no emergency backup generators or emergency lighting will re-introduce power. Use building managers/engineers or reporting parties for information. Assure the pole is not in an affected or gas saturated area.

7.8.2. Power cuts are very situational and incident dependent. Occupancy type and evacuation profile must be considered. Power cuts may create further ignition sources through evacuating occupants (e.g., using spark producing items such as a light, flashlight, or cell phone). Evaluate time vs. task completion and the control of the civilian evacuation.

8. EVACUATION

8.1. When evacuating, Command should evaluate ventilation consistent with this SOG.

8.2. Consider using apparatus PA systems or other remote means of notification in order to evacuate the Hot Zone (e.g., possibly move Chief's buggy or aid car closer to structure(s) based upon conditions such as upwind, etc.). Do not use systems within a structure (i.e., fire alarm or building PA systems) that could itself provide an ignition source.

8.3. Include in repeated verbal evacuation instructions the importance of not creating ignition sources (e.g. "Do not use: light switches, flashlights, elevators, cell phones.").

8.4. Provide an assembly area for evacuated civilians.

9. VENTILATION

9.1. Ventilation should be based upon RBA and life safety factors in consideration with ventilation options and timing. Listed below are some key ventilation tactics that may be used individually, sequentially, or simultaneously.

9.2. When an atmosphere is above the Upper Explosive Limit (UEL), ventilation efforts or natural dilution will move the atmosphere through the flammable range once the gas is shut off. Command must evaluate incident factors, formulate an RBA, and determine a ventilation plan.

9.2.1. *No Ventilation* – May be used when a structure is saturated with concentration levels above the UEL. This may result in a reduced risk to personnel operating in the Hot Zone; however, the risk of explosion may remain for a longer period of time. Command may wait on ventilation until ignition sources can be confirmed (e.g., power cuts) and then balance the RBA with a ventilation strategy.

9.2.2. *Natural/Horizontal Ventilation* – During Hot Zone assessment from investigating teams, ventilation openings can be made as the crew(s) progress systematically through the structure. Understanding the natural flows or building characteristics and using prevailing winds to assist through an established ventilation corridor is highly recommended. Natural ventilation may be slow, but is the least likely to find an ignition source (e.g., common strategy in a single family residence with an interior gas leak).

9.2.3. *Forced Ventilation or Positive Pressure Ventilation (PPV)* – Provides a faster ventilation process, but can be an ignition source. Depending on saturation levels, PPV may also create a potential challenge in establishing a reliable exit point that does not direct gas to an ignition source. Fans should be placed upwind, in a clean area verified by a monitor. Entry and exit points should enhance the buildings natural ventilation characteristics and/or construction features. Example: place fans upwind at the stairwell base of a three story structure with a third floor saturated apartment and a favorable vent corridor and exit point. This strategy may be implemented if an incident RBA favors quickly passing through the explosive range or preventing a release from reaching the LEL.

9.2.4. *Mobile Ventilation Unit (MVU)* – Primarily used for large scale operations and used consistent with forced ventilation. Example: a saturated warehouse with no life profile and secured power/ignition sources and a favorable vent/exit corridor.

9.2.5. *Combination Strategy* – As in all ventilation strategies, methods may phase in and out or be simultaneous depending on the RBA and specific incident factors and assessments.