



In-Service Training

IS 22-43 Farmington Propane Incident

Author: Chief Ed Hartin

Reviewed by: Division Chief Jim Mirabile

Purpose

Gas major incidents (report of a possible gas leak in a building) are one of the most common hazardous materials incidents encountered by Central Whidbey Island Fire & Rescue. While in most cases, these incidents are easily resolved, they have potential to present significant hazards and risk. Safe and effective response to a propane leak requires a solid understanding of the characteristics of the flammable gas, the hazards presented, and the risks to occupants and responders.

This in-service training session examines the Farmington, Maine propane incident which resulted in the death of Captain Michael Bell and serious injury to Chief Terry Bell, Sr., Deputy Chief Clyde Ross, Captain Scott Baxter, Captain Timothy Hardy, Firefighter Ted Baxter, and Firefighter Joseph Hastings (Maine Public Safety Family, n.d.) and a facility maintenance worker

National Institute for Occupational Safety and Health (NIOSH) Death in the line of duty reports are an extremely valuable resource for the fire service. However, to not cast blame, these reports frequently omit critical details that would allow improved understanding, the perspectives of those involved, and critical factors involved in the event. NIOSH [Death in the Line of Duty Report F2019-16](#) (2022) examined the Farmington, Maine propane explosion. The investigative report compiled by the Maine State Fire Marshal focuses on investigation of the explosion, a somewhat different perspective than NIOSH. However, this report has key information redacted. This case study integrates these two major sources of information as well as other open-source data such as news reports to provide a sound basis for developing lessons learned. The purpose of this case is not to find fault with others, but to provide a basis for improvement in safety and operational effectiveness in response to similar incidents.

Learning Outcomes

Firefighters and officers:

- Recognize the characteristics of propane.
- Understand the explosive potential presented by accumulation of propane and air mixtures within the flammable range inside a structure.
- Select an appropriate strategy, and implement tactics based on the strategic decision-making model when responding to gas leak incidents

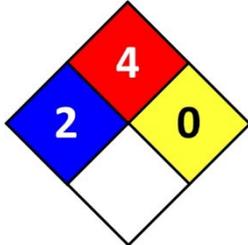
Conducting the Drill

This in-service training session builds on 10-Minute Training TM 22-32 Gas Major. This 10-Minute Training provided an opportunity to apply the strategic decision-making model as the initial incident commander (IC #1) when confronted with the conditions encountered by the first arriving companies and command officer at this incident.

Characteristics of Propane

Propane (C₃H₈) is a flammable hydrocarbon gas. It is a gas at standard temperature and pressure, but compressible to a transportable liquid. Propane is commonly used as a fuel gas. Table 1 provides an overview of the characteristics and physiological effects of propane.

Table 1. Characteristics & Physiological Effects of Propane

Product Name (UN/NA ID) Propane (1075)		Formula C ₃ H ₈	NAERG Guide 115	
Description Colorless, tasteless, odorless, heavier than air, flammable gas. As propane is odorless, ethyl mercaptan is added to provide a distinctive “gas” odor. This odorant may fade as propane passes through dirt or concrete.				
Molecular Weight 44.09	Vapor Density 1.5	Specific Gravity 0.59 @ 60° F	Vapor Pressure 124.9 psi @70° F	Ionization Potential 14.01 eV
Solubility 0%	Flash Point n/a (gas)	LEL 2.1 %	UEL 9.5 %	Ignition Temperature 920° F (493° C)
TLV-TWA (ACGIH) 1000 ppm (5% LEL)	STEL (15 min) n/a	IDLH 2100 ppm (10% LEL)	Routes of Entry Inhalation, Contact (Liquid)	
Physiological Effects Propane is a simple asphyxiant and rapid evaporation of propane liquid on the skin will result in rapid cooling.				
Symptoms of Exposure Inhalation of propane may result in dizziness, confusion, excitation, or asphyxia; Contact with propane liquid may result in frostbite				
Other Propane containers may present risk of a boiling liquid expanding vapor explosion (BLEVE) if the container is damaged (typically due to mechanical harm) or thermally stressed (due to flame contact above the vapor space). Note that a BLEVE does not require a fire or flame impingement prior to container failure (mechanical damage and an increase in ambient temperature may result in a BLEVE).				

Propane Systems

A propane system typically includes a propane container (cylinder or tank) with a variety of valves to allow the gas supply to be turned off and on, filling of the container, prevent overpressure, and in some cases to allow removal of liquefied propane. The following components are typical of those found on a

500-gallon propane tank such as that involved in this incident (Amerigas, 2021, Hildebrand & Noll, 2007, & Gastite, 2022).

Propane Fill Valve: This valve is used to fill the propane tank using a hose from a delivery truck.

Service (Shut Off) Valve: The service valve is the point at which propane gas enters the piping system to supply all the appliances that connect to it. ***This is the valve used to shut off the supply of propane in an emergency.***

Float Gauge Assembly: The float gauge shows the volume of propane in the tank. Sometimes called a dial gauge, the float gauge is made of several parts: a mechanical float that lives inside the tank connected to a reader on the outside of the tank that displays the liquid level. The numbers will range from 5 to 95, indicating a percentage of volume, not the number of gallons remaining. ***If the percentage of volume is 80 or greater the tank is over-filled. Move away from the tank, keep everyone away and call the propane supplier immediately for emergency response.***

Pressure Relief Device: Propane containers are equipped with pressure relief valves to relieve excess pressure during emergency conditions such as a fire, or when the container is in danger of failing due to overpressure. Pressure relief valves are preset to relieve internal pressure to the atmosphere. They are usually set to open between 250 psig and 375 psig, depending on whether the container is an ASME tank or a DOT cylinder. Operation of the relief valve may result from the tank being overfilled, overpressure do to thermal exposure, or failure of the valve. ***If a tank is venting due to thermal exposure, cool the vapor space, preferably with an unstaffed portable monitor, move away from the tank and keep everyone away!***

Fixed Liquid Level Gauge: Also known simply as the bleeder valve, this is the only tank component that gives a precise measure of how much liquid propane is in the tank. It's used only by certified propane service providers when filling the tank.

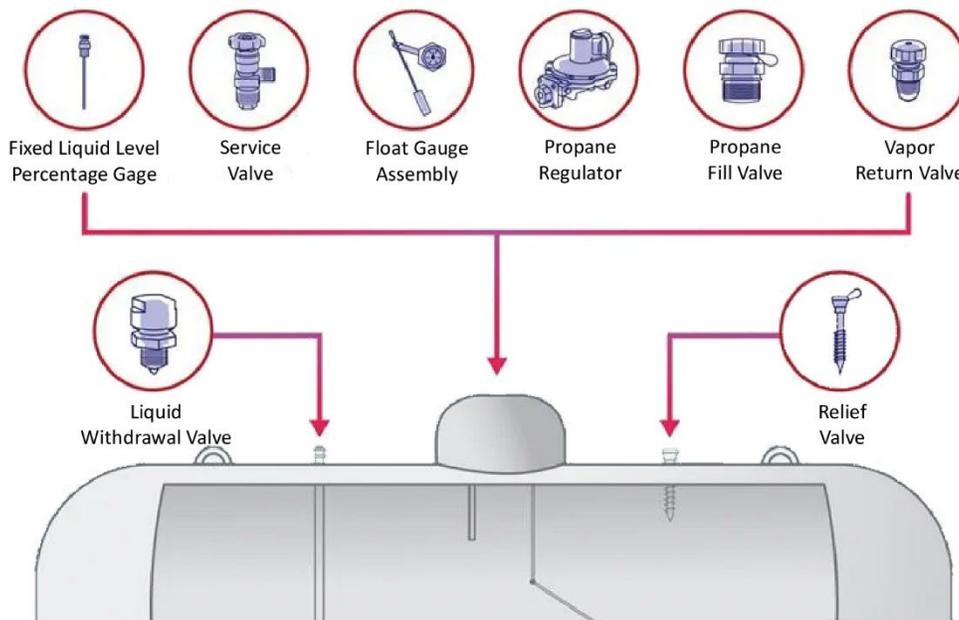
Vapor Return Valve: Also known as the vapor equalizing connection or vapor equalization valve, this feature is required on all ASME propane tanks. They are usually deployed if the liquid in the container becomes very overheated and must be evacuated from the container.

Liquid Withdrawal Valve: Used by propane service technicians to withdraw liquid propane from the tank so it can be moved or disposed of.

Pressure Regulator: High pressure inside a propane container must be reduced for use in appliances or vehicles. There may be a single regulator at the container or there may be a regulator at the container and another at the building or point of use. The first stage decreases container pressure to the supply line pressure (usually 10 psi), and then a second-stage regulator decreases the pressure to the building distribution line pressure (1/2 psi or approximately 11 inches water column or less).

Propane Piping: Piping for propane installed above ground must be metal. Underground piping is often made of polyethylene with risers to transition to metal piping for connection to the propane connector and at the building (e.g., connection to a second stage regulator).

Figure 1. Propane Tank Valves



Note: Adapted from Amerigas. (2021). Propane primer: A guide to home propane tank components, from gauges to regulators [web page]. <https://bit.ly/3olfo5Y>

In addition to the service valve found on propane cylinders and tanks, residential or commercial propane heating and cooling appliances will also have a gas shut off at the device. ***These valves can be used to isolate gas supply to a specific device, but firefighters should not enter an atmosphere indicating any percentage of the LEL to isolate a leak at an appliance.***

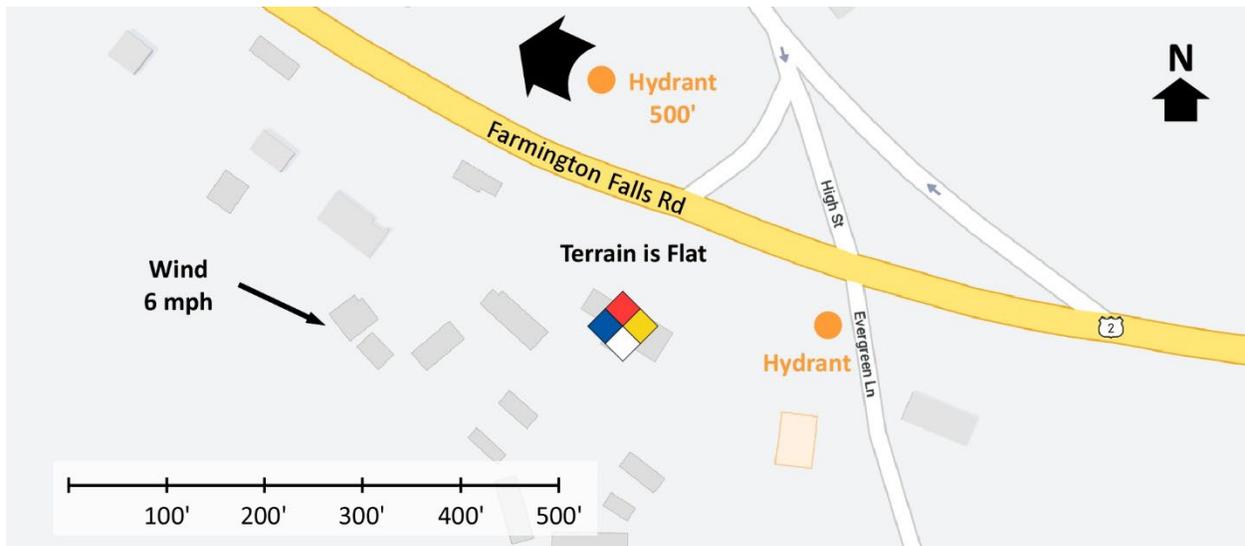
The Community and Fire Department

Farmington, Maine is a small community located approximately 30 miles northwest of Augusta. The department delivers fire protection and life safety and serves 56 square miles and a population of 8,200 and operates out of two fire stations. Fire apparatus operated by the department includes two engines, aerial tower, squad, and rescue/air unit. Staffing includes five full-time personnel and 10 paid on call members.

The Area and Building Involved

This incident involved a gas major at the Life Enrichment Advancing People (LEAP) office building at 313 Farmington Falls Road in Farmington, Maine on September 16, 2019, at 08:00 (NIOSH, 2022, Wagner, Hayes, & Rocha, 2019, & Andrews, 2020). Review the map and photos (Figures 2-6) to gain an understanding of area and building involved.

Figure 2. Map of the Incident Area



Note: Adapted from Google. (2022a). [Google map 313 Farmington Falls Road in Farmington, ME]. <http://bit.ly/2kO0wFQ>.

The closest hydrant is on Evergreen Lane at Farmington Falls Road with an additional hydrant on Farmington Hills Road to the west of the incident location as illustrated in Figure 2.

Figure 3. Aerial View



Note: Adapted from Google. (2022b). [Aerial view 313 Farmington Falls Road in Farmington, ME]. <http://bit.ly/2IYwC1C>. This figure has been edited to approximate the configuration of the building and parking area at the time of the incident.

Figure 4. Alpha/Delta Corner (older section of the building)



Note: Adapted from Google. (2018). [Street view 313 Farmington Falls Road in Farmington, ME]. <https://bit.ly/3OzoXP0>.

Figure 5. Alpha/Bravo Corner (new addition)



Note: Adapted from Wagner, M., Hayes, M., & Rocha, V. (2019). Deadly explosion in Maine. <https://cnn.it/3PxV7vw>.

Figure 6. Bravo/Charlie Corner



Note: Adapted from News Center Maine (n.d.). Investigators release some findings in Farmington explosion. <https://bit.ly/3PDZHZy>.

The incident occupancy was renovated and expanded shortly prior to this incident. A two-story addition was added to Side Bravo Figure 4 is the only available photo of the older section of the incident occupancy. In addition to the doors on Sides Alpha and Bravo, there are two additional doors on Side Charlie, one of which provides the closest access to the basement under the new section of the building on Side Bravo. The basement under the older section of the building on Side Delta is accessed from the interior of the building. The two were not interconnected (NOISH, 2022)

Heat for the building was provided by a propane burner system located in the basement of the new addition. There were two openings in the poured concrete floor of the basement in the new addition, a hole for radon testing which was capped and a sump with a five-gallon bucket inside the opening (ME OFSM, 2019).

As part of the renovation and expansion the propane tank used with the original building was removed and a new, 500-gallon propane tank installed outside the parking lot approximately 100' to the southeast of the Bravo/Charlie corner of the new addition. Propane was supplied to the building through underground plastic piping with a riser connecting to iron pipe where gas entered the building (on Side Charlie).

Events Leading Up to the Incident

Construction of the new addition was started in October of 2018 and completed June 20, 2019. When construction was completed the new 500-gallon propane tank was installed and filled with 125 gallons of propane. On July 25, 2019, the tank was filled with 257.3 gallons of propane (NIOSH, 2022 & ME OFSM 2019).

On September 10, 2019, four bollards were drilled into the ground to protect air conditioning units installed on Side Bravo. The installer did not call Maine Dig Safe to locate underground utilities prior to installing the bollards. These bollards were designed with an auger on one end to allow them to be drilled into the ground (NIOSH, 2022 & ME OFSM, 2019)

Figure 7. Bollard Auger



Note: Adapted from WMTW8. (2020). *Maine Fire Marshal's Office releases findings of investigation into deadly Farmington explosion.* <https://bit.ly/3O0mXmj>.

On September 13, 2019, maintenance staff notified C.N. Brown (the propane supplier) that the tank was empty, and it was filled with 391.9 gallons of propane. When the propane supplier filled the tank, there was 10 percent in the tank and that the tank had pressure, therefore a leak check was not done. The propane supplier's policy was that if the tank is empty employees must perform a leak test. She continued that if an owner/occupant was not present for them to conduct a leak test; the tank would be locked until the test could be performed. However, following investigation, the Maine Fuel Board fined and suspended the license of the propane and natural gas technician employed by CN Brown for failing to conduct a leak test following an interruption in service (Perry, 2020)

The Incident

The following timeline will examine events from 07:50 until occurrence of an explosion at 08:17 which destroyed the building, killing Captain Michael Bell and seriously injuring Chief Terry Bell, Sr., Deputy Chief Clyde Ross, Captain Scott Baxter, Captain Timothy Hardy, Firefighter Ted Baxter, and Firefighter Joseph Hastings (Maine Public Safety Family, n.d.) as well LEAP Maintenance Supervisor Larry Lord (WGME, 2020).

This timeline integrates data from National Institute for Occupational Safety and Health (NIOSH) *Death in the Line of Duty Report F2019-16* and [Maine] Office of the State Fire Marshal (ME OSFM) *Incident Report 19F049458*. An effort was made to resolve inconsistencies between these two reports and

provide clarity by identifying those involved by name and company assignment. However, some information is not available in published reports or other open-source data. All information in this chronology was derived from the NIOSH and ME OSFM Reports unless otherwise specified.

07:50

A LEAP maintenance assistant arrived at the office building. He started moving folding tables from the 1st floor of the building to the basement, which was in the new addition of the building. After several trips to the basement, he started to feel lightheaded, which he mentioned to the building's maintenance supervisor, Larry Lord. Both the maintenance assistant and Lord exited the building on Side Charlie and smelled propane.

08:05

Maintenance supervisor Larry Lord advised he was going to evacuate all employees from the building. The lights were on in the basement, but Lord turned the lights off when he left. There were no offices in the basement, only utilities in this new section of the building. There was one office in the basement of the old section of the building, but it had a separate entrance.

Upon exiting the building, the maintenance assistant looked at the propane tank, which was located on the Side Bravo/Side Charlie corner of the property. Checking the propane level and determining the tank was empty, Larry Lord and the maintenance assistant observed frost on the bottom of the tank and on the ground.

08:06 [ME State Fire Marshal's report indicates 08:03]

At approximately 0806 hours, LEAP Maintenance Supervisor Larry Lord called the Chief Terry Bell (Car 1) at the fire station requesting the fire and rescue department respond to the facility due to a possible propane leak in the building. Approximately 12 employees were evacuated from the building and told to locate to the end of the parking lot on Side Delta.

08:07

Chief Bell called county dispatch requesting the fire and rescue department be dispatched to the office building for a possible propane leak in an office building. *FD Incident 2019-275.*

Note: The ME OSFM report indicates that maintenance workers smelled propane outside the building on Side Charlie. However, neither the NIOSH report nor the ME OSFM report indicates if that information was communicated to responders via telephone or face to face when they arrived on-scene. There was also discussion of the bollards by LEAP employees and Farmington Fire Department personnel in the ME OSFM report and this report identified a request by an unidentified (name redacted) individual to perform atmospheric monitoring around and in the bollards.

08:08 [ME State Fire Marshal's Report indicates 08:06]

County dispatch dispatched Car 1, Tower 3, and Engine 2 to Life Enrichment Advancing People (LEAP) at 313 Farmington Falls Road for a possible propane leak.

08:09

Car 1 responded from Station 1.

08:11

Just prior to Car 1's arrival, LEAP maintenance staff had opened exterior doors to the building on Side Charlie. Car 1 arrived at the office building and parked in the parking lot near the highway entrance to the building. The maintenance assistant met Chief Bell in the parking lot on Side Alpha and walked him to Side Charlie to meet with the Maintenance Supervisor Larry Lord.

Tower 3 responded from Station 1 with a staffing level of three, Captain Tim Hardy as the company officer, Captain Scott Baxter as the apparatus operator, and Firefighter Joe Hastings.

08:12

Tower 3 arrived on-scene and pulled in the parking lot past the fire chief's vehicle facing Side Alpha of the structure. When Tower 3 arrived, Chief Terry Bell advised the crew to bring the multi-gas detectors to Side Charlie of the structure. Captain Hardy and Firefighter Hastings (Tower 3) took at least one multi-gas detector to Side Charlie to the propane tank.

Note: The ME OSFM Report indicates that Firefighter Joe Hastings had a gas detector but did not identify anyone else conducting atmospheric monitoring.

08:13

Chief Terry Bell, Captain Tim Hardy and Firefighter Joe Hastings (Tower 3) were investigating to locate the source of the propane leak. Chief Terry Bell called county dispatch requesting the response of a service technician from the local propane dealer to this incident.

Note: ME OSFM Report states that Captain Tim Hardy observed that chunks of ice had fallen to the ground from the tank. Captain Hardy also stated that Firefighter Joe Hastings did not get any readings outside the building.

08:14

Engine 2 responded from Station 1 with a staffing level of three, Captain Mike Bell as the company officer, Deputy Chief Clyde Ross riding as a firefighter, and Firefighter Ted Baxter as the apparatus operator.

08:15

Firefighter Joe Hastings (Tower 3) checked the atmosphere on Side Charlie with the multi-gas detector and nothing registered.

Engine 2 arrived on-scene. Captain Mike Bell and Firefighter Ted Baxter (Engine 2) went to Side Charlie to meet the Chief Terry Bell and the crew from Tower 3.

Firefighter Hastings checked the area of the propane tank and each bollard with the multi-gas detector, and nothing registered on the multi-gas detector. Firefighter Hastings observed icing on the propane tank and the ground and Captain Hardy observed that this indicated a rapid leak from the tank.

Chief Terry Bell then directed the crew from Tower 3 to enter the building. Captain Tim Hardy and Firefighter Joe Hastings entered the 1st floor, and nothing registered on the multi-gas detector. Captain Bell and Firefighter Baxter joined the crew of Tower 3, Chief Terry Bell, and Maintenance Supervisor Larry Lord inside the building.

08:16

The Deputy Chief Clyde Ross (Engine 2) met Captain Baxter (Tower 3 AO) and walked to Side Bravo near the end of the parking lot.

Captain Tim Hardy and Firefighter Joe Hastings (Tower 3) went to the basement with LEAP Maintenance Supervisor Larry Lord. Firefighter Hastings stated the multi-gas detector started alarming at 10% LEL at the top of the basement steps. As the firefighter started down the steps, the % LEL reading increased. Once he reached the basement, the multi-gas detector read 100% LEL and went into full alarm. Firefighter Hastings mentioned this to Captain Hardy who went to the electrical panel to shut off power noticing the propane fired boiler near the wall. The maintenance supervisor advised Hardy that he was at the wrong panel. Captain Hardy was near the stairwell and was only in the basement approximately 30 seconds before the explosion occurred.

Note: ME OSFM Report states that Captain Tim Hardy stated that Firefighter Joe Hastings did not get any readings outside the building, but that after entering the building and going to the basement, Hastings said that he was picking up some LEL on the meter (specific readings not specified). The maintenance supervisor and Firefighter Ted Baxter (Engine 2) were in the basement with Tower 3 prior to the explosion. However, neither the NIOSH report nor ME OSFM report indicate when Firefighter Baxter went to the basement. Captain Hardy's statement indicates that only the three of them (Hardy, Hastings, and Lord) were in the basement. The post blast investigation found the main breaker shut off and Captain Hardy's helmet under debris near the electrical panel.

08:17

Prior to the explosion, Captain Tim Hardy and Firefighter Joe Hastings (Tower 3) were in the basement with the maintenance supervisor, along with Firefighter Ted Baxter (Engine 2). Chief Terry Bell (Car 1) and the Captain Mike Bell (Engine 2) were on the 1st floor of the office building on Side Charlie. Deputy Chief Clyde Ross (Engine 2) and Captain Scott Baxter (Tower 3) were in the parking lot on Side Bravo.

A flammable mixture of propane and air inside the basement of the LEAP building ignited, resulting in an explosion, destroying the new addition and original building. The explosion resulted in a fireball and ignition of building debris which continued to burn after the initial blast. Blast effects also severely damaged eleven mobile homes located to the southwest (Abbott, 2019) and a tire shop to the east of the LEAP building. In addition, a vehicle was damaged by the blast and blown across the intersection of Farmington Hills Road and High Street directly in front of the LEAP building.

The force of the explosion knocked down and seriously injured Captain Hardy and Firefighter Hastings (Tower 3), Firefighter Ted Baxter (Engine 2), and Maintenance Supervisor Lord in the basement. Chief Bell (Car 1) and Captain Bell (Engine 2) were blown from the first floor into the basement. Captain Baxter (Tower 3 apparatus operator) was walking towards Side Alpha of the building when the explosion occurred. He was blown into the grass on Side Bravo. Deputy Chief Ross (Engine 2) who was standing on Side Bravo was knocked down. After the explosion, the Deputy Chief Ross moved Captain Baxter towards the tire shop and started medical treatment.

08:18

A Farmington police department sergeant (radio designation “PD3”) called county dispatch to check on the status of the fire and rescue department due to a possible explosion. He left police department headquarters and started driving in the direction of the explosion. He turned onto the state highway and could see a building had exploded, though he wasn’t sure which one. He arrived on-scene and advised the county dispatch that an explosion had occurred at an office building and provided the address. PD3 made a request for the power company and ambulances to respond. PD3 informally took command of the incident until arrival of Deputy Chief Timothy A. Hardy (Car 3) at 08:29. The Incident Commander (PD3) requested a mass casualty response resulting in dispatch of five medic units and Farmington Fire Department Squad 1 with a staffing level of three and Engine 1 with a staffing level of two.

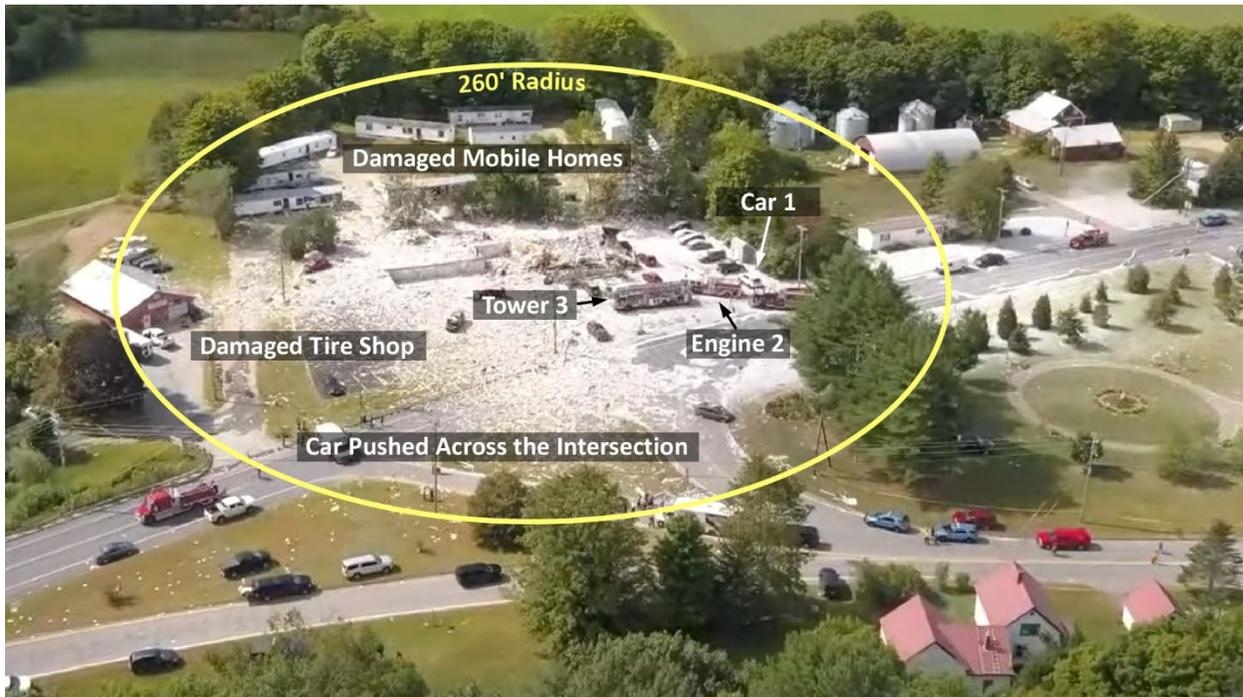
Chief Bell and Captain Bell, Captain Hardy, Firefighter Hastings, Firefighter Baxter, and Maintenance Supervisor Larry Lord received thermal burns and traumatic blast injuries in the explosion and were initially trapped in the basement. Deputy Chief Clyde Ross and Captain Scott Baxter were in the parking lot on Side Bravo and were knocked down, suffering traumatic injuries.

Captain Hardy and Firefighter Hastings were able to escape from the basement and began firefighting operations assisted by law enforcement and bystanders before receiving medical treatment. Other injured members were rescued by later arriving Farmington Fire Department personnel and bystanders and transported to area hospitals. Captain Michael Bell was declared dead at the scene.

Post Blast Conditions

Watch the [aerial video](#) (News Center Maine, 2019) and examine Figures 8 through 12 to gain perspective on the extent of damage resulting from this explosion.

Figure 8. Post-Blast Aerial View



Note: Adapted from News Center Maine. (2019). Drone footage of Farmington, Maine, explosion at LEAP, Inc. <https://bit.ly/3cVZEth>.

Figure 9. Post-Blast Side Alpha



Associated Press. (2019). Firefighter killed in Maine building explosion identified. Retrieved July 31, 2022, from <https://bit.ly/3oHMrHj>.

Figure 10. Post-Blast Alpha/Delta Corner



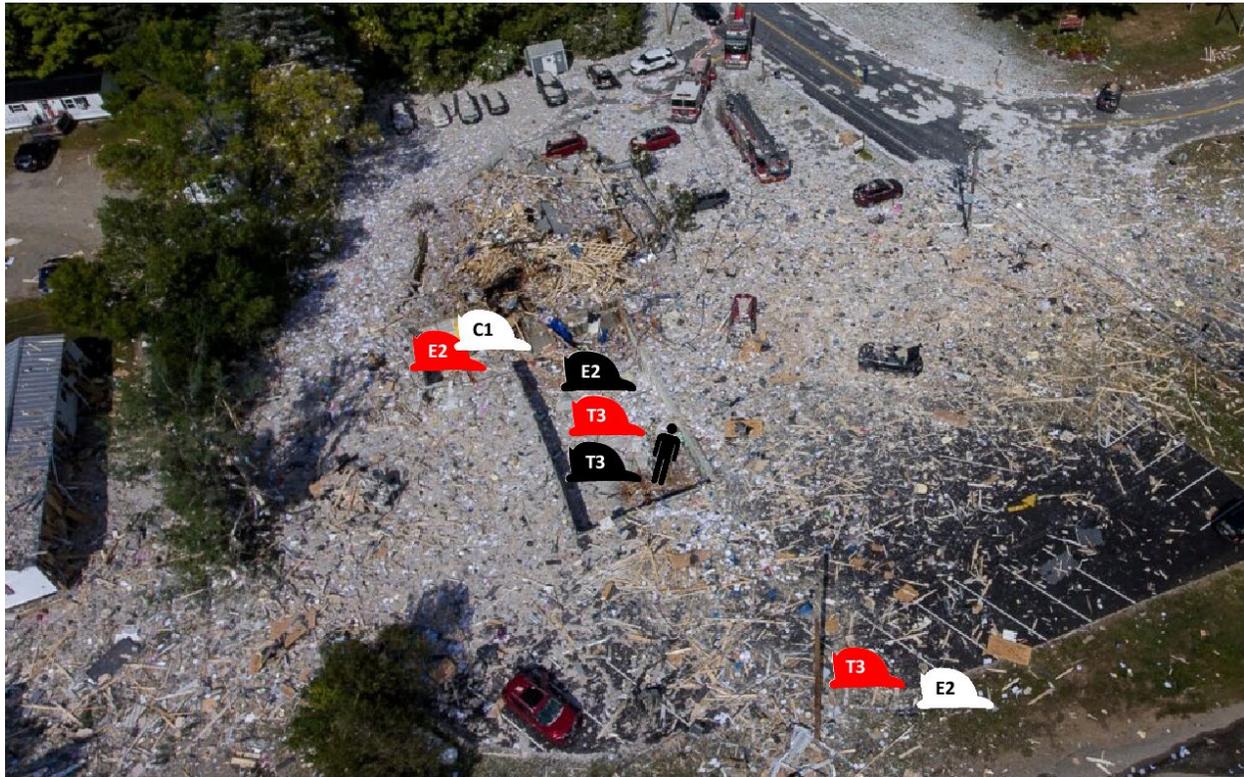
Associated Press. (2019). Firefighter killed in Maine building explosion identified. Retrieved July 31, 2022, from <https://bit.ly/3oHMrHj>.

Figure 11. Damage to Mobile Homes



Note: Adapted from Seamans, M. (2019). Collateral damage: Farmington tenants piece lives back together after explosion [photo]. <https://bit.ly/3SdEMhk>.

Figure 12. Victim Locations



Note: Adapted from Berry, D. (2019). Veteran firefighter killed, seven others injured in Farmington explosion. <https://bit.ly/3oCSLA0>.

Application-Learning from this Incident

Maine [State] Fire Marshal Joe Thomas said

the firefighters did everything by the book [emphasis added]. The firefighters did exactly what their protocols required them to do. They had their equipment with them. They were metering the scene to determine if there was gas there, at what percentage. **They followed the protocols and best practices of what fire departments would do under those circumstances** [emphasis added],” (WMTW8, 2020).

Is this true or can firefighters and fire officers learn from the circumstances facing the members of the Farmington Fire Department, the actions they took, and those that they did not take?

There were multiple investigations conducted by the National Institute for Occupational Safety and Health Firefighter Fatality Investigation Program, the Maine State Fire Marshal, the United States Occupational Safety and Health Administration (OSHA). Each of these investigations attempted to determine the facts surrounding this tragic event from a different perspective. OSHA issued citations to the propane supplier, the company that installed the bollards, and the Town of Farmington based on violation of occupational safety regulations. In addition, there were multiple lawsuits filed by the family

of Captain Michael Bell and the surviving firefighters and by Maintenance Supervisor Larry Lord. These lawsuits served to place blame for the propane leak and subsequent explosion.

Examination of this incident serves to identify lessons that can be learned from this incident and how those lessons can improve safety and operational effectiveness. The Wildfire Lessons Learned Center says, “a lesson is learned when we change our behavior” (2022). If we do not act based on the lessons provided by this incident, we have not learned, and history will repeat itself. Case studies are powerful stories.

Through storytelling we build slides from which we can draw if ever we find ourselves in a similar situation. In essence, a well told story can elicit a reaction so strong that learning can happen. With no story, there is no dialogue. With no dialogue, internal or external, there is no learning (Woods, 2021)

This incident involved underground release of propane from the gas line between the 500-gallon tank and the new addition to the LEAP building and migration of propane from the point of release to the interior of the building’s basement. Notice of this release was hampered by odor fade as ethyl mercaptan was scrubbed from the odorized propane absorbed by dirt or concrete. Breach of the propane gas line was due to installation of bollards without use of utility locate (811) to identify the presence and location of underground utilities. There were multiple errors and points of failure before the Farmington Fire Department was called to the LEAP office building. The pre-incident errors and points of failure provide a basis to prevent reoccurrence on a proactive basis. However, this case study focuses on fire department response to and mitigation of gas leaks occurring inside buildings.

After Action Analysis

Working first individually and then as a group, identify the contributing factors that collectively resulted in the release of propane and subsequent explosion.

Compare this list of contributing factors to those identified in [NIOSH Death in the Line of Duty Report F2019-16](#) (2022).

Working first individually and then as a group, identify what went well and what could have been improved in response to this incident. Use the following categories to organize your responses (but feel free to add additional categories if needed):

Incident Leadership

Understanding Characteristics of Propane

Understanding Propane Systems

Operational Safety

Tactical Operations

List your responses on an easel pad or dry erase board.

CWIFR Action Items

Consider CWIFR's response to gas major incidents (possible propane leak in a building). What do we do well and what can we do better? Are there any parallels to the incident in Farmington, Maine? List at least three action steps that CWIFR can take to improve the safety of our members and operational effectiveness when responding to gas major incidents.

List your responses on an easel pad or dry erase board.

NIOSH Recommendations

NIOSH Death in the Line of Duty Report F2019-16 (2022) identifies three key recommendations and ten other recommendations related to analysis of the Farmington Maine propane incident. Key recommendations include:

- Fire departments responding to a hazardous materials incident should ensure that a scene size-up and initial risk assessment are performed. In addition, fire departments should establish isolation zones and ensure a continuous risk assessment is conducted throughout the incident.
- Fire departments should ensure incident commanders initiate a defensive strategy and communicates the incident action plan (tactics) during initial operations of a hazardous materials incident. The strategy and incident action plan are revised based upon the tactical objectives taken to mitigate the hazard
- Fire departments should ensure firefighters are trained to understand the scrubbing or odorant fade of ethyl mercaptan from propane. This training includes the use of multi-gas detectors to determine if a potentially explosive atmosphere is present.

In addition to these three key recommendations, NIOSH published ten additional recommendations:

- Fire departments should ensure that firefighters wear proper PPE including SCBA when entering an IDLH environment involving propane and natural gas.
- Fire departments should have a SOP/SOG (standard operating procedure/standard operating guideline) for conducting sampling, detection, and monitoring at propane and natural gas emergencies.
- Fire departments should ensure that firefighters are properly trained and certified to understand the capabilities of the department's multi-gas detectors, especially catalytic LEL combustible gas sensor performance.
- Fire departments should ensure that multi-gas detectors are properly maintained per the manufacturer's recommendations.
- Fire departments that respond to propane and natural gas emergencies should comply with the requirements of 29 CFR Part 1910.120, Hazardous Waste Operations and Emergency Response.
- Fire departments should use a personnel accountability system requiring a check-in and check-out procedure with a designated accountability officer or the incident commander.
- Fire departments should develop and implement a SOP/SOG on the use and deployment of rapid intervention crews.
- Fire departments should ensure that their radio communication system can provide adequate coverage based on the demands of an incident and complies with NFPA 1561, Standard on Emergency Services Incident Management System and Command Safety and NFPA 1221,

Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.

- States should ensure anyone (including homeowners) using power tools or other digging equipment that will penetrate the ground call “811 or 811 Dig Safe” three business days (72 hours) prior to digging to identify if any buried utilities are present and mark their location(s).
- Local and state enforcement agencies should ensure that a leak test of the piping system is conducted in accordance with the requirements of NFPA 54, National Fuel Gas Code, and NFPA 58, Liquefied Petroleum Gas Code, whenever propane service is initiated or restored.

OSHA Citations All Around

Federal and state occupational safety and health regulations applied to the Farmington Fire Department, Life Enrichment Advancing People (LEAP)(building owner), C.N. Brown (propane supplier) and Techno Metal Post Maine (installer of the bollards). OSHA issued citations for serious violations to LEAP and Techno Meal Post Maine (Evans, 2020). In addition, OSHA cited the Farmington Fire Department for violation of the following regulations (2020):

- Willful violation of 29 Code of Regulations (CFR) 1910.120 Hazardous Waste Operations and Emergency Response regulation Section (q)(6)(ii) First Responder Operations
- Willful violation of Maine Revised Statutes (MRS) Title 26: Labor and Industry, Chapter 28: Minimum Safety Standards for Firefighter, Section 2103(1). Protective Equipment.
- Four serious violations of MRS Title 26: Labor and Industry, Chapter 6: Occupational Safety Rules and Regulations Board, Section 561-A. General duties
- Serious violation of MRS Title 26: Labor and Industry, Chapter 28: Minimum Safety Standards for Firefighter, Section 2103(1). Protective Equipment.
- Serious violation of MRS Labor and Industry, Chapter 28: Minimum Safety Standards for Firefighter, 2105. Inspection procedure [full-time fire department].

A willful violation is defined as a violation in which the employer either knowingly failed to comply with a legal requirement (purposeful disregard) or acted with plain indifference to employee safety. A serious violation is one in which there is substantial probability that death or serious physical harm could result and that the employer knew, or should have known, of the hazard.

The Washington Department of Labor and Industries (L&I) has similar requirements specified in the following regulations: *Washington Administrative Code (WAC) 296-305 Safety Standards for Firefighters* and *WAC 296 824 [Hazardous Materials] Emergency Response*:

- WAC 296-305-01509 Management's responsibility.
- WAC 296-305-03002 Hazardous materials.
- WAC 296-824-30005 Train your employees.

Additional Learning

Perform one or hopefully more than one of the following:

- Read [Responding to Propane Incidents](#) (Angermuller, 2022).
- Read the [Safety Advisory on Odor Fade in Natural Gas and Propane](#). (NIOSH, 2021).
- Review the functions and operation of the atmospheric monitoring equipment carried on your apparatus and the action levels for flammability, and the concentration of oxygen, carbon monoxide and hydrogen sulfide.
- Visit a target hazard that has a 500-gallon or larger propane tank and review the valves on the tank, their purpose and function.
- Visit a target hazard and practice positioning apparatus as if you were responding to a gas major incident at that location.
- Conduct a tactical walk around at a target hazard that has a 500-gallon or larger propane tank.

Evaluation

Lessons learned in this case study will be evaluated through in-class discussion and recommendations developed by learner work groups.

References

- 29 Code of Federal Regulations 1910.120(q)(6)(ii) First responder operations level. Retrieved July 31, 2022, from <https://bit.ly/3clx9PI>.
- Abbott, T. (2019). *Collateral damage: Farmington tenants piece lives back together after explosion*. Retrieved July 31, 2022, from <https://bit.ly/3SdEMhk>.
- Amerigas. (2021). *Propane primer: A guide to home propane tank components, from gauges to regulators* [web page]. Retrieved July 30, 2022, from <https://bit.ly/3olfo5Y>.
- Angermuller, C. (2022). *Responding to propane incidents*. Retrieved July 31, 2022, from <https://bit.ly/3cO5UDr>.
- Associated Press. (2019). *Firefighter killed in Maine building explosion identified*. Retrieved July 31, 2022, from <https://bit.ly/3oHMrHj>.
- Berry, D. (2019). *Veteran firefighter killed, seven others injured in Farmington explosion*. Retrieved July 31, 2022, from <https://bit.ly/3oCSLA0>
- Evans, B. (2020). *OSHA levies fines to businesses connected to Farmington explosion*. Retrieved July 31, 2022, from <https://bit.ly/3bjlmWJ>.

- Gastite. (2022). *Underground gas polyethylene piping system*. Retrieved July 30, 2022, from <https://bit.ly/3blUhmL>.
- Google. (2018). [Street view 313 Farmington Falls Road in Farmington, ME]. Retrieved July 24, 2022, from <https://bit.ly/3OzoXP0>.
- Google. (2022a). [Google map 313 Farmington Falls Road in Farmington, ME]. Retrieved July 24, 2022, from <http://bit.ly/2k00wFQ>.
- Google. (2022b). [Aerial view 313 Farmington Falls Road in Farmington, ME]. Retrieved July 24, 2022, from <http://bit.ly/2lYwC1C>.
- Hildebrand, M. & Noll, G. (2007). *Propane Emergencies*. Chester, MD: Red Hat Publishing.
- Maine Public Safety Family. (n.d.). *The Maine public safety family honors Captain Michael Bell*. Retrieved July 24, 2022, from <https://bit.ly/3PNqVwn>.
- Maine Revised Statutes Title 26: Labor and Industry, Chapter 6: Occupational Safety Rules and Regulations Board, Subchapter 1: General Provisions, §561-A. General duties*. Retrieved July 31, 2022, from <https://bit.ly/3zJnWzF>.
- Maine Revised Statutes, Title 26: Labor and Industry, Chapter 28: Minimum Safety Standards for Firefighter, §2103. Standards for equipment and clothing, 1. Protective Equipment*. Retrieved July 31, 2022, from <https://bit.ly/3cU8pUF>.
- Maine Revised Statutes, Title 26: Labor and Industry, Chapter 28: Minimum Safety Standards for Firefighter, §2103. Standards for equipment and clothing, 1. Protective Equipment*. Retrieved July 31, 2022, from <https://bit.ly/3cU8pUF>.
- Maine Revised Statutes, Title 26: Labor and Industry, Chapter 28: Minimum Safety Standards for Firefighter, §2105. Inspection procedures, 1. [SCBA inspection], B. [full-time fire departments]*. Retrieved July 31, 2022, from <https://bit.ly/3cU8pUF>.
- Maine State Fire Marshal's Office (2019). *Incident report 19F049548*. Retrieved July 31, 2022, from <https://bit.ly/3PPQX2v>.
- National Institute for Occupational Safety (NIOSH) (2021). *Safety Advisory on Odor Fade in Natural Gas and Propane*. Retrieved July 24, 2022, from <https://bit.ly/46jriJN>.
- National Institute for Occupational Safety (NIOSH) (2022) *Death in the line of duty report F2019-16, captain killed and six firefighters injured at a propane explosion in an office building—Maine*. Retrieved July 24, 2022, from <https://bit.ly/475rc8K>.

- News Center Maine (n.d.). *Investigators release some findings in Farmington explosion*. Retrieved July 24, 2022, from <https://bit.ly/3PDZHzy>
- News Center Maine. (2019). *Drone footage of Farmington, Maine, explosion at LEAP, Inc.* Retrieved July 31, 2022, from <https://bit.ly/3cVZEth>.
- Perry, D. (2020). *Technician who filled tank before Farmington explosion is fined, suspended*. Retrieved July 31, 2022, from <https://bit.ly/3BvDw3s>.
- Seamans, M. (2019). *Collateral damage: Farmington tenants piece lives back together after explosion* [photo]. Retrieved July 31, 2022, from <https://bit.ly/3SdEMhk>
- United States Department of Labor, Occupational Safety and Health Administration (OSHA). (2020). *Inspection: 1431040.015 - Town of Farmington*. Retrieved July 31, 2022, from <https://bit.ly/3OMXA4e>.
- Wagner, M., Hayes, M., & Rocha, V. (2019). *Deadly explosion in Maine*. Retrieved July 24, 2022, from <https://cnn.it/3PxV7vw>.
- Washington Administrative Code (WAC) 296-824 [hazardous materials] emergency response*. Retrieved July 31, 2022, from <https://bit.ly/3oH0BID>.
- Washington Administrative Code (WAC). 296-305 safety standards for firefighters*. Retrieved July 31, 2022, from <https://bit.ly/3mPOp7Q>.
- WGME (2020). *Larry Lord still fighting on long road to recovery*. Retrieved July 31, 2022, from <https://bit.ly/3vsj5AE>.
- WGME. (2019). *Officials confirm bollard severed propane line that caused deadly Farmington explosion*. Retrieved July 24, 2022, from <https://bit.ly/3z6zJqd>.
- Wildfire Lessons Learned Center (2022). [Web page]. Retrieved July 31, 2022, from <https://bit.ly/30O3Clh>.
- WMTW8. (2020). *Maine Fire Marshal's Office releases findings of investigation into deadly Farmington explosion*. Retrieved July 31, 2022, from <https://bit.ly/30OmXmj>.
- Woods, K. (2021, Summer). *Understanding the Value of Storytelling, Two More Chains*, 10(2). Retrieved July 31, 2022, from <https://bit.ly/3Jlhimi>.