[redacted]

[redacted]

Re: Fire Loss at [redacted]
Date of Loss: November 18, 2021
Fire Pro File No: 21-4382-TH

[redacted]

Introduction

At the request of Technical Safety BC (TSBC), I conducted an investigation into the origin and cause of a natural gas explosion that occurred on November 18, 2021 at [redacted] Comox. The building involved is a multi-unit residential occupancy and it was occupied at the time of the incident. On November 24, 2021 I examined the scene and conducted interviews. The following is a summary of my findings from the investigation.

Fire Department Information

I spoke with [redacted] and was provided the following information:

1. The unit was built in the 1950's-1960's;
2. The unit was occupied and the natural gas fueled heating appliances were operating at the time of the incident;
3. Work was being carried out on the perimeter drains around the unit;
4. A small excavator was digging near the mechanical room located at the rear of the structure where it struck a 1" (25mm) natural gas line located approximately 2 feet below the surface; and
5. The time from the first line rupture to having the natural gas line turned off was approximately 20 minutes.

I later learned from TSBC that: *"the explosion occurred 10-15 minutes after the gas line was struck and that* [redacted] *turned off the gas supply approximately 2 hours following the event."* I have assumed this to be accurate.

The Structure

For the purposes of this report, the building faces northeast. The building is a two level multi-unit residence. The building is wood frame construction. The exterior of the building is wood with hardi-plank siding with an asphalt shingle roof. The electrical service enters at the rear of the building into a mechanical service room.

Examination

TSBC and an investigator from [redacted] had attended the scene, conducted a scene examination and removed some of the physical evidence prior to my attendance, specifically the damaged natural gas line. TSBC provided information on the location of the break in the natural gas line.

Due to the structural damage caused by the explosion, the structure could not be safely entered for a full examination. However, sufficient information could be documented from the exterior. An exemplar building adjacent to the subject structure provided additional information on the layout. However, the appliances and layout of the mechanical room are different. The building is constructed on a 4' crawl space with open passive venting located near the area of the natural gas line break (see **Figure 1**). This would provide for openings under the main structure.

Figure 1. The rear of the building including the mechanical room. The lines indicate the open doorway to the mechanical room.

The mechanical room is located at the rear of the building and was separated from the main part of the building by a fire rated door leading into the building and by a service entrance located to the rear of the mechanical room leading to the exterior. The exterior doors for the service entrance had not been installed at the time of the event, leaving an open doorway. The mechanical room contained the main electrical distribution system for the building, as well as the natural gas fueled hot water system.

The location of the natural gas line break is approximately 7 feet away from the mechanical room's open doorway (see **Figure 2**).

Figure 2: Shows area of exterior to the mechanical room. The vertical lines indicate the open doorway, the dashed line shows the natural line and the arrow indicates the approximate location of the break in the natural gas line.

The physical damage indicates an explosion occurred inside the structure. The pressure on the interior of the structure due to the explosion caused extensive damage to the structure, with items forced away the building.

Explosion Debris

Some debris had been removed and cleaned prior to my arrival, including debris found away from the source structure and mechanical room. Debris from the explosion was measured up to 106 meters away from the location of the mechanical room (see **Figure 3**).

A relatively large piece of plywood, likely used as siding for the exterior wall for the mechanical room, was located 90 meters from the mechanical room (see **Figure 4**). As well, smaller pieces of debris, including wood chips and building materials, were located 106 meters away (see **Figure 5**).

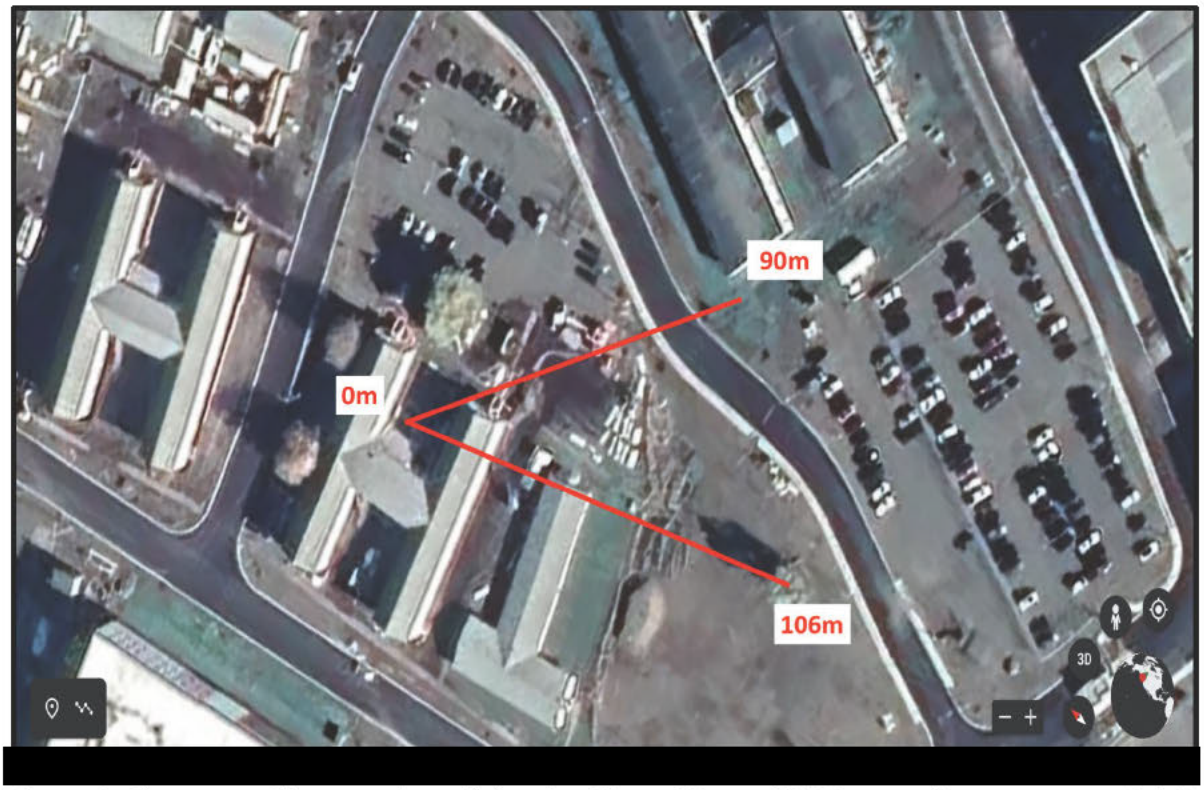

Figure 3: Shows satellite overview of the site. Note: 90m and 106m are distances some debris was found away from the line break (which is approximately 5 feet from the mechanical room).

Figure 4: Taken at 90m indicator. Piece of plywood removed from the explosion site.

Figure 5: Taken at the 106m indicator where smaller pieces of wood found; however, most had been cleaned/removed prior to our arrival.

Discussion

Natural gas was the only fuel identified in the structure capable of producing a fuel air mixture capable of producing the damage observed. Natural gas is lighter than air and easily migrates through normal airflow. In this case, the proximity of the break/leak in the natural gas line would allow the natural gas vapours to flow through the passive air openings and open doorway into the mechanical room. The natural gas/air mixture would first accumulate in the upper portions of the room. When the air/fuel within the proper mixture came in contact with a competent ignition source, ignition of all of the air/fuel mixture would be almost instantaneous. This would result in an overpressure inside the structure and would cause the damage observed.

Although the natural gas line was broken prior to the event, residual gas in the line downstream of the break could have continued to fuel an appliance's pilot assembly, which would be a competent ignition source for the air/fuel mixture. The mechanical room also contained many electrical devices, including circulating pumps, which could also have been a competent ignition source.

The break in the natural gas line was outside the building. Therefore, it could not be reasonably estimated as to how much of the natural gas vapours migrated into the building or the potential force that would have been produced upon ignition. It must also be considered that the migration of the natural gas vapours outside the room of origin could have created secondary explosions ignited by the flame front of the initial explosion.

National Fire Protection Association 921 Guide for Fire and Explosion Investigations – 2021 Edition (NFPA 921) is an industry accepted document that provides a methodology on the overall analysis of fire and explosion events. NFPA 921 offers the following on explosions as they relate to this incident:

> ***22.7 Non-seated Explosions.*** *Non-seated explosions occur most often when the fuels are dispersed or diffused at the time of the explosion because the rates of pressure rise are moderate and because the explosive velocities are subsonic.*
>
> ***22.8.2 Interpretation of Explosion Damage.*** *The explosion damage to structures (low-order or high- order) is related to the number of factors. These include the fuel to air ratio, specific gravity of the fuel, turbulent affects, volume of the confining space, location, and magnitude of the ignition source, venting and the characteristic strength of the structure.*

NFPA 921 sections 4.5 and 4.5.1 offers the following on the level of certainty when providing an opinion on the cause of fire or explosion:

> ***4.5 Level of Certainty****. The level of certainty describes how strongly someone holds an opinion (conclusion). Someone may hold an opinion to a higher or lower level of certainty. That level is determined by assessing the investigator's confidence in the data, in the analysis of that data, and testing of the hypotheses form. That level of certainty may determine the practical application of the opinion, especially in legal proceedings.*

***4.5.1**. The investigator should know the level of certainty that is required for providing an expert opinion. Two levels of certainty commonly used are probable and possible:*

> ***(1)** Probable. This level of certainty corresponds to being more likely true than not. At this level of certainty, the likelihood of the hypothesis being true is greater than 50 percent.*
>
> ***(2)** Possible. At this level of certainty, the hypothesis can be demonstrated to be feasible but cannot be declared probable. If two or more hypotheses are equally likely, then the level of certainty must be "possible."*

Conclusion

Based on the physical evidence at the scene, information obtained from witnesses and TSBC it is my opinion it is probable that:

- The break in the natural gas line released vapours into the air, which migrated into the mechanical room;
- The explosion initiated within the mechanical room;
- The material first ignited was the natural gas/air mixture;
- Possible ignition source in the mechanical room include the pilot assembly for the natural gas fueled appliances and electrical appliances and motors; and
- Natural gas was the only fuel identified to produce an air/fuel mixture capable of causing the explosion and damage observed or reported.

I am solely responsible for the opinions in this report. These opinions are based on information available as at the date of this report. I reserve the right to revise the report if new information becomes available. A more detailed report will be produced if required.

I certify that I am aware of my duty as an expert witness to assist the Court and that I must not be an advocate for any party when giving my expert opinion to the Court. I have made this report in the conformity with that duty. I will, if called upon to give oral and/or written testimony, give that testimony in accordance with that duty.

Regards,

Authored by:

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