



Residential Basement Fire Claims the Life of Career Lieutenant - Pennsylvania

SUMMARY

On January 9, 2004, a 45-year-old male career lieutenant (the victim) sustained serious injuries after he partially fell through the first floor while fighting a residential basement fire. The victim was among the first on the scene, and he reported light smoke coming from a two-story, middle row town home. The victim entered the structure without his self contained breathing apparatus (SCBA) to investigate, and reported to the Incident Commander (IC) that it was a basement fire. The victim exited the structure to assist his crew in advancing a 1 3/4-inch hoseline into the structure through the front door of the first floor. The victim's crew protected the first floor and looked for fire extension as another crew attacked the fire through a rear entrance into the basement. The victim exited the structure a second time, presumably for air, and spoke to another member who was conducting ventilation. The victim went back into the structure and was trapped on his third attempt to exit when he partially fell through the floor.

Rescue crews found and removed the victim within minutes and he was transported to an area hospital where he died from his injuries seven days later.

NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should:

- *require, and all officers should enforce the requirement, that all fire fighters wear their SCBAs whenever there is a chance they might be exposed to a toxic or oxygen-deficient atmosphere, including during the initial assessment*
- *ensure fire fighters are trained to recognize the danger of operating above a fire*
- *ensure that team continuity is maintained with two or more fire fighters per team*

INTRODUCTION

On January 9, 2004, a 45-year-old male career lieutenant (the victim) sustained serious injuries after he partially fell through the first floor while fighting a



Front of Structure

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at

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Fatality Assessment and Control Evaluation Investigative Report #F2004-05

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residential basement fire. The victim died from these injuries seven days later. On January 16, 2004, the U.S. Fire Administration (USFA) notified the National Institute for Occupational Safety and Health (NIOSH) of the fatality. On March 10, 2004 through March 12, 2004, two Safety and Occupational Health Specialists from the NIOSH Division of Safety Research investigated the incident. Meetings were conducted with the Fire Commissioner, the Fire Department's Operations Officer, representatives from the Fire Marshal's Office, and representatives from the International Association of Fire Fighters. Interviews were conducted with officers and fire fighters who were at the incident scene. The NIOSH investigators reviewed the department's standard operating procedures (SOPs), the fire marshal's report, victim's training records, and drawings of the building. The incident site was visited and photographed.

Department

The career department involved in this incident is comprised of 2,300 uniformed fire fighters. The department serves a population of approximately 1.7 million residents in a geographic area of about 130 square miles.

Training

The fire department provides all new recruits with a 15-week training conducted at the city's Fire Academy. The victim had more than 14 years of experience and had successfully completed numerous training courses such as: Fire Fighter I and II, Fire Instructor I, Incident Command System, Hazardous Materials Operations, Rapid Intervention, and SCBA orientation.

Building Information

The structure was a two-story, middle row, 16ft. x 45ft. brick dwelling. It was built in the 1930's, prior

to any existing building codes, and had a full basement with a ground level entrance in the rear of the structure. The flooring system where the incident occurred consisted of a parquet wood floor approximately 3/8-inch thick covering a wood plank sub-floor approximately 3-inches wide by 3/4-inch thick nailed to 2 1/2-inch by 8-inch floor joists that were 16-inches on center. The residence was equipped with smoke detectors.

Equipment

Additional units were dispatched; however, only those units directly involved in operations preceding the fatal event are discussed in the investigation section of this report.

Engine 72 (Victim, driver/operator, 2 fire fighters)
Engine 51 (Officer, driver/operator, 2 fire fighters)
Ladder 29 (Officer, driver/operator, 3 fire fighters)
Ladder 22 (Officer, driver/operator, 3 fire fighters)
Ladder 8/Rapid Intervention Team (Officer, driver/operator, 3 fire fighters)
B2 (Battalion Chief 2, Chief's Aide)

INVESTIGATION

On January 9, 2004, a 45-year-old male career lieutenant (the victim) sustained serious injuries after he partially fell through the first floor while fighting a residential basement fire. At 0626 hours, Engine 72 (E72), Engine 51 (E51), Ladder 29 (L29), Ladder 22 (L22), and Battalion Chief 2 (IC) were dispatched to a residential dwelling for a reported fire. At 0629 hours, E72 arrived on the scene and the victim reported light smoke coming from a two-story, middle row, 16ft. x 45ft. dwelling (see Cover Photo). The victim entered the structure without his self contained breathing apparatus (SCBA) to investigate, and reported to the Incident Commander (IC) that it was a basement fire. The victim exited the structure and placed E72 and L29 in service at the front of the structure. Two fire fighters and the victim from E72 advanced a 1 3/4-inch hoseline into the structure (see



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Diagram 1), while L29 placed ground ladders to the second floor to conduct ventilation. One of the fire fighters informed the victim that the floor was very hot and physically weakened or “spongy” as they advanced the handline. The victim notified the IC that they had a basement fire, and at approximately 0630 hours, the IC arrived on scene and placed an additional engine and ladder into service.

E51 and L22 were operating at the rear of the structure with the IC. L22 was assigned search and rescue, while E51 made entry into the basement through a door at ground level (see Photo 1). Entry was impeded approximately 10 feet inside the basement door due to an old appliance and debris which was stacked about five feet high over the entire basement floor (see Diagram 2).

E51 informed the IC that they were working on clearing debris to access the fire. The IC called the victim to inform him that E51 would attack the fire from the basement level. The Captain from L29 responded for the victim and confirmed the order at 0635 hours. *Note: The Captain and the victim were talking on the front porch of the structure after the victim exited the structure for the second time. The victim did not have his SCBA on and was leaning over the banister attempting to catch his breath. The Captain told the victim to get off of the porch and get some fresh air.* The victim went back inside a third time as the Captain was working on ventilating the basement. The Captain from L29 then radioed his crew to tell them to vent the porch floor after they finished venting the roof. *Note: The porch floor is also the ceiling over the north section of the basement (see Diagram 2).*

At 0641 hours, the IC called the Captain from Ladder 29 and requested that he take command of the front of the structure and to keep him posted on the fire conditions and ventilation of the front of the

structure. The IC stated that E51 was making progress on the fire at this time. The victim, two of his fire fighters, and a fire fighter from L29 were stationed at the door of the stairs leading to the basement with a 1 3/4-inch handline awaiting instructions. They were on their hands and knees to avoid the heat and smoke in near zero visibility conditions. At 0642 hours, the IC called the victim to tell him to hold his ground on the first floor and that E51 was attacking the fire from the basement. The IC wanted the victim to guard against fire extension on the first floor and to attempt hydraulic ventilation by flowing water through a window on the first floor to draw the smoke out of the window. At 0643 hours, the victim responded “That’s affirmative, we can do that.” The victim turned around to exit the first floor and tripped over the hand of one of his fire fighters and stumbled towards the front door. Fourteen seconds after his last transmission, the victim keyed his radio for 4 seconds without speaking. *Note: The victim did not make it out of the structure. It is believed that the victim’s foot fell through the floor at this time (see Photos 2 and 3).*

After the crew from E72 did not hear from the victim for a couple of minutes, one fire fighter started to crawl towards the front door to check for the victim. As he was nearing the threshold to the living room from the dining room, his hand penetrated through the floor and the fire lit up right in front of him. The crew put water on the fire and radioed for the victim at 0646 hours with no response. The crew’s exit path through the front door was cut off by the fire. They turned around, went down the basement stairs, and exited through the basement door in the rear of the structure. Upon exiting, the fire fighter from L29 with E72 radioed an “Urgent” message then followed up with the IC at 0650 hours that the crew from the first floor exited, but that they didn’t know the location of the victim. The IC deployed the Rapid



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Intervention Team (RIT) at 0651 hours to search for the victim. The victim was found by a member of the RIT and a fire fighter from L29 face down with one of his legs through a hole in the floor at 0701 hours (see Photo 4). Within a few minutes the victim was removed and transported to an area hospital where he died seven days later from his injuries.

CAUSE OF DEATH

The medical examiner lists the cause of death as smoke and soot inhalation and thermal burns.

RECOMMENDATIONS/DISCUSSIONS

Recommendation #1: Fire departments should require, and all officers should enforce the requirement, that all fire fighters wear their SCBAs whenever there is a chance they might be exposed to a toxic or oxygen-deficient atmosphere, including during the initial assessment.¹⁻⁵

Discussion: Since carbon monoxide (CO) is given off in varying quantities during all fires, and other toxic materials are typically present, it is paramount that officers enforce and fire fighters follow the department's guidelines for the wearing of masks at structure fires. In this incident, a number of fire fighters reported not wearing their masks inside the structure even while encountering moderate smoke conditions. Far more fire deaths occur from carbon monoxide than from any other toxic product of combustion. This colorless, odorless gas is present in every fire. The poorer the ventilation and the more inefficient the burning, the greater the quantity of carbon monoxide formed.

Table 1 lists the toxic effects of carbon monoxide. Concentrations of carbon monoxide in air above five hundredths of one percent (0.05 percent) or 500 parts per million can be dangerous. When the level

is more than 1 percent, unconsciousness and death can occur without physiological signs. Therefore, the signs and symptoms outlined in Table 1 are not good indicators of safety.

The toxicity of carbon monoxide (CO) varies with the length of exposure, the concentration, breathing and heart rate. CO causes tissue hypoxia (low oxygen content) by preventing the blood from carrying sufficient oxygen. CO combines much more readily with the oxygen-carrying sites on the hemoglobin molecule than oxygen itself. The carboxyhemoglobin thus formed is unavailable to carry oxygen. Toxicity of CO varies with the percent carboxyhemoglobin in the blood. Reactions to CO poisoning vary with the individual and include headache, vertigo, difficulty breathing, confusion, convulsions, and coma. A 1 percent concentration of carbon monoxide in a room will cause a 50 percent level of carboxyhemoglobin in the blood stream in 2 1/2 to 7 minutes. A 5 percent concentration can elevate the carboxyhemoglobin level to 50 percent in only 30 to 90 seconds. Because the newly formed carboxyhemoglobin may be traveling throughout the body, a person previously exposed to a high level of carbon monoxide may react later. Carboxyhemoglobin levels greater than 55 percent usually are fatal; 40 percent levels are associated with collapse and syncope (a faint); at 15 percent to 25 percent headache and nausea may be present. If fire fighters are potentially affected by carbon monoxide, they should not be allowed to continue with firefighting operations. If fire fighters suspect they have been exposed to carbon monoxide, they should immediately notify their officer or the IC. In this incident, the victim entered the structure to conduct an initial assessment and continued to operate without a SCBA. His exposure to carbon monoxide started when he first entered the structure and may have affected his decision making process throughout the incident.



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Carbon Monoxide (CO)(ppm)	Carbon Monoxide in air (percent)	Symptoms
100	0.01	No symptoms-no damage .
200	0.02	Mild headache; few other symptoms.
400	0.04	Headache after 1 to 2 hours.
800	0.08	Headaches after 45 minutes; nausea, collapse, and unconsciousness after 2 hours.
1,000	0.1	Dangerous; unconscious after 1 hour.
1,600	0.16	Headache, dizziness, nausea after 20 minutes.
3,200	0.32	Headache, dizziness, nausea after 5 to 10 minutes; unconsciousness after 30 minutes.
6,400	0.64	Headache, dizziness, nausea after 1 to 2 minutes; unconsciousness after 10 to 15 minutes.
12,800	1.28	Immediate unconsciousness, danger of death in 1 to 3 minutes.

Table 1. Toxic Effects of Carbon Monoxide

Recommendation #2: Fire departments should ensure fire fighters are trained to recognize the danger of operating above a fire.⁶

The danger of being trapped above a fire is greatly influenced by the construction of the burning building. Of the five basic building construction types (fire resistive, noncombustible, ordinary construction, heavy timber, and wood frame) the greatest danger to a fire fighter who must operate above the fire is posed by wood-frame construction. Vertical fire spread is more rapid in this type of structure. Flames may spread vertically and trap fire fighters operating

above the fire, in four ways: up the interior stairs, through windows (autoexposure), within concealed spaces, or up the combustible exterior siding. Extreme caution must be used to determine if the structural stability of the flooring system is adequate to facilitate the operations. In this incident, the floor was noticeably weakened as the victim’s crew advanced the initial handline, indicating that the floor was not structurally sound to support operations on the first floor above the fire. As soon as fire fighters become aware of structural instability, they should immediately exit the structure and notify the IC.



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Recommendation#3: Fire departments should ensure that team continuity is maintained with two or more fire fighters per team.^{3,7}

Discussion: Each fire fighter must be assigned to a team of two or more and be given specific assignments to help reduce the chance of injuries. Team continuity relies on some very important key factors: knowing who is on your team and the team leader, staying within visual contact at all times (if visibility is obscured then teams should remain within touch or voice contact distance of each other), communicating your needs and observations to the team leader, rotating to rehab and staging as a team, and watching your team members (practice a strong “buddy-care” approach). These key factors help to reduce serious injury or even death resulting from the risks involved in fire fighting operations by providing personnel with the added safety net of fellow team members. Company or crew members should enter and exit the environment together.

INVESTIGATOR INFORMATION

This incident was investigated by Jay Tarley and Virginia Lutz, Safety and Occupational Health Specialists, Division of Safety Research, NIOSH.

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Photo 1. Rear of structure



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Photo 2. Floor area consumed by fire



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Photo 3. View from basement of floor area consumed by fire



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Photo 4. Living room floor



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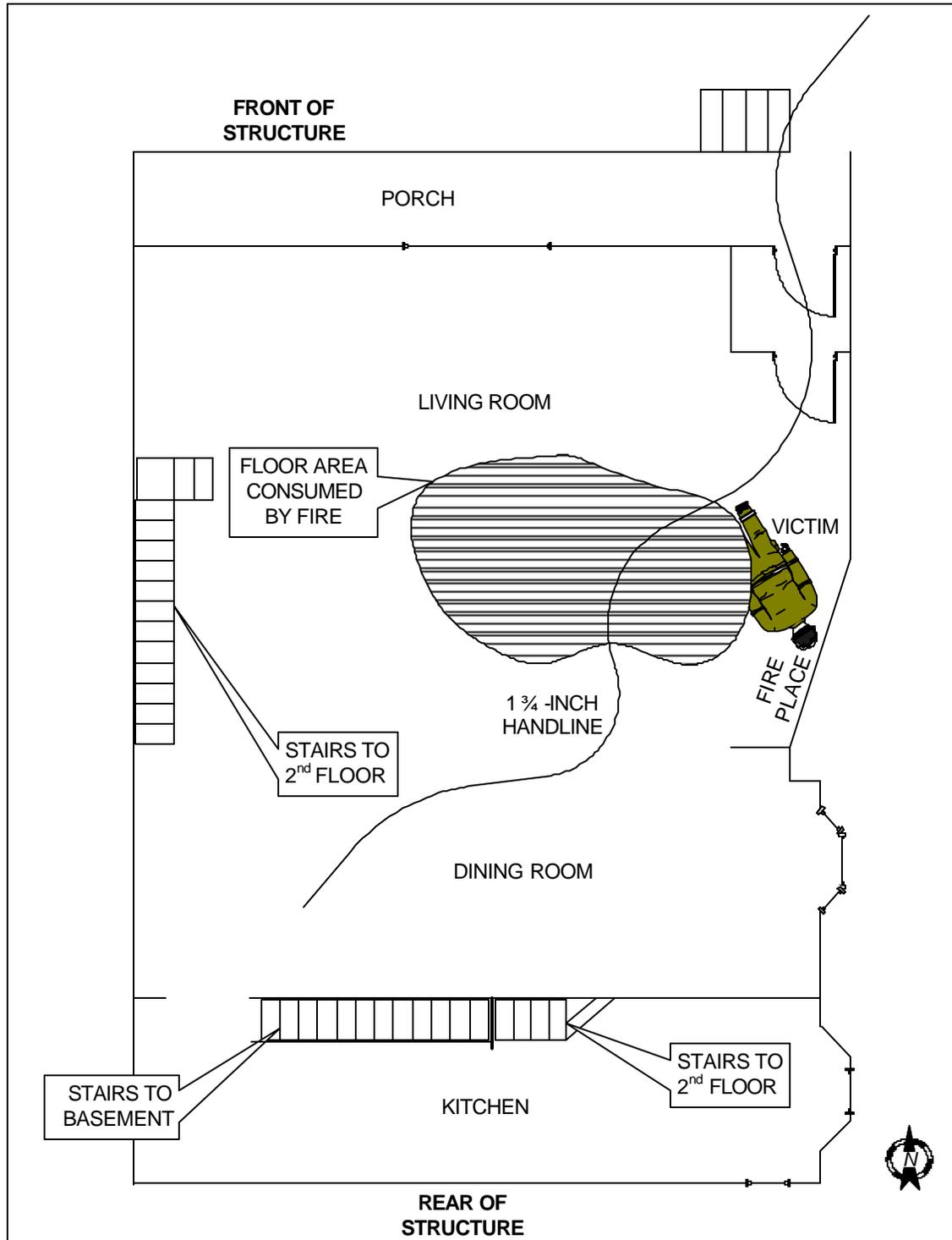


Diagram 1. First floor aerial view layout



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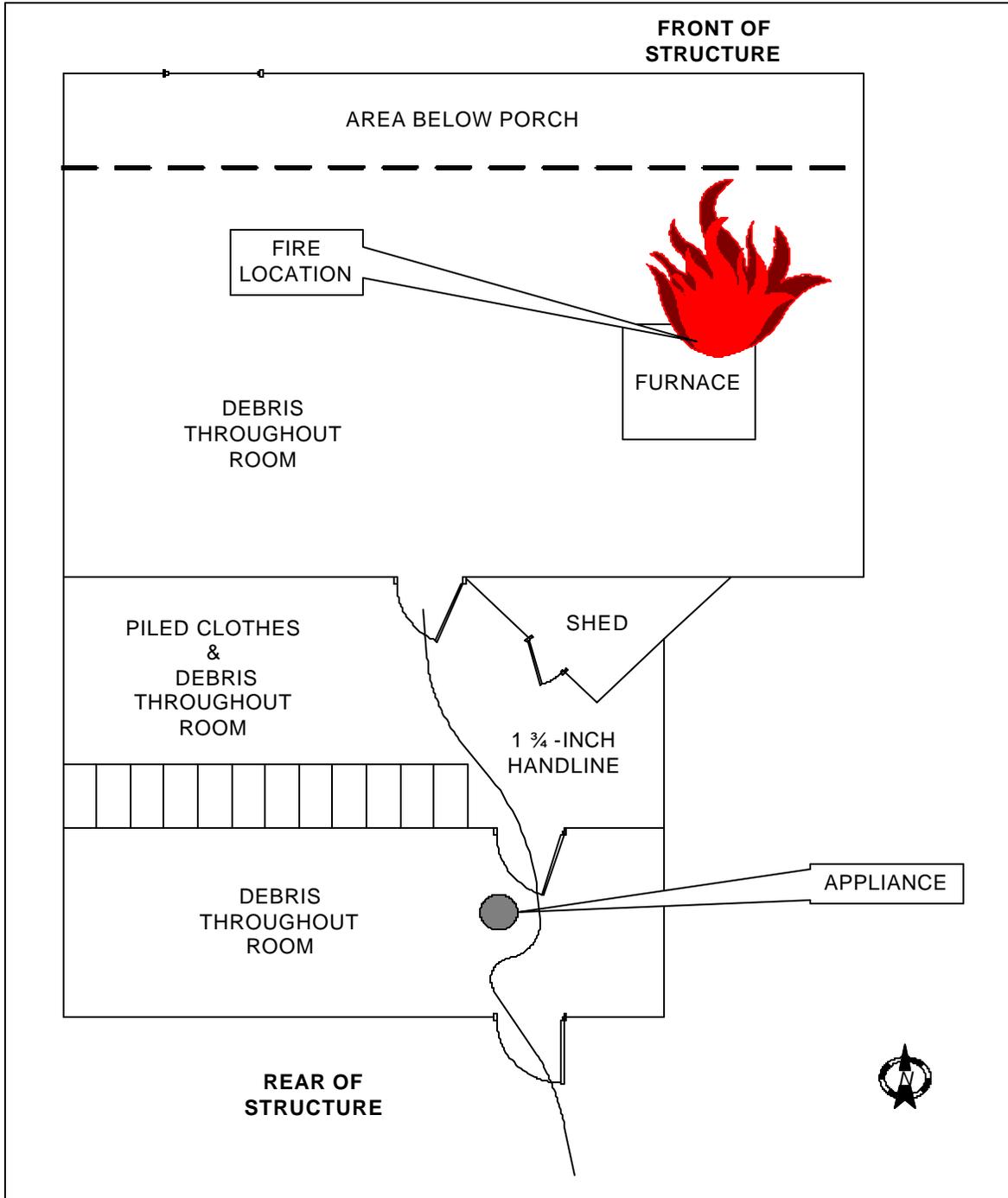


Diagram 2. Basement aerial view layout

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