RESIDENTIAL HOUSE
Pittsburgh, PA
February 14, 1995

FIRE INVESTIGATIONS
NATIONAL FIRE PROTECTION ASSOCIATION

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FIRE INVESTIGATION REPORT

One-Family Dwelling Fire
Three Fire Fighter Fatalities
Pittsburgh, Pennsylvania
February 14, 1995

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Abstract

On Tuesday, February 14, 1995, a fire in a one-family dwelling resulted in the deaths of three Pittsburgh, PA fire fighters. Three other fire fighters were also injured.

The building involved was a three-story, wood-frame structure with a basement and was constructed on a sloping grade that caused the building to have a different appearance depending on the side being viewed. Fire fighters entering the building saw only one side and were not aware of the building’s actual arrangement. The fire fighters’ distorted perception of the building may have impaired their ability to assess alternate escape routes.

During interior fire operations, the stairway used by fire fighters to enter a room collapsed. Sometime after that collapse, fire fighters outside the building realized that other fire fighters were trapped inside. Since fire fighters from several companies were working at the scene, fireground supervisors were not able to quickly assess which companies and individual fire fighters were working in the building. After several trapped fire fighters were rescued through an exterior window, a full accounting of all fire fighters was not performed. Unknown to the incident commander, three other injured fire fighters remained trapped in the building. These fire fighters were discovered after most of the fire had been extinguished and smoke had been removed from the building, about one hour and ten minutes after they originally entered.

Adherence to procedures that allow for quick accounting of fire fighters on the fireground and the use of rapid intervention teams are precautions that can reduce risks to fire fighters during structural collapse and other unplanned events that can threaten fire fighters during suppression operations. The importance of these precautions is evident in two NFPA documents, i.e., NFPA 1561, Standard on Fire Department Incident Management System, and NFPA 1500, Standard on Fire Department Occupational Safety and Health Program. Both have complete sections containing specific accountability requirements. In addition, NFPA 1500 contains requirements for rapid intervention crews.

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I. INTRODUCTION

The National Fire Protection Association (NFPA) investigated the Bricelyn Street fire in order to document and analyze significant factors that resulted in the loss of the three Pittsburgh fire fighters.

The study was funded by the NFPA as part of its on-going program to investigate technically significant incidents. The NFPA's Fire Investigation Department documents and analyzes incident details so that it may report lessons learned.

The NFPA became aware of the Bricelyn Street fire on the day it occurred, and Michael S. Isner, Senior Fire Investigator in the NFPA Fire Investigations Department, and Chuck Smeby, Senior Fire Service Specialist in the NFPA Public Fire Protection Department, visited Pittsburgh to perform an on-site study of this incident. That two-day study and subsequent analysis of the event were the basis for this report. Access to the fire scene and data collection activities was made possible through the cooperation of the Pittsburgh Bureau of Fire.

This report is another of the NFPA's studies of fires that have particular important educational or technical interest. All information and details regarding fire safety conditions are based on the best available data and observations made during the on-site data collection phase and on any additional information provided during the report development process. It is not the NFPA's intention that this report pass judgment on, or fix liability for, the loss of life resulting from the Bricelyn Street fire. Rather, the NFPA intends that its report present the findings of the NFPA data collection and analysis effort and highlight factors that contributed to the loss of life or property.

Current codes and standards were used as criteria for this analysis so that factors contributing to the loss of the fire fighters could be compared with state-of-the-art fire service practices. It is recognized, however, that these codes and standards may not have been formally adopted in Pittsburgh.

The cooperation and assistance of Fire Chief Charlie Dickinson and the members of the Pittsburgh Bureau of Fire Board of Inquiry are greatly appreciated.

II. BACKGROUND

The Site

The dwelling involved in this incident was constructed on property located at 8361 Bricelyn Street in Pittsburgh, PA. The property sloped down and towards the north, making the Bricelyn Street (south) side of the site the high point. Wood-frame, single-family dwellings were constructed on the east and west sides of the fire building (see Figure 1). On the west side, the distance between the exterior walls of the two buildings was approximately 27 inches. The narrow alley between the buildings hid the vertical drop when the fire building was viewed from Bricelyn Street. On the east side, the distance between buildings was 12 feet. A four-foot-high wood picket fence was located between the fire building and the east exposure building. This fence was atop an 11-foot-high stone retaining wall that also hid the vertical drop. There was a yard and alley on the north side of the building. This side was the low point of the site.

![Figure 1: Plot Plan](image-url)
The Building

The single-family dwelling involved in this fire was a wood-frame building 33 ft x 19 ft x 32 ft. It appeared to be at least 50 years old. The building had a gambrel roof covered with asphalt shingles (see Photo 1), and its exterior wall finish was aluminum siding. The structure was constructed using a combination of wood framing techniques. The floor assembly above the basement was built using “platform-style” construction, i.e., the flooring covered the entire length of the joists and framing for the first-floor walls was erected atop the flooring. This type of construction provided inherent barriers against vertical fire spread from the basement into the joist channel for the exterior wall assemblies. Above the first-floor assembly, balloon framing was used for exterior wall construction. As a result, the stud channels in the walls were open to the wood-frame roof assembly.

The building had three occupiable floors including a finished attic (see Figure 2). In addition, the building had a full basement. For the purposes of this report, the floors have been designated as follows:

- Level 2  Finished Attic
- Level 1  Grade-level, Bricelyn Street Side
- Sub-level 1  Grade-level, Alley Side
- Sub-level 2  Basement

As a result of the sloping site, only Level 1 and Level 2 were visible from Bricelyn Street, making the building appear to be a two-story structure. Level 1 had a living room, a bedroom, and a bathroom. The building’s front entrance, which faced Bricelyn Street, was located on this level. Level 2, the finished attic, had two bedrooms. Sub-level 1, another occupied floor, contained a family room and a kitchen. An exterior door in the kitchen provided direct access to grade on the alley (north) side of the building. Sub-level 2 was the building’s basement and was being used for general storage. The basement also had an exterior door that provided direct access to grade on the alley (north) side of the building.

Stairs located in the center of the building connected all levels. The stairways between the top three levels were open; the stairway between Sub-level 1 and Sub-level

Figure 2: Building Elevation - East Side
2 had a door on Sub-level 1. The stairs had treads, risers, and stringers with nominal dimensions of 1 inch x 8 inches.

Most windows in the building were wood-frame, double-hung type and had wood trim around the interior window opening. A 3/32-inch-thick plastic glazing material was installed on the interior side of the double-hung windows (see Photo 2). This plastic glazing was flush with the interior wood trim and, apparently, installed to reduce drafts and heat loss. Quarter-turn fasteners on the windows’ wood molding secured the plastic glazing material in the window frame.

At least one battery-operated smoke detector was installed on each level of the dwelling.

Photo 2: Double-hung window with plastic glazing mounted on inside.

Pittsburgh Bureau of Fire

At the time of the fire, the Pittsburgh Bureau of Fire was responsible for protecting a 55.3 square mile community with a population of 370,000 which would rise to 500,000 during business days. The bureau was divided into three divisions, i.e., administrative, operations, and prevention, with an authorized strength of 894 fire fighters. The actual number of fire fighters was not provided. The Fire Operations Division was divided into four platoons. Each platoon had one deputy chief, five battalion chiefs, and 180 operations personnel which included captains, lieutenants, and fire fighters. The bureau’s resources, which included 30 engines, 11 ladder trucks, 3 quints, and 35 fire stations, were distributed throughout five battalions protecting the city’s many areas. The engines and trucks responded with one officer and three fire fighters, and the quints responded with one officer and four fire fighters. In 1994, fire suppression personnel responded to 30,000+ emergency calls.

Within its fire prevention division, the bureau has a training section responsible for training fire fighters. This section operates the training facility where all Pittsburgh fire fighters attend the bureau’s 14-week basic fire academy. Advanced fire training courses, such as hazardous materials, search and rescue, and emergency medical courses are also taught in the training facility. In addition to the training received at this facility, fire fighters performed regularly scheduled training exercises in their station houses.

The company officer and two fire fighters who died in this incident had a variety of training and experience with the bureau. All had successfully completed basic fire fighting training at the bureau’s training facility. The company officer had been with the bureau for 13 years. One fire fighter had been with the bureau for 8 years and was a State Fire Service Instructor. The other fire fighter had been with the bureau for 14 months. Both fire fighters were certified as Fire Fighter II.

The fire fighters were certified through the Pennsylvania Fire Service Certification Program which allows fire fighters to be trained and tested by the Pittsburgh Bureau of Fire using training that follows NFPA fire service professionals qualification standards. The Pennsylvania Fire Service Certification Program is accredited by the National Board of Fire Service Professional Qualifications.

In order to maintain minimal staffing levels required by the bureau for both the officer and fire fighters, personnel adjustments were often made. Fire fighters were regularly detailed to fire companies other than that to
which they were normally assigned. In the absence of a company officer, the senior on-duty fire fighter acted as company officer. Similarly, company officers would act in out-of-grade assignments as needed. Off-duty personnel commonly were "called back" to perform additional shifts. Regardless of their rank, all off-duty fire fighters and officers performed the duties of a fire fighter when working a "call back" shift.

On the night of this fire, the two fire fighters on Engine 17 had been detailed to that company. Their normal assignment was to Engine 8. One of the fire fighters on Truck 17 was the captain for Engine 8 who had been "called back" to fill a fire fighter’s position, and the battalion chief assigned to the Bricelyn Street fire was actually a captain acting as a battalion chief. Often, personnel who acted as officers were not provided with training regarding the additional responsibilities of senior positions, as was the case with the acting battalion chief for this fire. Even though he had acted as a battalion chief several times before, the Pittsburgh Bureau of Fire had not provided the captain with specific training for this position.

Pittsburgh fire fighters wore protective clothing and equipment that, according to the Pittsburgh Bureau of Fire, met NFPA standards at the time of purchase and included the following equipment:

- Fire fighter’s protective helmet.
- Flame-resistant hood.
- Coat (one of two styles).
- Pants (one of two styles).
- Fire fighter’s gloves.
- Fire fighter’s boots.
- Personal alert safety system (PASS) device.
- Self-contained breathing apparatus (SCBA).

The three fire fighters who died in this incident were wearing all of their protective gear, including SCBA’s and PASS devices.

At the time of the fire, the city of Pittsburgh was divided into 85 fire response zones, and the first alarm assignment was dependent on the hazard associated to a zone. The typical first alarm assignment was three engine companies, one truck company, and a battalion chief. In the city’s four high hazard zones, the first alarm response was four engine companies, two truck companies, and a battalion chief; and in three of the high hazard zones, a deputy chief was dispatched on the first alarm. The second alarm response was the same throughout the city, two engine companies, one truck company, the safety unit, the mobile air compressor unit, and the deputy chief. All subsequent alarms received two engine companies and, depending on the fire zone, an additional ladder company.

The safety unit had diverse roles and responsibilities. The unit responded as a suppression company within its own zone and responded to all second alarm fires throughout the city. The members of the safety unit could provide "first responder" medical services, and they were responsible for incident safety monitoring, administrative support, and logistical support.

The Pittsburgh Bureau of Fire developed many standard operating procedures (SOP’s) to establish operational guidelines and to enhance fire fighter safety. Two of the departmental SOP’s that have relevance to this incident were SOP 6: Incident Command - Command Procedures (revised 5/21/90) and SOP 44.0: Personal Alert Devices (Effective 7/21/87).

**Pittsburgh Emergency Medical Services Bureau**

The City of Pittsburgh Emergency Medical Services (EMS) Bureau was responsible for medical responses within the city. The EMS Bureau dispatched medical personnel with an advanced life support (ALS) ambulance and a rescue unit (similar to a fire department heavy rescue) to all confirmed structural fires. The EMS Bureau also provided physicians and additional medical support upon request.
III. THE FIRE

Fire Discovery and Fire Department Notification

On the morning of Tuesday, February 14, 1995, four of six members of the same family were in the home at 8361 Bricelyn Street. Reportedly, two of the family members were sleeping in a Level 2 bedroom and two family members were on Level 1 at the time of the fire. An adult male reported that as a standard practice, he would check that the doors in the basement were secure just before going to bed. According to his statement, the adult male discovered the fire while making his check, and notified the other occupants. They all left the building at that time and went to a neighbor’s house where a 911 call was made to report the fire.

Fire Suppression and Rescue Operations

At 12:22:53 a.m., Engines 17, 18, and 19, Truck 17, and Battalion Chief 4042 were dispatched to investigate the report of a fire at 8366 Bricelyn Street. Engine 19 was “filling” for Engine 15 which was already on another assignment. Similarly, the regular battalion chief for the area of this response - Battalion Chief 4043 - had been previously dispatched to another zone, so Battalion Chief 4042 was dispatched to fill this assignment. While the companies were en route, the Battalion Chief 4043 was released from his assignment, responded to Bricelyn Street and released the “fill” battalion chief, i.e. Battalion Chief 4042.

Engine 17 was first to arrive at 8366 Bricelyn Street - the home from which the 911 call was made. This company found no external indication of fire at that address.

An adult male on the front porch of 8361 Bricelyn Street caught the attention of the fire fighters and pointed to this building as the actual location of the fire. Engine 17 moved to this location and found smoke showing from the house. The adult male informed the fire fighters that no one was left in the house.

The captain from Engine 17 and the two detailed fire fighters advanced a 150-foot, 1-3/4 inch attack line through the front door on the Bricelyn Street side of the building (see Figure 3). In addition to the hose line, one of the fire fighters brought a hand light and the other fire fighter brought an ax and a portable radio. Before entering the building, the officer contacted dispatch (12:27:42 a.m.) on his portable radio to report that smoke was coming from the first floor (Level 1). In that transmission, he also directed the next arriving engine company to take a hydrant and supply Engine 17 with water. The crew entered the building with the intention of locating, confining, and extinguishing the fire. They moved through the hallway and went down the stairs to Sub-level 1. Since the officer had initially reported smoke coming from the first floor, he probably thought he and his crew were entering a basement when they went down to Sub-level 1. Local investigators believe that the fire fighters found fire that was extending up to this level and began their suppression operation.

Truck 17 arrived at 12:28:09 a.m. and fire fighters from this company began ventilation operations by breaking out the front windows on Level 1. Electric power lines prevented the use of the aerial ladder so fire fighters placed ground ladders against the building to reach windows on Level 2 and the roof. The fire fighters broke out the windows and began opening the roof for vertical ventilation of the building.

Engine 18 arrived at 12:32:27 a.m., connected a 5-inch hose to a hydrant and stretched it to Engine 17. Fire fighters from Engine 18 helped the Engine 17 pump operator connect the supply line to his engine.

While breaking out the front windows on Level 2, a fire fighter from Truck 17 (the “called back” captain from Engine 8) observed heavy smoke but no fire inside the building. Based on these conditions, he believed that the fire was in the building’s walls and decided to inform the fire attack crew of these conditions. At some point in time before the fire fighters from Engine 19 entered the building, the Truck 17 fire fighter donned an SCBA, took an ax and hand light, and entered the building alone. He followed Engine 17’s hose line to the stairway.

Unknown to the Truck 17 fire fighter, the fire had weak-
Figure 3: Fireground Operation

enched the 1-inch by 8-inch wood treads. As the fire fighter followed the hose line down the stairway, several treads collapsed under his weight, and he fell into Sub-level 2 - the actual basement and location of the fire. Landing below the Engine 17 crew, he was able to climb out of Sub-level 2 and up to the Sub-level 1 where he made contact with the three crew members of Engine 17. They appeared to be in good condition at this time. A few minutes later, low pressure alarms on the SCBA's of the crew from Engine 17 began to operate.

Even though the four fire fighters realized that they had to find their way out, several factors appear to have contributed to their inability to do so. First and foremost, the stairway by which they entered — their only known exit — had collapsed preventing them from making their way back up to the front entrance. Visibility was extremely limited due to heavy smoke and darkness. The open door to Sub-level 2 covered the entrance to the kitchen so the fire fighters probably did not realize that the kitchen was accessible. The flush-mounted plastic glazing on the inside of the windows may have prevented the fire fighters, who were in a dark, smoke-filled room, from locating the windows by touch. The Pittsburgh Bureau of Fire review panel also believes that the fire fighters were most likely exposed to ele-
vated carbon monoxide levels, and this exposure impaired their ability to think clearly. (See ANALYSIS for further discussion of identified problems with SCBA's).

With the stairway up to Level 1 collapsed, the fire vented up the opening. The hose line that Engine 17 fire fighters had brought down to Sub-level 1 was now in the path of the rising flames, which burned through the line leaving the fire fighters without the protection of a hose line.

At some point in time, the three Engine 17 fire fighters became unconscious and the Truck 17 fire fighter approached unconsciousness.

Engine 19 arrived at 12:32:48 a.m., and the crew was not assigned to supply water. As a result, the company officer and two fire fighters went to Engine 17 and took a 1 3/4-inch hose line from that engine in order to "back up" the hose line that was already in the building. They advanced the hose line along the hallway on Level 1 and encountered heavy heat and smoke. Their hose line was not charged at this time so the crew left the building and reentered shortly thereafter to search for occupants and locate any fire on Level 1.

Since Engine 19 was not needed to supply water, the pump operator put on his protective gear and helped another company for a few minutes. When the other members of his crew left the building to change their air bottles, the pump operator paired up with another Engine 19 fire fighter. The pump operator entered the building not knowing how far his partner was behind him and followed the sound of running water from a charged hose line thinking he could relieve someone on the hose. He proceeded down the stairs and suddenly fell into the same collapsed area of the stairway that the Truck 17 fire fighter fell through earlier. Moments later, the second Engine 19 fire fighter, attempting to meet his partner, also fell into the collapsed area. These two fire fighters were able to assist each other as they climbed from Sub-level 2 up to Sub-level 1.

Battalion Chief 4043 arrived at 12:37:21 a.m., approximately 10 minutes after Engine 17 arrived, and radioed the dispatch center reporting that a 3-story, aluminum covered building was involved. He also stated that heavy smoke was coming out of the first and second floors. Battalion Chief 4043 assumed command upon arrival, although radio transcripts have no record of a formal change in command. At this point 15 minutes had elapsed since the original dispatch.

The crew from Engine 18 placed a ground ladder against the retaining wall on the east side of the building and advanced a 1 3/4-inch attack line down to the rear of the dwelling. A second alarm was requested at 12:46 a.m. Engines 7 & 15, Truck 8, the safety unit, the mobile air compressor unit, and a deputy chief were dispatched. While these companies were responding, Engine 18 began operations at the rear (alley side) of the building. These operations included forcing open the exterior door to the kitchen, fire suppression, and horizontal ventilation.

One of the Engine 18 fire fighters broke out the east windows on Sub-level 1. When he cleared the window in the family room, he heard moaning and realized that someone was inside the building. The Engine 18 fire fighter ran to other members of his crew and told them that he heard moaning in the building. Information regarding the downed fire fighter was relayed to the incident commander who made a radio report that a "fireman was down inside the building". The time was approximately 12:58 a.m.

The fire fighter with two others, returned to the window. From the window they could still hear a low moaning plus a low-air bell operating. One of the fire fighters was lifted up to the window and he entered the building. The fire fighter believed that he was above the fire and that there was a real potential for collapse. Initially unable to locate the moaning individual, he called out in the direction of the moan. Once he heard the person's voice, the fire fighter was able to locate the downed Truck 17 fire fighter and bring him to the window where the other fire fighters and a paramedic pulled the injured fire fighter from the building.

After being taken to the rear side of the building, the rescued fire fighter, though quite disoriented, relayed that more fire fighters were down inside the dwelling.
At 1:01:19 a.m., the incident commander radioed dispatch and reported, “We found him, he’s all right!” Medic 11 reported at 1:05:58 that there were more firemen down.

As the fire fighters outside of the building learned of the serious situation inside, the two Engine 19 fire fighters who had managed to climb out of Sub-level 2 up to Sub-level 1, saw the light beam from a hand light that had been placed in the window during the rescue of the Truck 17 fire fighter. They exited through that window, and personnel believed that the two Engine 19 fire fighters were the downed fire fighters referred to by the injured Truck 17 fire fighter.

During the discovery and rescue of the injured fire fighters, companies that had been dispatched for the second alarm were arriving on the scene and were assigned to the rear of the building. The engine crews established additional water supplies and attack lines, and the truck company raised its aerial ladder to the bathroom window on Level 1. Using this ladder, fire fighters entered the building and began opening walls in an attempt to expose the fire.

Both the deputy chief and the medical supervisor arrived close to 1:00 a.m., and command of the incident was transferred to the deputy chief. At 1:09:50 a.m., the deputy chief reported to dispatch that all of the downed fire fighters were found and under the care of medical personnel. The deputy chief also requested a third alarm for personnel at 1:10 a.m. The medical supervisor coordinated care of the injured fire fighters, and at 1:15:28 a.m. reported that all fire fighters were accounted for.

Information about the trapped fire fighters being found was quickly communicated among personnel on the fireground and aggressive search and rescue efforts stopped at this time. The pump operator for Engine 17, who had been concerned for the members of his crew because he had not heard from them for awhile and, as far as he knew, they had not changed their air bottles, received the news about trapped fire fighters being found and thought that they were the members of his crew. He thought his crew was safe.

As fire fighters involved in the search heard that the missing fire fighters were found, normal fire suppression operations were resumed. Fire fighters from Engine 7 (a company that responded to the second alarm) were involved in fire suppression operations in the kitchen on Sub-level 1. They were able to eventually progress past collapsed floor sections in this room to reach the open door to the stairway to Sub-level 2. At approximately 1:39 a.m., they moved past the open door to Sub-level 2 (the basement) and entered the family room (see Figure 4). Reflective tape on the protective gear of one of the downed Engine 17 fire fighters shined in the light beam of a hand light alerting the Engine 7 fire fighters that a fire fighter was down in that room. An immediate search of the room revealed that three fire fighters were actually down. All were removed as quickly as possible and emergency medical treatment was started. All attempts to revive the fire fighters were unsuccessful.

The Engine 17 captain was found face down in the center of the room. The fire fighter with the radio was found face up near the east window and the last fire fighter was found in a kneeling position on a couch. All three were wearing their SCBA face mask and their cylinders were empty. The low pressure hose for the captain and one of the fire fighters was still connected to the regulator. The position of the low pressure hose for the second fire fighter was not confirmed.

At approximately 1:42 a.m., the on-call assistant chief arrived and at approximately 1:51 a.m., he assumed command after being briefed. A fourth alarm was requested at 1:46 a.m., and Engines 6 & 12 responded. A third battalion chief was requested at 2:00 a.m., and a fifth alarm was called at 2:09 a.m. Engines 5 & 10 responded to that call. The battalion chief and the fourth and fifth alarm companies relieved the personnel who had responded to the first, second, and third alarms. The released fire fighters went to Engine 17's quarters where debriefing and counseling sessions began immediately.

The fire was declared “under control” at 2:43 a.m.
**Casualties and Damage**

All three fire fighters died of smoke inhalation. Post-mortem blood tests revealed that two of the three victims had carboxyhemoglobin (COHB) levels above 40 percent and that the third had a COHB level of 10 percent.* After being removed from the building, the three victims were given 100 percent oxygen for approximately 15 to 20 minutes. As a result, the post-mortem test results may not accurately reflect the fire fighters’ actual COHB levels while they were still in the building. The protective gear of all three victims was not burned because they collapsed in an area where only heat and smoke spread; there was no flame damage in this area.

The three fire fighters who fell down the collapsed stairway were injured. The Truck 17 fire fighter, who was rescued successfully, also had a COHB level of 40 percent, and sustained minor burns to his neck and ears. The two Engine 19 fire fighters suffered from minor smoke-related injuries.

The heaviest damage occurred in Sub-level 2 and Level 2. Fire damage in Sub-level 2, the basement, was concentrated in the north half of that area. The central stairway was severely damaged in the area between Sub-level 1 and Level 1. In this area, the fire weakened structural members for the stairs allowing the stairway to collapse under the weight of the Truck 17 fire fighter. Soot covered all surfaces in the family room on Sub-level 1, and the only flame damage in this room occurred in the immediate vicinity of the central stairway. Several small areas of floor collapsed in the kitchen allowing fire to spread into this area. Similar to the family room, soot covered all surfaces on Level 1. Flame damage occurred in the area of the central stairway and inside the exterior wall assemblies. The two bedrooms on Level 2 (the finished attic) and a combustible concealed space under the roof assembly sustained heavy flame damage.

*The Occupational Safety and Health Administration (OSHA) Occupational Health Guideline for Carbon Monoxide states that COHB levels over 60% are usually fatal; 40% is associated with collapse and fainting; above 25% there may be changes on electrocardiograph test results; between 15% and 25% there may be headache and nausea.*
IV. TIME LINE

<table>
<thead>
<tr>
<th>TIME</th>
<th>EVENT/ACTIVITY</th>
</tr>
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<tbody>
<tr>
<td>——</td>
<td>Male occupant discovers fire. He and his family evacuate and go to a neighbor house.</td>
</tr>
<tr>
<td>12:22 a.m.</td>
<td>The fire department receives a telephone call reporting the fire.</td>
</tr>
<tr>
<td>12:22:53 a.m.</td>
<td>Engines 17, 18, and 19, Truck 17, and a Battalion Chief 4042 are dispatched.</td>
</tr>
<tr>
<td>12:27:42 a.m.</td>
<td>Engine 17 arrives on scene and reports that smoke was showing from the first floor. This crew advances an 3/4-inch hose line into the building.</td>
</tr>
<tr>
<td>12:28:09 a.m.</td>
<td>Truck 17 arrives on scene and ventilation operations begin.</td>
</tr>
<tr>
<td>12:32:27 a.m.</td>
<td>Engine 18 arrives on scene and establishes a water supply for Engine 17.</td>
</tr>
<tr>
<td>12:32:48 a.m.</td>
<td>Engine 19 arrives on scene and advances a back-up line into the building.</td>
</tr>
<tr>
<td>12:37:21 a.m.</td>
<td>Battalion Chief 4043 arrives on scene.</td>
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<tr>
<td>12:38:38 a.m.</td>
<td>Battalion Chief 4043 provides a status report and assumes command.</td>
</tr>
<tr>
<td>12:46 a.m.</td>
<td>Incident commander (Battalion Chief 4043) orders a second alarm response. Engines 7 &amp; 15, Truck 8, a safety company, a mobile air compressor unit, and a deputy chief respond</td>
</tr>
<tr>
<td>12:58 a.m.</td>
<td>Incident commander radios fire department dispatch center and reports “a down fire fighter inside the building ....”.</td>
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<tr>
<td></td>
<td>Medic 11 reports to the EMS dispatch center that a fireman is down.</td>
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<tr>
<td>1:00 a.m.</td>
<td>The deputy chief and the medical supervisor arrive on the scene.</td>
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<tr>
<td>1:01:18 a.m.</td>
<td>Medic 11 reports to the EMS dispatch center that the fireman had been found.</td>
</tr>
<tr>
<td>1:01:19 a.m.</td>
<td>The incident commander informs fire dispatch that the missing fire fighter has been found.</td>
</tr>
<tr>
<td>1:05:58 a.m.</td>
<td>Medic 11 reports “We have more firemen (down) in the building”.</td>
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<tr>
<td>1:07 + a.m.</td>
<td>Engine 19 fire fighters escapes from building.</td>
</tr>
<tr>
<td>1:07:33 a.m.</td>
<td>Medic 11 reports to EMS dispatch “three men were in, we have all three out.”</td>
</tr>
<tr>
<td>1:09:45 a.m.</td>
<td>Fire dispatcher asks the incident commander about a report that a fire fighter was missing and two others were down.</td>
</tr>
<tr>
<td>1:09:50</td>
<td>Deputy chief reports to dispatch that all fire fighters are found and under the care of medical personnel.</td>
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<tr>
<td>1:10 a.m.</td>
<td>Third alarm requested; Engines 8 &amp; 11 respond.</td>
</tr>
<tr>
<td>1:15:28 a.m.</td>
<td>Medical supervisor reports that “all [fire fighters] have been accounted for.”</td>
</tr>
<tr>
<td>1:39 a.m.</td>
<td>BC 3 reports that three fire fighters are down and being removed from building.</td>
</tr>
<tr>
<td>1:46 a.m.</td>
<td>Fourth alarm requested; Engines 6 &amp; 12 respond.</td>
</tr>
<tr>
<td>2:09 a.m.</td>
<td>Fifth alarm requested; Engines 5 &amp; 10 respond.</td>
</tr>
<tr>
<td>2:43 a.m.</td>
<td>Fire declared “under control.”</td>
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V. ANALYSIS

Cause and Origin
Local fire investigators determined that the area of fire origin was the basement and found evidence of flammable liquid in a pile of clothing that was piled on the floor between a washer/dryer and the building’s furnace. The fire was determined to be the result of an act of arson, and the investigation was still in progress at the time this report was prepared.

Fire Growth and Spread
The fire in Sub-level 2 spread horizontally through that area, and when it reached the stairway, the fire spread up to Sub-level 1. Fire or other damage to the stairway’s ceiling allowed the fire to enter joist channels in Sub-level 1’s ceiling assembly. That fire spread horizontally to the exterior, balloon-framed walls entering the channels between the studs, and then spread vertically within the exterior walls up to Level 2. The fire reentered the occupiable spaces on this level causing the heavy damage in the two bedrooms and in the concealed space under the roof assembly.

Fireground Operations
What began as a seemingly routine response to a fire in a single-family dwelling, a scenario that the experienced Pittsburgh fire fighters were well prepared to handle, escalated to the largest loss of fire fighters in Pittsburgh since 1924 when seven fire fighters were lost in an industrial building. The transition from a routine dwelling fire to an incident that claimed the lives of three fire fighters was not the result of a single event or action. Rather, the loss of the three fire fighters was the result of an accumulation of many conditions, events, and actions on the fireground.

Fireground operations were affected by conditions as simple as the time of day and, grade of the terrain on which the fire building was located. Since the fire occurred shortly after midnight, the fire building and its surrounding area were immersed in darkness and shadows. When the first fire fighters arrived, they were on the high side of the building site - the Bricelyn Street side. Based upon what they could see under the ambient light, the fire fighters likely believed the building was a two-story structure. Fire fighters entering the building had the misconception that they were on a “first floor.” More importantly, however, they thought they entered a basement when they went down one flight of stairs. Darkness and smoke conditions hid cues that could have helped the fire fighters adjust their perception of the building during their interior fire suppression operations. The darkness and smoke also may have prevented them from identifying alternate escape routes, such as the windows that were covered with clear plastic glazing materials and the exterior door located in the kitchen. Without identified alternate escape routes, the fire fighters may have believed that they had lost their only way out of the area when the stairway collapsed.

Even though the Engine 17 officer had a portable radio that he used just before entering the building, there was no record of this officer providing progress reports or having any other radio communication with the incident commander or any other fire fighters. This radio was tested after the incident by the Pittsburgh Bureau of Fire Telecommunications Section, and was found to be inoperative at that time. When disassembled, water damage was discovered inside the bottom of the radio’s housing. Investigators were, however, unable to confirm that this damage prevented radio transmission while the Engine 17 crew was in the building. A second fire fighter who was trapped on Sub-level 1 also had a radio. That radio was tested by the bureau’s telecommunications section and was found to be operational. Even though the radio was operational, no one recalled receiving any transmissions from the fire fighter in possession of the radio. Similarly, the bureau’s tape recordings of radio transmissions did not capture any transmissions from this radio. A direct consequence of this apparent lack of communication was that the incident commander remained unaware of difficulties encountered by the Engine 17 fire fighters who were inside the building.
**Personal Protective Gear**

The helmets, coats, pants, gloves, and boots of the three Engine 17 fire fighters and the Truck 17 fire fighter were in good condition since all were entrapped in an area filled with only smoke and heat.

During the Pittsburgh Bureau of Fire inquiry following this incident, all four SCBA’s were tested by National Institutes for Occupational Safety and Health (NIOSH). The bureau’s inquiry report, *Findings and Recommendations of the Brucely Street Board of Inquiry*, proved the following discussion based upon the NIOSH test results:

Each of the four SCBA units that were tested after this incident failed to meet one or more of the standard performance tests that are used for certification by the National Institutes for Occupational Safety and Health (NIOSH). Problems were noted with exhalation valves. Of the three face pieces tested, two exhalation valves were leaking and the third had a dislodged spring. There were also problems with the calibration of the low pressure alarms on all four units. One of the alarms failed to function during one of the tests. Only one of the four SCBA regulators met NIOSH flow rate requirements.

Some of the problems noted with these units appear to have been contributing factors to the deaths and injuries, however, it is very difficult to determine if the SCBA problems were primary causal factors or secondary factors that contributed to the sequence of events.

Blood gas tests performed at the hospital upon admittance revealed that the Captain and two Firefighters who died as well as the Captain who was rescued all had elevated levels of Carbon Monoxide (CO) in their blood stream.

A concentration of CO less than 10% can result in CO intoxication. Three of the affected individuals had readings of over 40% CO level.

Some of the effects of CO intoxication are headache, nausea, fainting, impaired judgment, illogical thought processes, loss of concentration, and short term memory loss.

The personnel may have been directly exposed to CO in one of several ways or a combination of means:

1. Inward leakage through the face piece.
2. Head straps not completely tightened or not tightened sufficiently to secure a leak proof seal.
3. Loose or damaged low pressure hose connection.
4. Negative pressure within the face piece.
5. Removal or loosening of the face piece at some time.
6. In an unknown manner for which we are unable to account.

This high level of CO intoxication could help to explain the victim’s actions of:

1. Being unaware of (or underestimating) the danger they were in.
2. Unable to rescue themselves as their air supply was exhausted.
3. Not alerting others on the fire ground of their predicament.
4. Not attempting to remove their face pieces.

Serious deficiencies were also noted in the Pittsburgh Bureau of Fire’s SCBA maintenance program.

At the time the Truck 17 fire fighter was discovered, no personal alert safety system (PASS) alarms were heard even though three other fire fighters were incapacitated in the same room. The Pittsburgh Bureau of Fire’s inquiry report had the following commentary regarding the PASS devices:

PASS devices are designed to help locate fire fighters who have become incapacitated. The first priority should be to ensure that all fire fighters use their PASS devices. The existing technology of PASS devices has proven to be inadequate and many fire fighters do not routinely activate them. (This problem has been identified by several fire departments and in several other investigations of fire fighter fa-
The failure to turn on a PASS unit may be attributed to frequent false alarm problems, a lack of training, or a psychological denial that something may go wrong.

Of the total personnel on the scene, only two were known to have activated their PASS device.

An approved, maintained, and operating PASS device will not prevent events that may lead to the entrapment and incapacitation of fire fighters. The PASS device can, however, improve the potential for rescue and survival when fire fighters are incapacitated and unable to remove themselves from a hazardous environment.

Incident Command

Incident command and fire fighter accountability systems that were used also affected activities on the fireground. The Pittsburgh Bureau of Fire’s standard operating procedures provided for an accountability system and required that the system be used only for large incidents, i.e., three alarm and greater responses. On small incidents, fire officers maintained an informal accounting through their awareness of company activities on the fireground.

During this incident, the Engine 17 officer was first on-scene and, by default, he had responsibility for his company and incident command. Because he had been previously dispatched to another incident, the Battalion Chief 4043 who would have quickly assumed command at the very beginning of the operation arrived approximately 10 minutes after Engine 17. Upon Battalion Chief 4043’s arrival, fire companies were already involved in several operations. Based upon the information that he had, the incident commander was not able to quickly account for all fire crews after he became aware that some fire fighters were trapped in the dwelling. As a result, fire fighters from one crew were mistaken to be fire fighters from another crew and a search for missing fire fighters was stopped after the first three fire fighters were located.

The Pittsburgh Bureau of Fire’s inquiry report had comment regarding command and control:

Within Pittsburgh’s utilization of the present Incident Command System, in which a battalion chief usually arrives on scene quickly and assumes command, practice has been for the first arriving company Officer to give a quick report of the situation and status of water supply, and proceed with normal fire fighting operations. This procedure was followed at the Bricelyn Street incident.

All first alarm companies were already committed upon the arrival of Battalion Chief 4043, due to his responding from a previous alarm.

Unforeseen circumstances surrounding this incident hindered accepted command procedures.

The following points were noted as being deficient on all levels in respect to the current SOP on Command as it is written:

1. Formal command was not established until late in the incident.
2. Transfer of command procedures were not followed.
3. The use of radio transmissions and face-to-face contact were not utilized to effectively communicate.
4. Strong command presence was lacking.
5. There was an inadequate size up and assessment of the situation.
6. Individuals acted independently as well as companies worked independently.
7. Overall lack of accountability.
8. No additional sector Commanders were designated.
9. The personnel identification tag system utilized at all multiple alarm fires was not fully implemented.

Presently, the Pittsburgh Bureau of Fire is not staffed at the Officer and Fire fighter levels required for day to day operations. This results
in numerous "call backs" and acting out of grade assignments. Many personnel who assume the acting Officer positions have not been provided the necessary training for the additional responsibilities they encounter. That situation existed at the initial Command level of this incident.

**Code Analysis**

Selected sections of the 1992 edition of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and the 1995 edition of NFPA 1561, *Standard on Fire Department Incident Management System*, have been cited in the following discussion so incident details may be compared with current NFPA codes and standards. It was recognized, however, that these documents were not part of the legal requirements in Pittsburgh at the time of the fire. The following discussion was not intended to be a complete description of all parts of these documents that might apply.

Recognizing the importance of fire fighter accountability, both NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program* and NFPA 1561, *Standard on Fire Department Incident Management System*, contain requirements that address fire ground operations. Those requirements include the following:

- NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition:

  **6-3.1** The fire department shall establish written standard operating procedures for a personnel accounting system in accordance with Section 4-3 of NFPA 1561, *Standard on Fire Department Incident Management System*, and that provides for the tracking and inventory of all members operating at an emergency incident.


  **2-6.2** The fire department shall adopt and routinely use a system to maintain accountability for all personnel assigned to the incident. This system shall provide a rapid accounting of all personnel at the incident scene.

A fire fighter accountability system cannot prevent entrapment or other events that can incapacitate fire fighters. However, a rapid and complete accounting for all fireground personnel after an entrapment or other event
can disclose exactly which fire fighters are missing. A rapid intervention team could begin the search improving the missing fire fighters' survival potential. Recognizing the value of effective accountability systems, the NFPA requirements are intended to be applied during both complex and simple incidents. Fire fighter accountability systems with less structure than that detailed in the NFPA requirements can become ineffective during the high-stress and confusion associated with the entrapment of fire fighters or other unplanned events.

The 1995 edition of NFPA 1561, Standard on Fire Department Incident Management System, contains the following requirement related to fireground communications:

4-2.3 supervisors shall work toward assigned objectives within the overall strategy defined by the incident commander. They shall regularly report progress, or lack of progress, in meeting those objectives and any deviations from established plans.

The appendix material associated with this requirement goes on to suggest that progress reports be provided every 10 to 15 minutes. During these reports, the incident commander can be informed of progress changing conditions and difficulties being encountered. One of the recommendations of a Board of Inquiry established by the Pittsburgh Bureau of Fire following this incident was that "Emergency Operations Center (EOC) shall issue a time check to the incident commander at fifteen (15) minutes intervals from the dispatch time of the incident."

NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, contains the following requirement regarding personal alert safety systems (PASS):

5-7.1 Each member involved in rescue, fire suppression, or other hazardous duties shall be provided with and shall use a PASS (Personal Alert Safety System) in the hazardous area. PASS devices shall meet the requirements of NFPA 1982, Standard on Personal Alert Safety Systems (PASS) for Fire Fighters.

This incident confirms the potential value of PASS devices. Since the four fire fighters were entrapped in a small room and were in close proximity to one another, the fire fighters who rescued the Truck 17 fire fighter most likely would have heard operating PASS alarms, realized that other incapacitated fire fighters were in the room, and would have been able to rescue the three Engine 17 fire fighters. Earlier removal of these fire fighters would have increased their potential for survival.

**DISCUSSION**

The most beneficial lessons derived from this tragic incident are those that can prevent injury or death to other fire fighters. The factors contributing to the loss of the Pittsburgh fire fighters, i.e., building configuration, fireground communications, accountability, and use (or lack thereof) of PASS devices, are factors that could affect fireground operations anywhere and at any time.

The Bricelyn Street incident is one of several incidents that the NFPA has investigated and concluded that the building configuration complicated fireground operations. On January 5, 1995, four Seattle fire fighters died in an abandoned warehouse built on sloping terrain. The building's design, as a result of the sloping terrain, complicated both the fire suppression tactics and removal of the fire fighters' bodies after they were lost. On September 8, 1990, a fire occurred in a fraternity house in Berkeley, California. Again, the building was constructed on sloping terrain. The sloping grade hindered the placement of fire suppression equipment and the search for the civilian victims. On October 22, 1984, three Baltimore County fire fighters died in Dundalk, Maryland while fighting a fire in a furniture warehouse that appeared to be a two-story structure but, in reality, was a three-story structure. This seemingly minor difference between the perceived and the actual building configuration had a significant impact on the effectiveness of the incident commander's tactical decisions. More importantly, fire fighters working inside the building were unaware of severe fire conditions developing in areas not identified during the initial building size-up.
These incidents, like the one in Pittsburgh, show that building configuration, a detail that may be affected by the terrain, can have a subtle yet significant affect on fire ground tactics and fire fighter safety. A complete survey of the exterior of the building will provide the basis for an accurate understanding of the building configuration. This information can then be used to help incident commanders and other fire officers make changes to their tactical plans as appropriate.

An effective incident management system is an important tool that fire departments can use to minimize the unique risks encountered during fireground operations. One of the main advantages of such systems is they can establish the means for effective communications during both the simplest and the most complex fireground operations. In addition to being essential for efficient and safe fireground operations, communication is an effective component of a fire department’s accountability system, a safety net that can help fire officers and other personnel to identify when members may be incapacitated or experiencing other problems.

Since an incident command system can contribute to safe fireground operations, each member of a fire department must understand how the system operates and how that system can protect him or her should they become incapacitated while operating on the fireground. Additionally, all fire officers and fire fighters must also recognize that everyone on the fireground is responsible for operating within the spectrum of the department’s incident management system. Only when members are actively participating in the department’s accounting system can it properly function and minimize the risks to fire fighters.

A conscious awareness of the passage of time can help incident commanders while managing a fire incident. For example, Chief Alan Brunacini in his book Fire Command provides the following commentary regarding the use of time as a method for gauging the possibility of structural collapse:

One of the real concerns for the FGC (Fire Ground Commander) is how long the structure can be expected to hold together under fire conditions. A fire resistive or heavy timber building may stand up to prolonged assaults, but other types will begin to come apart much more rapidly.

The old 20 minute rule told us that we could expect most ordinary construction buildings to withstand about 20 minutes of heavy fire involvement before failure. Based on this assumption, the FGC would be able to set a timer for 15 minutes, make an evaluation when the bell rang, and still have 5 minutes of safety margin. Unfortunately, buildings do not come with any 20 minute guarantee certificates, so the FGC must constantly monitor and re-evaluate the safety of the structure and use the rule as a way to maintain an awareness of time in relation to structural conditions. Many newer types of lightweight construction will not last even 10 minutes, and all types of buildings may contain hidden flaws.**

Expanding Chief Brunacini’s concept, time can also be used as a benchmark for regular communications between the incident commander and the various sector officers. Such communications could provide a perfect opportunity for commanders to check on the progress (or lack thereof) being made by fire attack crews, prompt information about changing conditions and structural stability, and provide an opportunity for commanders to confirm the well-being of crews. Whatever time interval is selected, (i.e., every 15 or 20 minutes) the incident commander would need a reliable method of notifying him when a status check is necessary. For example, a radio dispatch center could monitor the time and advise the incident commander of the need of a status check, as is being proposed in Pittsburgh.

According to NFPA requirements, PASS devices are a required component of a fire fighter’s personal protective equipment. All too often, however, fire fighters wearing a PASS device fail to activate it before entering a hazardous environment. An incident such as the Bricelyn Street fire serves as a stark reminder of the value of PASS devices. Fire department members may want to reflect on their own departmental and personnel use of PASS devices:

*Fire Command, Page 227, Alan V. Brunacini, 1985.*
• Does the department provide PASS devices?
• Does the department require that the PASS device be worn when members enter hazardous environments?
• Do fire fighters routinely turn on their PASS devices?

If the answer to any of these questions is NO, fire department members (both managers and the rank and file) should establish a means to improve the use of PASS devices within the department. One manufacturer of SCBA’s has recently announced a new integrated PASS device that turns on when the main valve of the SCBA is opened, ensuring activation.

Fire fighters routinely face risks while participating in fire suppression and rescue operations. They minimize these risks by wearing personal protective gear and relying on their own abilities, knowledge, and other personal resources. These skills and resources should be supplemented by incident management and communication systems that can be used to manage risks that are beyond the control of individual fire fighters. In addition, accountability systems and PASS devices can provide safety nets should problems occur despite all attempts to minimize risk to fire fighters. Failure to adhere to any or all of the fireground safe practices simply increases the risk to fire fighters involved in suppression and other fireground operations. The means to reduce risk rests in the hands of both fire department supervisors and the fire fighters themselves.

POST SCRIPT

Pittsburgh, like hundreds of other fire departments across the country, has over the last several years adopted and implemented numerous policies and procedures focusing on fire fighter safety. With the tragic experience of the Bricelyn Street Fire, the Pittsburgh Bureau of Fire aggressively again reviewed their fireground operations and initiated many changes within the bureau.

The combined experience of the Bricelyn Street fire and the implementation of changes within the Bureau will ensure that Pittsburgh Bureau of Fire will never operate the same at “routine fires.” Many of the bureau’s most recent changes are reflected by the following initiatives that have already or will be put into place:

C = Completed at time this report was prepared.
P = Planned at time this report was prepared.

Operations Initiatives
C Dispatch transmit to Command a time announcement every 15 minutes after the initial dispatch.
C Second battalion chief responds as a Safety Officer on all structural fires.
C Safety Unit/Command Board (Engine 39) responds to all structural fires.
C A standby team (Rapid Intervention Team) is dispatched to all first alarm structural fires.
C A “Hazard Zone” is established at all emergency incidents.
C Mandate the use of PASS devices while working in a “Hazard Zone.”
C The first engine company is to establish a water supply (forward lay) unless special circumstances arise.

In such case, this company will ensure that a subsequent company establishes a water supply.
C Expand requirements for radio status reports by first arriving officers.
C Establish “MayDay” as the trigger word to immediately clear fireground radio channels for emergency traffic.
C Reinforce the use of the existing Incident Command and accountability systems.
C EMS Bureau units reassigned to Fireground Channel during structural emergencies.
C Establish the policy that company officers will not operate nozzles on fire attack lines. (This was a traditional, but informal practice of the fire suppression personnel)
Equipment Initiatives

P Upgrade PASS devices and ensure that the company officer has a PASS device equipped with a heat-sensing function.

P Relocate the Fireground Channel(s) on dials of portable radios. Move the channel(s) from their current position in the center of the dial to first or last positions on the dials.

P Upgrade SCBA's to state-of-the-art equipment.

C Revise and expand the Bureau's SOP concerning inspection/use/care of SCBA.

C Increase the SCBA annual maintenance/inspection cycle to, at least, semi-annually and in busy stations to quarterly.

Training Initiatives

C Require all chief officers to attend annual ICS/Tactic and Strategies training courses.

C Require all company officers to attend annual ICS/Tactic and Strategies training courses.

P Provide in-service training regarding SCBA’s.

P Provide in-service training regarding Fire Fighter Survival Techniques.

Perhaps under the term, “Lessons Learned,” these changes reflect the greatest dangers that officers and fire fighters faced during the apparently routine fire at 8361 Bricelyn Street — yet clearly it was not.