



Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

Executive Summary

On December 28, 2015, a 28-year-old male career fire fighter died due to thermal injuries and smoke inhalation with severe pulmonary edema at a single-family residential structure fire. At 0113 hours, the fire department was dispatched to a report of residential structure fire. The dispatcher advised on the dispatch channel that heavy, black smoke was showing. The dispatcher advised at 0114 hours that two elderly people may be in the house.

Additionally, the dispatcher stated there was smoke coming from the basement in the back of the house. These last two transmissions were on the dispatch channel and not

simulcast on the tactical channel. Quint 25 responded at 0114 hours and was on-scene at 0117 hours. Upon arrival, the acting officer of Quint 25 met a police officer who advised him that the neighbors reported two residents possibly inside. Heavy smoke was showing from the front half of the house, but no flames were visible. The acting officer of Quint 25 told the fire fighter on Quint 25 to get the thermal imager and take the irons to the front porch (Side Alpha). The acting officer from Quint 25 walked along Side Bravo to Side Charlie. He then proceeded back to Side Alpha. He advised the dispatcher at 0118 hours that smoke was showing from three sides of a residential structure but he could see no visible fire. The acting officer of Quint 25 decided to enter the house through the front door, which was on Side Bravo/Side Alpha corner. The engineer from Quint 25 had stretched a 1¾-inch hoseline to the front door. The fire fighter from Quint 25 forced the front door. The fire fighter from Quint 25 made entry into the foyer and then turned right into the family/living room. The acting officer of Quint 25 was behind the fire fighter on the hoseline. The acting officer of Quint 25 stated that the smoke was about a foot off the floor but not hot. As the Quint 25 fire fighter crawled into the family/living room, the floor collapsed and the fire fighter immediately fell into the basement. **Note: The term basement will be used in this report versus the term cellar. This is the term used by the fire**



The initial attack hoseline went into the structure on the Alpha/Bravo corner (Red Arrow). The fire fighter from Quint 25 entered the living room and fell into the basement. (Photo courtesy of the fire department.)

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department in their reports and correspondence. The acting officer of Quint 25 started calling for the fire fighter. The acting officer from Quint 25 and the foyer were immediately enveloped in fire. The officer from Engine 24 called a Mayday at 0123 hours. Command ordered Tower 22 and Engine 21 to locate the missing fire fighter in the basement at 0125 hours. In approximately 10 minutes, the fire fighter from Quint 25 was located, placed in a Stokes basket, and removed from the basement. Once outside, the fire fighter was treated by six paramedics, moved to a stretcher, and transported in Medic 22 to the local hospital, where he was pronounced dead at 0226 hours.

Contributing Factors

- *Arson fire*
- *Incomplete scene size-up*
- *Wind-driven fire*
- *Lack of tactical priorities (incident action plan)*
- *Lack of resource status management*
- *Lack of command safety*
- *Ineffective dispatch center operations*
- *Lack of a written professional development program*

Key Recommendations

- *As part of the strategy and incident action plan, incident commanders should ensure a detailed scene size-up and risk assessment occurs during initial fireground operations, including the deployment of resources to Side Charlie. Scene size-up and risk assessment should occur throughout the incident*
- *Incident commanders should ensure that the strategy and tactics (incident action plan) match the conditions encountered during initial operations and throughout the incident*
- *Fire departments should develop and implement a standard operating procedure, training programs, and tactics for wind-driven fires.*

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In 1998, Congress appropriated funds to NIOSH to conduct a fire fighter initiative that resulted in the NIOSH Fire Fighter Fatality Investigation and Prevention Program, which examines line-of-duty deaths or on-duty deaths of fire fighters to assist fire departments, fire fighters, the fire service, and others to prevent similar fire fighter deaths in the future. The agency does not enforce compliance with state or federal occupational safety and health standards and does not determine fault or assign blame. Participation of fire departments and individuals in NIOSH investigations is voluntary. Under its program, NIOSH investigators interview persons with knowledge of the incident who agree to be interviewed and review available records to develop a description of the conditions and circumstances leading to the death(s). Interviewees are not asked to sign sworn statements and interviews are not recorded. The agency's reports do not name the victim, the fire department, or those interviewed. The NIOSH report's summary of the conditions and circumstances surrounding the fatality is intended to provide context to the agency's recommendations and is not intended to be definitive for purposes of determining any claim or benefit.

For further information, visit the program website at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).



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Introduction

On December 28, 2015, a 28-year-old male career fire fighter died after falling into the basement at a residential structure fire. On December 28, 2015, the United States Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On January 6–13, 2016, an investigator and an occupational physician from the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to Ohio to investigate this incident.

The NIOSH investigators met with the city’s public safety director, fire chief, and executive staff of the fire department; the department’s fire marshal and his staff; the SCBA maintenance and repair staff; the International Association of Fire Fighters local union; physicians with the county medical examiner’s office; investigators from the fire department; and the county’s dispatch center. The NIOSH investigators reviewed the fire department’s standard operating procedures, training records from the department and the state of Ohio training records, and dispatch and tactical channel radio transmissions. The NIOSH investigators visited and photographed the fire scene. During the investigation, witness statements were reviewed. Interviews were conducted with the fire fighters, fire officers, and deputy chiefs who responded to the incident. The NIOSH investigators inspected and photographed the personal protective clothing (turnout gear) and SCBA of the affected fire fighter, which was under control of the city’s fire department investigator.

Fire Department

This career fire department consists of five fire stations protecting 22 square miles and a population of 63,000. The city has a council-manager form of government. The city’s public safety director oversees the fire and police departments. The fire department consists of 96 members. The rank structure is fire chief, deputy chief, captain, lieutenant, and fire fighter/paramedic. Front line apparatus include four engines, one quint, one tower ladder, three medic units (Life Squads), and one battalion chief command vehicle (deputy chief). One engine and the tower ladder are cross-staffed by an officer and two fire fighters. Depending on the incident, either apparatus responds. The minimum staff on fire apparatus is an officer and two fire fighters. Each fire station has a house captain. The department operates three shifts (24/48) with a Kelly Day every 7 shifts. Within the past several years, the city closed one fire station and laid off five fire fighters. Seven frontline units have been reduced to five frontline units. The minimum daily staffing was reduced from 28 fire fighters to the current level of a minimum of 22 fire fighters. The battalion chief operates without a staff aide or field incident technician. The department has a deputy chief assigned as the training officer plus a deputy chief assigned as the fire marshal with one fire inspector. A fire fighter is assigned as a fire investigator with full police powers.

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For working incidents, the fire department and the county fire dispatcher assign back-fills or fill-ins for empty department fire stations. The fire department also uses the callback of off-duty personnel as necessary. The shift commander (Battalion 20) has the discretion on the fill-in/backfill process.

The majority of the fire department's responses are calls for emergency medical service (EMS). In 2015, the fire department responded to 13,702 incidents, and 10,211 incidents were for emergency medical service response. The fire department has a hazardous materials team with 50 members certified to the technician level. Also, the fire department has members trained for swiftwater, ice water, and surface rescue compliant with NFPA 1006, *Standard for Technical Rescuer Professional Qualifications*, Level II.

The hiring process for the fire department is administered by the city's Civil Service Commission. The Civil Service Commission for the fire department is comprised of three citizens appointed by the city council. This Civil Service Commission is responsible for overseeing the department's hiring and promotional processes. The commissioners have staggered terms of 1, 2, and 3 years. To become a member of the fire department, the hiring process is as follows:

- The candidate must be 18 years old.
- The candidate must possess a high school diploma or GED.
- The candidate must be certified as a paramedic by the state of Ohio.
- The candidate must be certified as a NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, Fire Fighter I and Fire Fighter II.
- The candidate must complete a competitive written examination.
- The candidate must complete a physical fitness evaluation, fire-based.
- Background investigation and polygraph examination are administered.
- 10 names are submitted to the Civil Service Commission for employment.
- Selected candidates are given a health maintenance evaluation, which complies with NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.

Training and Experience

The state of Ohio has three certification levels for fire fighters: Volunteer, Fire Fighter Level I, and Fire Fighter Level II:

- Volunteer Fire Fighter requires 36 hours of training in basic concepts, equipment, and techniques. This training does not include live fire training. After successful completion, the student may take the state certification examination.
- Fire Fighter I requires a minimum of 156 hours training that includes a comprehensive introduction of basic fire-fighting concepts and skills and permits the students to practice the skills, including live fire training.
- Fire Fighter II requires a minimum of 104 hours of training that includes additional practice of skills on advanced rescue and prevention concepts, including participation in live fire training evolutions. Level II certification is required for full-time paid (career) fire fighters.

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With the exception of full-time career fire fighters, the state of Ohio permits the authority having jurisdiction to determine the level of fire fighter certification. The state also requires continuing education credits after certification. For Fire Fighter I and Fire Fighter II, any certification after 2012 requires 56 hours of continuing education every 3 years.

Prior to applying for a position as a fire fighter, the fire department requires candidates to have completed NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, Fire Fighter I and Fire Fighter II, and must be a paramedic certified by the state of Ohio. This training can be obtained through a community college, college, or vocational school. Additionally, the fire department requires a fire fighter/paramedic to complete a 36-month apprenticeship program that includes monthly written evaluations as well as monthly practical skill training. The Training Bureau is responsible for test development, test administration, and all associated record keeping. Certified apprentices will receive a “Certificate of Completion of Apprenticeship” from the United States Department of Labor.

The fire fighter from Quint 25 was hired by the fire department in April 2015. Prior to his employment with the fire department, he had worked 6 years as a part-time fire fighter for two other fire departments in Ohio. The fire fighter had completed the following training and possessed these certifications: NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, Fire Fighter I and Fire Fighter II; state of Ohio Paramedic; ICS 100, *Introduction to ICS*; ICS 200, *Basic ICS*; ICS 300, *Intermediate ICS*; ICS 400, *Advanced ICS*; IS-00700, *Introduction to the National Incident Management System*; IS-00701.a, *NIMS Multiagency Coordination System (MACS)*; IS-00800.B, *An Introduction to the National Response Framework*; Swiftwater Rescue Technician; Fire Apparatus Operator; Basic Ice Rescue Course, *Technician Level*; Basic and Advanced Auto Extrication; Incident Response to Terrorist Bombings; and University of Cincinnati—*Associate in Technical Services*. The fire fighter had 682 hours of company-level training with two previous fire departments.

The acting lieutenant of Quint 25 had 16 years on the job with this fire department and 20 years total fire service experience. He had completed the following training and possessed these certifications: NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, Fire Fighter I and Fire Fighter II; National Registry of Emergency Medical Technicians – Emergency Medical Technician; ICS 100, *Introduction to ICS*; ICS 200, *Basic ICS*; IS-00700, *Introduction to the National Incident Management System*; IS-00701.a, *NIMS Multiagency Coordination System (MACS)*; IS-00800.B, *An Introduction to the National Response Framework*; IS-00120.a, *An Introduction to Exercises*; IS-200, *Basic ICS for Federal Disaster Workers*; IS-00130, *Exercise Evaluation and Improvement Planning*; Urban Search and Rescue, *Basic Emergency Rescue Technician*; Rope Rescue Tech Course; FEMA NIMS, *All Hazard Incident Management Team*; Ohio Fire Academy *Incident Safety Officer*; Swiftwater Tech Course; HAZWOPER, 8-hour Refresher Course; Structural Collapse Rescue; Fire Fighter “Certificate of Completion of Apprenticeship” from the United States Department of Labor; Fire Fighter Self-Rescue Training Course; and the IAFF 8-hour *Fire Ground Survival Awareness Course*.

The acting deputy chief for Battalion 20 had 13 years on the job with this fire department, 4 years as a lieutenant and 4 years as a captain. He had completed the following training and possessed these

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certifications: NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, Fire Fighter I and Fire Fighter II; National Registry of Emergency Medical Technicians – Emergency Medical Technician Basic; ICS 100, *Introduction to ICS*; ICS 200, *Basic ICS*; IS-00700, *Introduction to the National Incident Management System*; IS-00701.a, *NIMS Multiagency Coordination System (MACS)*; IS-00800.B; Fire Safety Inspector; Hazardous Materials Technician; Swiftwater Technician; Rope Rescue Technician Course; Fire Fighter “Certificate of Completion of Apprenticeship” from the United States Department of Labor; Confined Space Rescue Technician Course; Fire Fighter Self-Rescue Training Course; the IAFF 8-hour *Fire Ground Survival Awareness Course*; Fire Department Incident Safety Officer; and NFPA 1851, *Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting Course* – Advanced Inspection and Advance Cleaning.

Equipment and Personnel

The county in which the fire department is located operates the 9-1-1 and dispatch center under the direction of the sheriff’s office. In addition to answering calls for the sheriff’s office, the regional dispatch center answers calls for 9 law enforcement agencies and 17 fire/EMS departments in the county. Dispatchers also process calls related to animal control, probation officers, and other county agencies. A computerized phone system brings hundreds of thousands of emergency and non-emergency calls into the dispatch center annually from wireless and wireline telephones. The radio designation for the dispatch center is 9Com.

The staffing for the dispatch center is 43 personnel. Each shift has a supervisor and 6 -7 dispatchers. The shift schedule for dispatchers is 0600 hours–1400 hours, 1400 hours–2200 hours, and 2200 hours–0600 hours.

Every officer and fire fighter is assigned a portable radio with a spare battery, which is checked daily. The fire fighter from Quint 25 had a portable radio in his turnout coat, though the portable radio was not turned on during this incident.

Each portable radio identifies the user: e.g., E24“A” (officer of Engine 24), E22“B” (right jumpseat of Engine 22), T22“C” (left jumpseat of Tower 22), and Q25“D” (fire apparatus operator of Quint 25). Every portable radio has an emergency button. When the emergency button is pressed, this opens (keys) the microphone for 10 seconds and gives this radio priority. The radio microphone remains keyed for 60 seconds unless the portable radio is re-set or cleared.

Building Construction

The structure involved was a two-story wood frame with aluminum/vinyl exterior, a full basement (unfinished), and a balloon frame construction. **Note:** *Balloon frame construction is defined as a wooden structure in which all vertical studs in the exterior bearing walls extend the full height from the bottom frame (sill), which is bolted to the foundation and to the roof. There are no firestops within the walls* [Brannigan and Corbett 2007].

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The structure was built in 1932 and had three bedrooms on the 2nd floor. The 1st floor consisted of a family/living room in the front of the house (Side Alpha), a dining room in the middle of the house, and a kitchen on Side Charlie. A stairwell to the 2nd floor was accessible through the dining room. The total available living space was 1,576 square feet. The 1st floor was approximately 46 feet long by 18 feet wide. The structure had been wrapped with vinyl siding. Access to the 1st floor was from a front porch, which covered the front of the house (Side Alpha) around to the entrance on Side Bravo (See **Photo 1**, **Diagram 1**, and **Diagram 2**). Also, one door on Side Charlie provided access to the 1st floor through the kitchen.



Photo 1. The fire building looking at Side Alpha and Side Bravo. Due to the balloon construction, the fire is running the walls on Side Bravo and Side Delta. The fire is running the walls on Side Bravo in the photograph.

(Photo courtesy of the fire department.)

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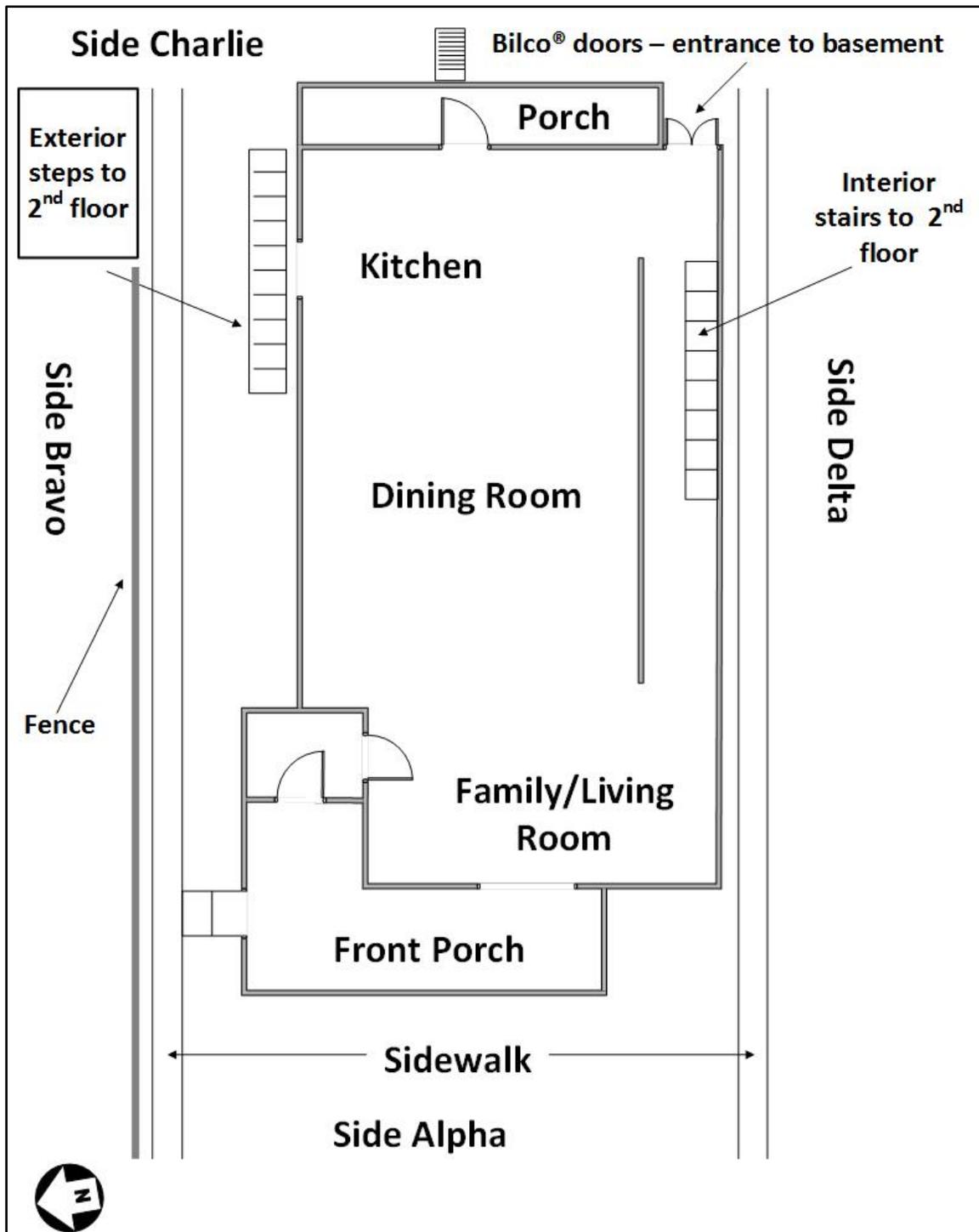


Diagram 1. The first floor of the fire building.

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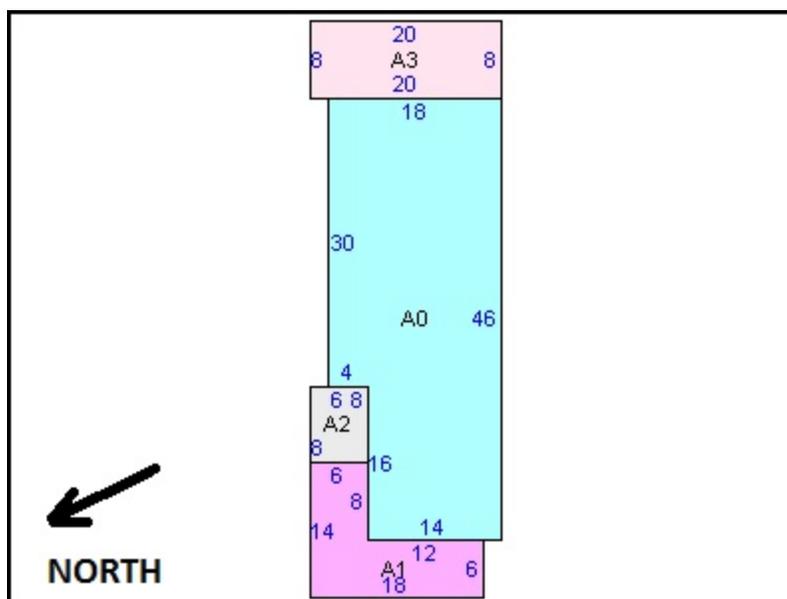


Diagram 2. The dimensions of the 1st floor of the fire building. Note: A1 is the front porch dimensions; A2 is the front foyer dimensions; A3 is the rear porch dimensions; A0 is the dimensions of the 1st floor.
(Diagram courtesy of the fire department)

The house had tongue-and-groove flooring. The floor joists (2-inch x 8-inch) were completely burned through in the basement near Side Alpha where the fire fighter from Quint 25 fell through the floor. The floor joists were 12 inches on center and ran east and west.

The basement was unfinished and primarily used for storage. The storage consisted of lawn equipment, shelving, and furniture. The hot water heater and furnace were located on the Side Bravo wall in the basement. The dimensions of the basement were approximately 46 feet long and 18 feet wide. The only entrance to the basement was through the Bilco® doors on the Charlie/Delta corner (See **Diagram 3** and **Photo 2**).

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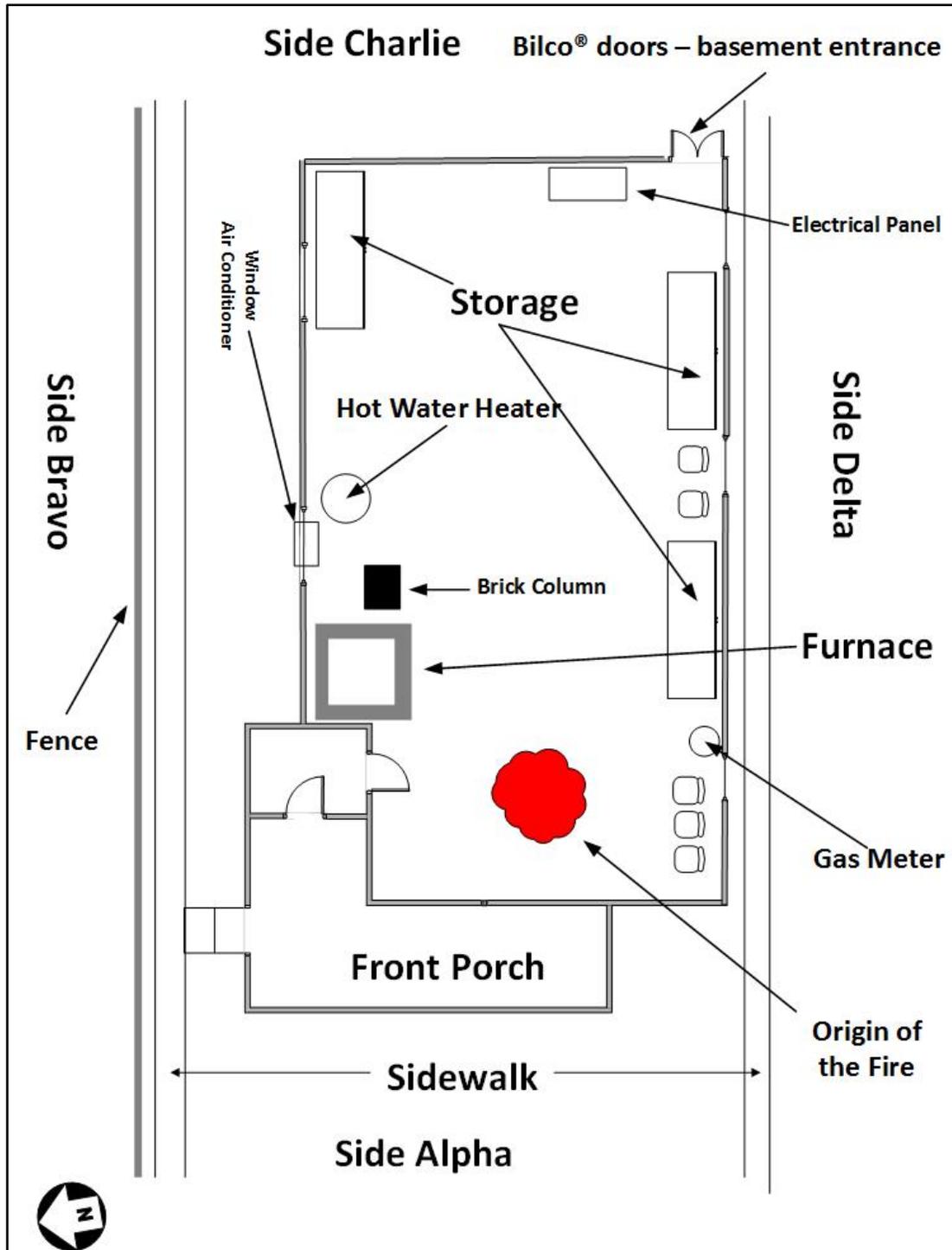


Diagram 3. The basement of the fire building.

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Photo 2. The Bilco® doors leading to the basement of the fire building. When the police officers arrived on-scene, one of the doors was open with heavy smoke showing. This was the only access to the basement. As noted, the entire structure had been wrapped in vinyl siding.
(NIOSH photo.)

Timeline

The following timeline is a summary of events that occurred as the incident evolved. Not all incident events are included in this timeline. The times are approximate and were obtained by studying the dispatch records, audio recordings, witness statements, and other available information. This timeline also lists the dispatch communications and fire department response, as well as fireground communications and fireground operations. The timeline is not intended, nor should it be used, as a formal record of events.

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
9Com received a telephone call from an alarm company for a residential burglar alarm at a single-family residence.	0103 Hours	
9Com dispatched the city police department for burglar alarm at a single-family residence.	01:05:38 Hours	
Police department reported on-scene with heavy smoke showing from the residence. Police reported an elderly couple lived at this residence. It was unknown if the couple was at home.	01:11:04 Hours	
9Com dispatched Engine 21, Engine 24, Engine 26, Medic 22, Medic 25, Quint 25, Tower 22, and Battalion 20 for a structure fire at the residence.	01:12:29 Hours	
Police on-scene advised that heavy smoke was coming from the cellar with one door open. Police officers advised they were not opening any doors or windows.	01:14:09 Hours	
9Com advised units there is smoke coming from the cellar door in the rear.	01:15:13 Hours	
Battalion 20 assigned Engine 21 as RAT (Rapid Assistance Team). Engine 21 acknowledged.	01:16:29 Hours	
	01:17:24 Hours	Quint 25 reported on-scene. Quint 25A reported: "Heavy smoke is showing from 3 sides of the structure. Engine 26 please make our water supply for us. Preparing to conduct a 360-degree walk-around."

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
	01:18:12 Hours	Quint 25 asked Battalion 20 if confirmation had been made that the occupants were out of the structure.
Medic 25 arrived on-scene.	01:18:16 Hours	
Battalion 20 arrived on-scene. Battalion 20 requested the response of a safety officer. Battalion 20 assumed Command.	01:20:12 Hours	
Engine 24 arrived on the scene.	01:20:21 Hours	
Medic 22 arrived on the scene.	01:20:33 Hours	
	01:21:40 Hours	Quint 25 (PAR 2) made entry through the front door after Quint 25A advised they had their 2-in and 2-out.
Tower 22 arrived on-scene.	01:22:12 Hours	
Engine 21 arrived on-scene.	01:22:45 Hours	
	01:23:11 Hours	Command ordered everyone out of the building. The fire fighter from Quint 25 fell through the first floor in the basement.
9Com dispatched mutual aid Engine 212.	01:23:23 Hours	
	01:23:26 Hours	Engine 24A called a Mayday on the fireground channel and stated, "We got a guy that's inside."
	01:23:42 Hours	Engine 24 advised: "We have a fire fighter inside. It's flashed."
Command asked 9Com to dispatch another engine.	01:24:04 Hours	

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Car 211 asked 9Com if there was a Mayday.	01:24:14 Hours	
Car 211 asked 9Com again if there was a Mayday.	01:25:01 Hours	
9Com responds: “Negative. No Mayday.”	01:25:06 Hours	
	01:25:13 Hours	Engine 24 to Command, “Making entry to find missing fire fighter.”
	01:25:36 Hours	Engine 21 reported, “Command, there is heavy fire in the basement.” Command ordered Tower 22 and Engine 21 to locate the Quint 25 fire fighter in the basement.
9Com dispatched mutual aid Engine 211.	01:26:24 Hours	
Engine 212 arrived on-scene and reported to Command.	01:26:47 Hours	
Medic 24 was dispatched.	01:27:55 Hours	
	01:28:18 Hours	Engine 24 reported, “Command, he is in the basement.”
	01:28:53 Hours	Command acknowledged, “Injured fire fighter is in the basement.”
	01:29:08 Hours	Engine 26 reported they were operating with Engine 24 at the front door.
	01:29:24 Hours	Engine 21 advised they were operating a 2½-inch hoseline on Side Bravo.
	01:29:33 Hours	Engine 24 reported: “I can hear the PASS alarm sounding. I need another hoseline. This one is burned through.”
	01:30:08 Hours	Tower 22 reported they were in the basement and could hear a PASS alarm.

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Command requested 9Com dispatch Car 20.	01:30:52 Hours	
	01:33:04 Hours	Tower 22 reported they had found the Quint 25 fire fighter.
Engine 211 arrived on-scene.	01:35:47 Hours	
	01:36:55 Hours	Medic 25 advised Command, “They have the fire fighter out and are going to the squad.”
	01:37:11 Hours	Command called for a PAR.
	01:38:15 Hours	PAR completed with Engine 21, Engine 24, Engine 26, Tower 22, and Engine 212.
	01:40:52 Hours	Command ordered Engine 212 out of the structure.
	01:43:18 Hours	Engine 212 reported they are out of the building.
An additional mutual aid fire department were dispatched by 9Com.	01:43:51 Hours	
Medic 22 responded to the hospital with the Quint 25 fire fighter.	01:44:35 Hours	
	01:48:41 Hours	Fireground operations changed from offensive to defensive.
Medic 22 arrived at the hospital.	01:51:36 Hours	
Police Unit 150 contacted 9Com advising them a nephew said the occupants were in Las Vegas.	01:58:37 Hours	
Command advised 9Com that the fire was under control. The overhaul process was started.	0358 Hours	

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Personal Protective Equipment

At the time of the incident, the Quint 25 fire fighter was wearing turnout pants, turnout coat, protective hood, helmet, boots, and gloves meeting current National Fire Protection Association (NFPA) requirements. The self-contained breathing apparatus (SCBA) and the personal alert safety system (PASS) that the victim was using were certified to the 2002 edition of NFPA 1981, *Standard on Open Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*. The department's fire investigator took possession of all personal protective equipment and clothing following the incident. All personal protective equipment and clothing were secured in a locked room at fire department headquarters.

The Quint 25 fire fighter was on air at the time of the collapse. He was found in the basement. When he was located by Tower 22, his facepiece, protective hood, gloves, and turnout boots had been removed. His helmet was off but he was wearing the impact cap from his helmet. At fire department headquarters, the NIOSH investigators inspected the Quint 25 fire fighter's helmet, protective hood, turnout coat, turnout pants, gloves, and boots. The turnout coat and turnout pants had been cut off the fire fighter to provide emergency medical care. The turnout coat had thermal damage along the right shoulder, arm, and back. The turnout pants had thermal damage to the right hip and thigh area and near the bottom of both pants legs. The helmet and impact cap had separated. The outer shell of the helmet was not damaged. The impact cap was damaged at some point after the fire fighter was removed from the structure. The boots, gloves, and protective hood were covered with debris but had no thermal damage. The personal protective equipment was not considered to be a contributing factor in this incident. The personal protective equipment was not further evaluated or tested by NIOSH.

The fire fighter was carrying a fire department-issued portable radio designated as Quint 25B. The radio was not turned on during this incident. When evaluated by NIOSH investigators, the portable radio was turned on but was not recognized by the radio system. Investigators were not sure why the portable radio was not recognized by the radio system.

The SCBA with integrated personal alert safety system (PASS) was also inspected at fire department headquarters by NIOSH investigators. The fire department requested that NIOSH National Personal Protective Testing Laboratory (NPPTL) evaluate and test this SCBA unit. The SCBA unit was hand-delivered by a NIOSH investigator to the NIOSH NPPTL facility in Morgantown, West Virginia, on January 13, 2016. As delivered, the SCBA unit was contained within a black plastic bag. The unit was placed in secured storage.

On May 3, 2016, NIOSH NPPTL personnel evaluated and tested the SCBA and the summary evaluation report is included as "**Appendix One: Summary of Personal Protective Equipment Evaluation—SCBA.**"

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Weather Conditions

At 0053 hours on December 28, 2015, the following weather conditions were reported. The temperature was 40 degrees Fahrenheit (40° F), the dew point was 31.1 degrees Fahrenheit (31.1° F), the relative humidity was 83%, and the winds were 11.5 miles per hour (MPH) from the east northeast and gusting to 30 MPH. The sky was overcast with 10 miles visibility. There had been 0.085 inches of precipitation (rain) in the past 24 hours [Weather Underground 2015].

Investigation

On December 28, 2015, the county dispatcher center (9Com) received a telephone call at 0103 hours from an alarm company who reported a burglar alarm at a single-family residence. 9Com dispatched two city police officers at 0106 hours. At 0111 hours, two police officers arrived on-scene and reported “heavy smoke showing” from the residence. As the police officers were responding, they stated they could see smoke from several blocks away and knew this was a “working fire.” When the officers arrived on-scene, a yellowish gray smoke was blowing across the street, east to west (from the rear of the house toward the front). There was so much smoke in the street, that the neighbors across the street were not sure which house was on fire. The neighbors advised the police that an elderly couple lived at this residence. The police officers walked around the house and found an open cellar door with smoke pushing out. One police officer went to the 2nd floor using the outside stairs. He knocked on the door, but there was no answer.

At 0113 hours, the fire department was dispatched to a report of residential structure fire. 9Com dispatched Engine 21, Engine 24, Engine 26, Medic 22, Medic 25, Quint 25, Tower 22, and Battalion 20 for a structure fire at the residence. The fire dispatcher advised on the dispatch channel that heavy, black smoke was showing. The fire dispatcher advised at 0114 hours that two elderly people might be in the house. Additionally, the dispatcher transmitted there was smoke coming from the basement in the back of the house. These transmissions were on the dispatch channel only and not simulcast on the tactical channel. *Note: During the interviews, most fire fighters and fire officers said they did not hear these radio messages. They had already switched to the fireground tactical channel. Also, most fire fighters were putting on their turnout gear and had not turned on the apparatus radio.*

Quint 25 responded at 0114 hours and arrived on-scene at 0117 hours. Upon arrival, the acting officer of Quint 25 met a police officer who advised him that the neighbors reported possibly two victims inside. Heavy smoke was showing from the front half of the house. The acting officer of Quint 25 told the fire fighter on Quint 25 to take the thermal imager and irons to the front porch. The acting officer from Quint 25 walked from Side Alpha along Side Bravo to the corner of Side Charlie before stopping and retracing his steps back to the Side Alpha. *Note: The acting officer did not walk the entire length of Side Charlie, and the raised porch prevented the acting officer from seeing the open Bilco® door leading to the basement (See Photo 2).* At 0118 hours, the acting officer of Quint 25 advised the dispatcher that smoke was showing from three sides of a residential structure but could see no visible fire. The wind was coming from the west at about 12 mph with gusts up to 30 mph and, although shifting, was generally coming from Side Charlie. The acting officer of Quint 25 stated that at one

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point the smoke was pushing through the front half of the house. This observation was consistent with the wind blowing directly through the open Bilco® door into the basement.

Battalion 20, Engine 24, and Medic 22 arrived on-scene at 0120 hours. Battalion 20 (a captain acting as the shift commander) parked in the church parking lot across the street from the residence. Battalion 20 assumed Command and requested a safety officer respond. Battalion 20 took the accountability board and walked to Side Delta of the structure. The basement windows were intact and had not vented. Heavy smoke was now showing on Side Alpha and the Alpha/Bravo corner, and the smoke was hanging. A 1¾-inch hoseline was pulled to the front door and a 1¾-inch backup line was pulled to the Alpha/Bravo corner. Command ordered Engine 24 to assist Quint 25.

The acting officer of Quint 25 decided to enter the house through the front door, which was on the Alpha/Bravo corner. The fire fighter from Quint 25 forced the front door. The smoke had a brownish, grayish tint. Quint 25 made entry into the foyer and then the family/living room. The acting officer of Quint 25 stated that the smoke was about a foot off the floor but was not hot. The time was 0123 hours (**See Diagram 4**).

Suddenly, the smoke changed color, and then fire started blowing out the front door onto the porch. On the fireground tactical channel, Command radioed everyone out of the building. At approximately the same time, the Quint 25 fire fighter crawled into the family/living room when the floor collapsed underneath him. The Quint 25 fire fighter immediately fell into the basement (**See Photo 3**). The acting officer of Quint 25 started calling for the fire fighter from the foyer but was immediately enveloped in fire. At 0123 hours, the officer from Engine 24 called a Mayday. The engineer from Tower 22 picked up the backup line and knocked the fire down around the acting officer of Quint 25. *Note: Command transmitted the Mayday to the dispatcher on the fireground tactical channel, not on the dispatch channel. The dispatcher does not monitor the fireground tactical channel. The dispatcher did not know that the fire fighter from Quint 25 had fallen into the basement. The fire department's standard operating procedure SOP 1.10 - Radio System Procedures requires that when a Mayday occurs on the fireground, Command must communicate the Mayday on the Fire Dispatch Channel. The dispatcher is automatically required to dispatch an extra alarm consisting of two engines, one ladder/quint or tower ladder, and two medic units, or as otherwise specified by the incident commander. These units should have been automatically dispatched by the dispatcher to respond and report to staging.*

At approximately 0125 hours, Command ordered Tower 22 and Engine 21 to locate an entrance to the basement and find the Quint 25B. Tower 22 forced the rear door going into the kitchen. Heavy, black smoke poured out of the doorway. At 0125 hours, Engine 24 made entry to the foyer. Engine 24A radioed there was heavy fire in the basement and after the collapse, used the thermal imager to check the basement while operating from the foyer. The thermal imager “whited” out when pointed at the basement. Engine 24 continued operating a 1¾-inch hoseline in the foyer and doorway of the family/living room, knocking down the fire on the 1st floor and the basement. At approximately 0128 hours, Engine 24A radioed Command that he could hear a PASS alarm from the basement. Engine 21

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

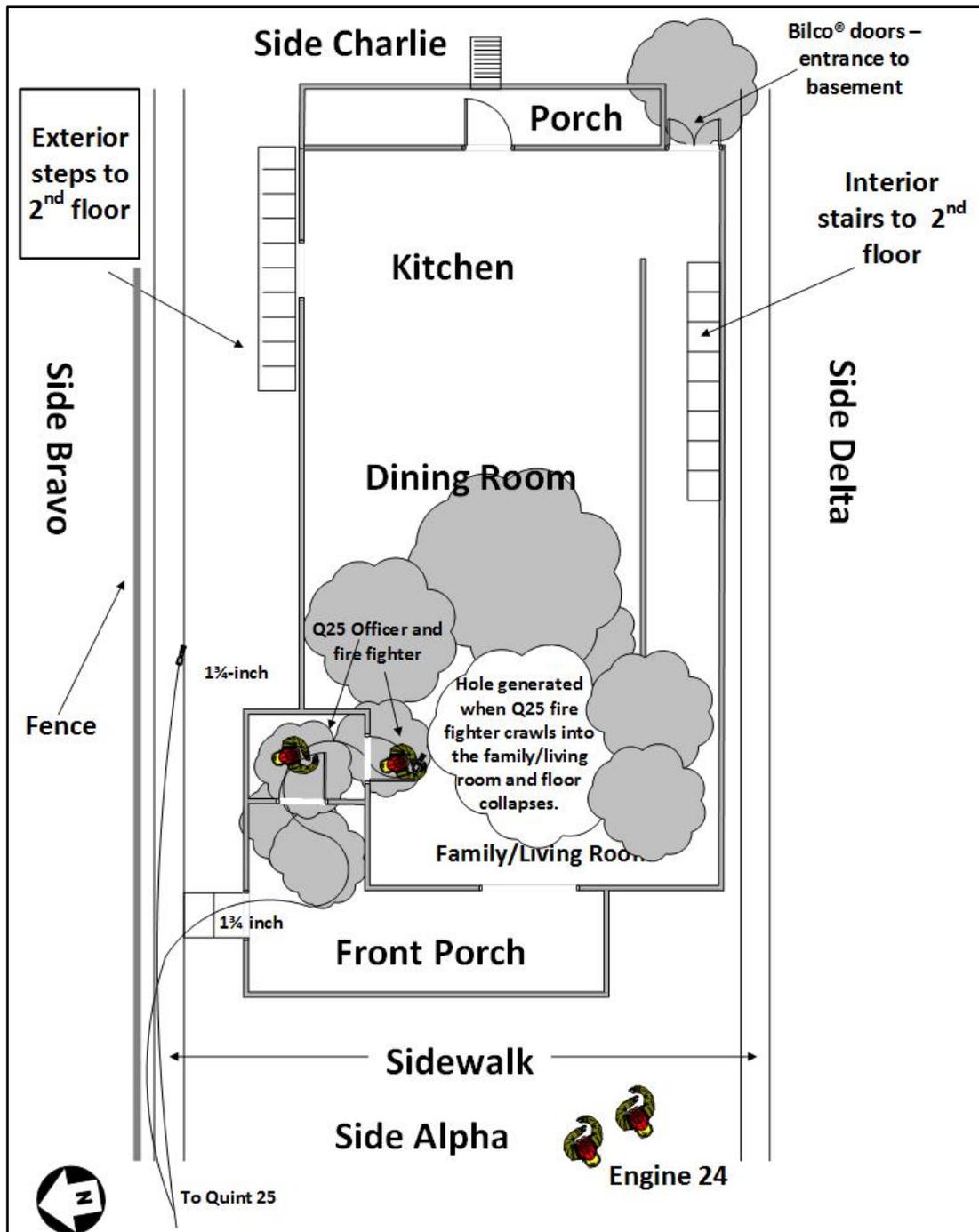


Diagram 4. The initial fire attack by Quint 25. The officer and fire fighter entered the front door on Side Bravo and went into family/living room. The time was approximately 0121 hours.

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio



Photo 3. Looking up from the basement at the hole in the 1st floor that was generated when the Quint 25 fire fighter moved into the family/living room.

(Photo courtesy of the fire department.)

was operating a 2½-inch hoseline in the basement window on Side Bravo. Engine 21 removed an air conditioner from the basement window on Side Bravo to improve water flow into the basement. At 0130 hours, Tower 22 radioed Command that they were in the basement as part of the Rapid Assistance Team (RAT) and had been joined by Engine 21. Tower 22A said he could hear a PASS alarm sounding toward Side Alpha. Tower 22 located the fire fighter from Quint 25 in the basement directly underneath the hole in the 1st floor (See Diagram 5).

Tower 22 could see fire in the rafters as they moved toward Side Alpha in the basement. Approximately 2 feet of water was in the basement. Quint 25B was found lying on his left side. When he was located by Tower 22, his facepiece, protective hood, gloves, and turnout boots had been removed. The impact cap from the helmet was still on his head. Tower 22 tried to move Quint 25B, but he was entangled. Quint 25B's foot was entangled and had to be freed from burned chairs and storage items.

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

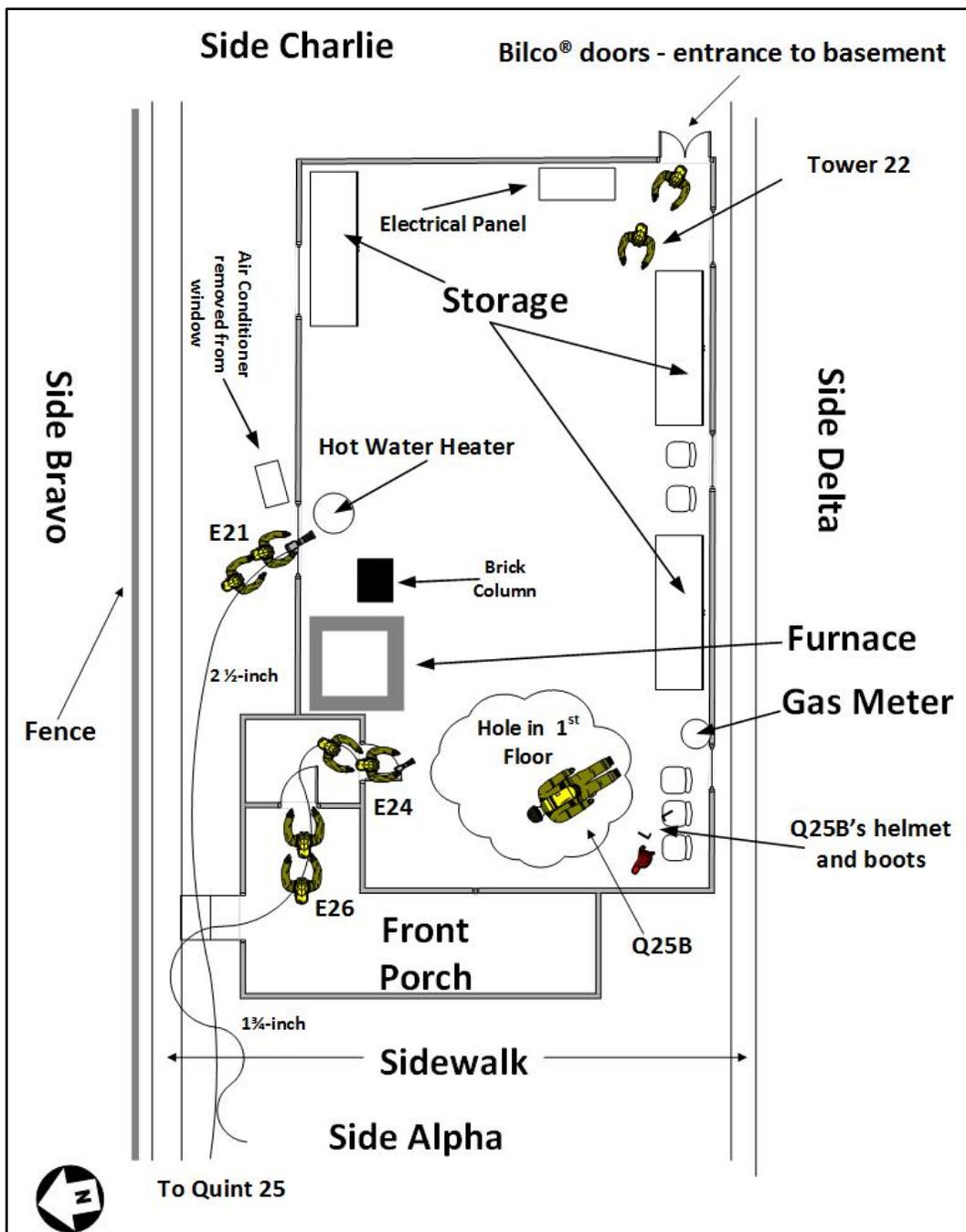


Diagram 5. The location of Quint 25B in the basement. Engine 24 and Engine 21 are operating hoselines into the basement trying to protect Quint 25B. Tower 22 is entering the basement trying to locate Quint 25B. The time was approximately 0130 hours.

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The Tower 22 officer radioed Command for webbing and a stokes basket. While Tower 22 was trying to secure the fire fighter in the Stokes basket with webbing, Engine 21 was clearing a path to the Bilco® doors.

They moved Quint 25B to the basement entrance with the help of Engine 21. The time was approximately 0137 hours. In less than 10 minutes, the fire fighter was placed in a Stokes basket and removed from the basement. Once outside the house, Q25B was moved to a stretcher. Quint 25B was then moved to Medic 22. Six medics from Medic 22, Medic 24, and Medic 25 started treatment on Quint 25B. Medic 22 transported Quint 25B to the local trauma center at 0144 hours and arrived at 0152 hours. The fire fighter from Quint 25 was pronounced dead at 0226 hours by the medical staff in the emergency room of the local trauma hospital.

While the rapid assistance team (RAT) operation was occurring in the basement, Command had Engine 212 take a hoseline to the 2nd floor to search for possible victims. At 0137 hours, Engine 212 (PAR 3) entered the 2nd floor by the exterior steps. Engine 212 conducted a complete search of the three bedrooms on the 2nd floor. At 0141 hours, Engine 212 reported the 2nd floor “all clear.” Command ordered Engine 212 out of the building. Engine 212 reported to Command, they were out of the building at 0143 hours.

After Quint 25B was transported to the hospital, Command temporarily stopped fireground operations. The duty shift commander (deputy chief) and the deputy chief in charge of training had arrived on-scene. The priority was to evaluate members and to contact Quint 25B’s immediate family and get them to the hospital. Several members left the scene for various assignments. Additional mutual aid companies responded to assist with fireground operations.

At approximately 0149 hours, Command switched from an offensive strategy to a defensive strategy. Quint 25’s ladder pipe was used until the automatic nozzle malfunctioned. Tower 22 was moved from behind Quint 25 to facing Quint 25 (**See Diagram 6**). The ladder pipe from Tower 22 and several handlines were used to knock down the fire. The deputy chief in charge of training assumed Command of the incident at this time. During this time, preparations were being made to get the critical incident stress management process started at the fire department headquarters (Fire Station 22). The fire was knocked down and placed under control at approximately 0358 hours. Overhaul of the structure was started at this time. At approximately 0500 hours, the incident commander declared the fire was out.

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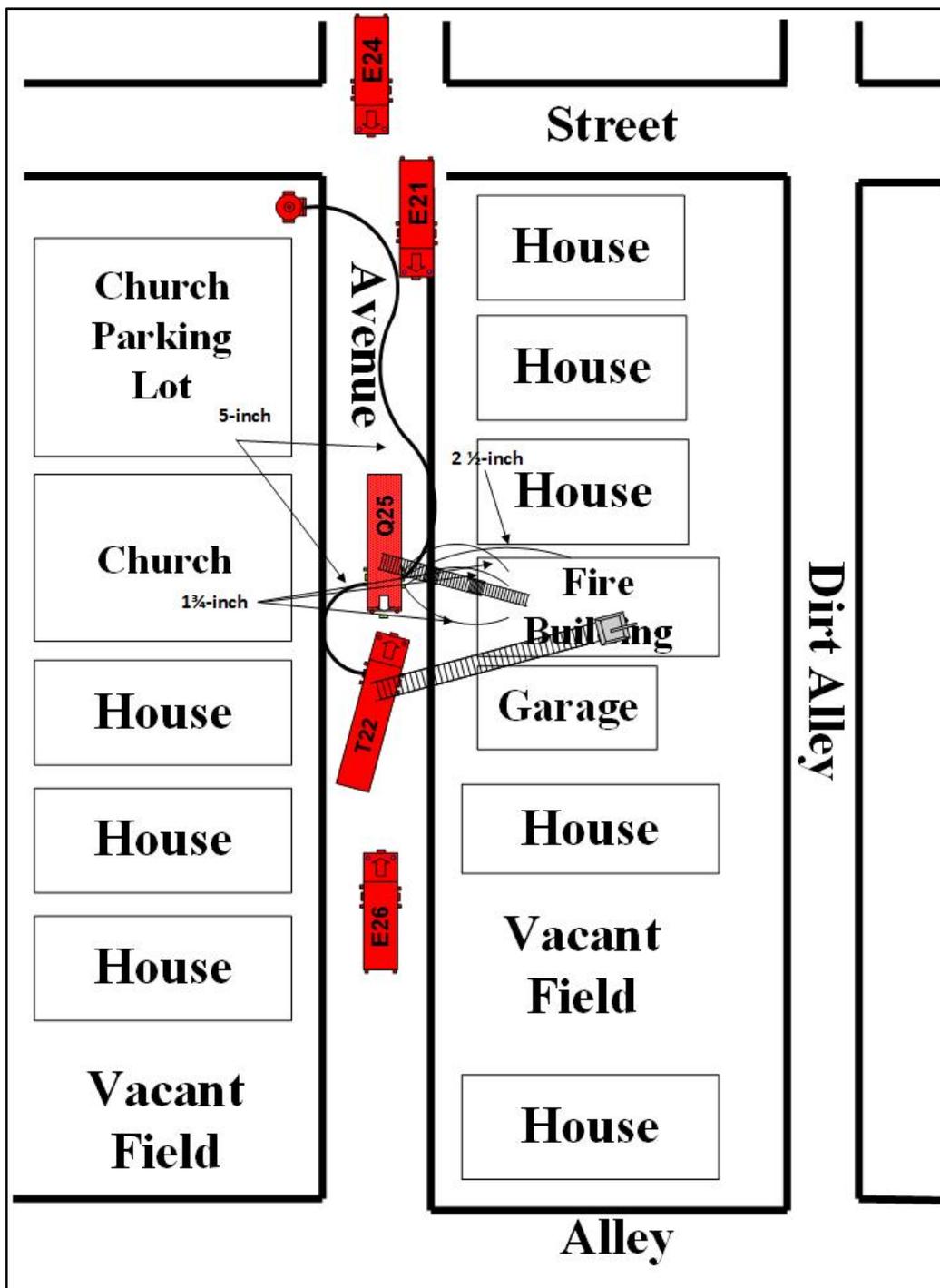


Diagram 6. The apparatus and hoseline placement when the incident commander changes the strategy to defensive operations. The time was approximately 0200 hours.

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Wind Driven Fires

Wind has been recognized as a contributing factor to fire spread in wildland fires and large-area conflagrations. Wildland fire fighters are trained to account for the wind in their tactics. While structural fire departments have recognized the impact of wind on fires, in general, the standard operating procedures for structural fire-fighting have not changed to address the hazards created by a wind-driven fire inside a structure.

The results of the "no-wind" and "wind" fire simulations demonstrate how wind conditions can rapidly change the thermal environment from tenable to untenable for fire fighters working in a single-story residential structure fire, in a multi-family residential structure fire, and high-rise structure fire. The simulation results emphasize the importance of including wind conditions in the scene size-up before beginning and while performing fire-fighting operations and adjusting tactics based on the wind conditions [Madrzykowski and Kerber 2009; Weinschenk, Overholt, and Madrzykowski 2015].

Adjusting fire-fighting tactics to account for wind conditions in structural fire-fighting is critical to enhancing the safety and the effectiveness of fire fighters. Studies have demonstrated that applying water from the exterior into the upwind side of the structure can have a significant impact on controlling the fire prior to beginning interior operations. It should be made clear that in a wind-driven fire, it is most important to use the wind to your advantage and attack the fire from the upwind side of the structure, especially if the upwind side is the burned side. Interior operations need to be aware of potentially rapidly changing conditions [FDNY 2013a; Madrzykowski and Kerber 2009; Weinschenk, Overholt, and Madrzykowski 2015].

A 360-degree scene size-up by arriving fire fighters can help determine the location of the fire and identify potential flow paths within a structure. Door control can also be used to avoid creating inlet and outlet vents that could result in the establishment of a flow path. First fire-fighting efforts should take place at the same level as the fire (i.e., fight basement fires from the basement level) with the wind at the back of fire fighters. Ongoing research by National Institute of Standards and Technology (NIST), Underwriters Laboratories (UL), and others has demonstrated that applying water from the exterior into the fire area of a structure (prior to the start of interior operations) can significantly improve the safety of fire fighters by reducing the thermal hazard from the fire and reducing the potential for developing high velocity hot gas flows within the structure [Weinschenk, Overholt, and Madrzykowski 2015].

There have been many previous fire incidents in which changes in the flow paths are thought to have had an adverse impact on fire fighter and occupant safety. Table 1 includes a list of NIOSH fire fighter fatality investigation reports where a flow path played a role in the outcome of a wind-driven incident. This table lists the NIOSH report number, the outcome, and a brief description of the flow path details.

Based on a review of these incidents, it is clear that fires with rapidly developing or changing ventilation may lead to flow paths that are a significant hazard to fire fighters during a response. The

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Fire Fighter Line-of-Duty

NIOSH Report Number	Deaths	Injuries	Flow Path Details
99-F01	3	0	From apartment into hallway on the 10 th floor of a high-rise apartment building
99-F21	2	2	Basement to 1 st floor
F2000-04	3 (3 civilians)	0	1 st floor to 2 nd floor
F2000-16	1	1	2 nd floor hallway through 2 nd floor apartment
F2000-23	1	2	From ground floor to the 1 st floor, then to the 2 nd floor, and flow exited through the ceiling
F2000-43		1 serious 2 minor	1 st floor to 2 nd floor
F2001-13	2	0	Lower level up the stairs, through the entry door, and into the garage
F2004-02	1	0	1 st floor to basement
F2005-02	1	4	Rear to the front of the building
F2005-04	1	9	Basement to 1st floor
F2007-09	1	2	3-story training burn-flow through all levels
F2007-35	0	4	1 st floor to the 2 nd floor
F2009-11	2	0	Rear to the front of the building
F2011-31	1	0	Fire extended from the lower level apartment
F2012-28	1	1	Attic fire that extended into a closed porch and then into the 2 nd floor
F2014-09	2	13	Fire extended from the basement to the 1 st floor via the stairwell

Table 1. Wind driven fires with flow path related line-of-duty deaths/injuries from NIOSH Fire Fighter Fatality Investigation and Prevention Program reports over a 15-year period.

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development of (or changes to) a flow path could be caused by the failure of a component of the structure, such as a door, window, or portion of a ceiling, wall or floor. Environmental conditions such as wind can generate hazardous thermal conditions within a flow path. Uncoordinated ventilation procedures can also be the cause of increased thermal hazards within a flow path [Weinschenk, Overholt, and Madrzykowski 2015].

The research conducted by NIST also provides potential guidance for fire fighters as a part of a scene size-up and when approaching the room of fire origin. ***Note:** Fire fighters should check for wind conditions in the area of the fire, look for “pulsing flames” or flames not exiting a window opening, examine smoke conditions around closed doors within the potential flow path, and maintain control of doors within the flow path. Even if flames are being forced out of adjacent windows with a high amount of energy, there could still be sufficient energy flows on the fire floor to create a hazard for fire fighters.*

Fire Origin and Cause

The fire cause was determined to be arson. The fire started in the basement of the structure. The homeowner has been charged with two counts of aggravated arson and murder. Another individual has been charged with aggravated arson and murder.

Contributing Factors

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. NIOSH investigators identified the following items as key contributing factors in this incident that ultimately led to the fatalities:

- Arson fire
- Incomplete scene size-up
- Wind-driven fire
- Lack of tactical priorities (incident action plan)
- Lack of resource status management
- Lack of command safety
- Ineffective dispatch center operations
- Lack of a written professional development program

Cause of Death

The county medical examiner listed the cause of death due to smoke inhalation with severe pulmonary edema, carbon monoxide toxicity (12.7%), and thermal injury—second-degree and third-degree burns to 40–50% of the body surface.

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Recommendations

Recommendation #1: As part of the strategy and incident action plan, incident commanders should ensure a detailed scene size-up and risk assessment occurs during initial fireground operations, including the deployment of resources to Side Charlie. Scene size-up and risk assessment should occur throughout the incident.

Discussion: Occupancies define the space inside the class of building. Construction types/classes of construction define how the building is constructed with either combustible or non-combustible materials. Occupancies exist inside the constructed building. SOPs must consider numerous factors that affect fire-fighting operations. This will ensure essential strategic-, tactical-, and task-level functions are performed by the incident commander, division/group supervisors, and fire fighters. Additionally, this process compliments the defined knowledge, skills, abilities, competencies, and fireground experience to assist:

- Incident commanders to plan and implement an effective strategy and incident action plan.
- Division/group supervisors to formulate and follow tactics.
- Company officers to successfully carry out assigned tasks.
- Individual members to effectively perform their duties [FDNY 2009].

At any incident, life safety is always the 1st priority, followed by incident stabilization (2nd priority) and then property conservation (3rd priority). The ability to ensure for the safety of fire fighters is a continuous process throughout the incident. A sound risk management plan ensures that the risks are evaluated and matched with the actions and conditions. The following risk management principles should be used by the incident commander:

- Activities that present a significant risk to the safety of fire fighters shall be limited to situations that have the potential to save endangered lives.
- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of fire fighters, and the actions shall be taken to reduce or avoid these risks.
- No risk to the safety of fire fighters shall be acceptable where there is no possibility to save lives or property [Brunacini 2002].

The strategy and tactics of an incident are dictated by the size-up, initial risk assessment, and situational report by the first arriving officer. The priority is to get a fire department resource or unit to Side Charlie as quickly as possible. However, unless an obvious life safety issue exists (e.g., visible victims requiring immediate assistance), interior fire-fighting operations should not commence until a report from Side Charlie is received. If physical barriers make the 360-degree size-up impractical for the 1st arriving officer, the size-up of Side Bravo, Side Charlie, and Side Delta may be delegated to another engine company or other resource on the 1st Alarm. Even if a 360-degree size-up can be conducted, recourses should be assigned to Side Charlie. Resources could be any unit—engine, truck, medic unit, or chief—preferably an engine company with a hoseline.

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A radio report of conditions, including those on Side Charlie, should be transmitted over the assigned tactical channel to the incident commander and the dispatch center. The transmission should include the following:

- Smoke and fire conditions, with an emphasis on identifying the seat of the fire. The initial radio report from the first arriving unit for a structural fire should include the signal for a working fire, number of stories, type of occupancy, and location of fire. This lays the foundation for additional reports and serves as notification to responding units as to the type of SOP to implement.
- If there were critical building description information through the critical incident dispatch system (CIDS) for the address, then this information would aid in implementing or adjusting SOPs. CIDS could contain information that would necessitate alternative actions to fulfill said operational goals.
- Building features: e.g., number of stories (particularly if there is a difference between Side Alpha and Side Charlie).
- Basement access and type.
- Any other life or safety hazards.

Any change to operational priorities or responsibilities based on the above size-up shall be clearly communicated to Command, all responding units, and the dispatch center via the assigned tactical radio channel [Modern Fire Behavior 2014; TSFRS 2013]. Command is then obligated to re-broadcast and receive acknowledgement from all operating companies.

The tasks that need to occur at any fire regardless of the occupancy are initial on-scene report upon arrival, initial risk assessment, situational report, water supply, deployment of handlines and back-up handlines, search and rescue, ventilation, rapid intervention crews (RIC), ground and aerial ladder placement, fire attack and extinguishment, and salvage and overhaul.

The fire service has recently been introduced to (and many fire departments have adopted) the acronym *SLICE-RS* by the International Society of Fire Service Instructors. This process has been specifically designed to help 1st arriving company officers apply recent research on modern fuels and fire dynamics to their early strategic and tactical decisions on the fireground.

- **S**ize up all scenes.
- **L**ocate the fire.
- **I**dentify and control the flow path.
- **C**ool the heated space from a safe location.
- **E**xtinguish the fire.
- **R**escue and **S**alvage (are actions of opportunity that must be considered not only at the initiation of operations but throughout the incident) [Modern Fire Behavior 2014].

The acronym *SLICE-RS* is not designed to replace the well-known *RECEO-VS* method that was developed by Lloyd Laymen and has been widely adopted by the fire service over the years. *SLICE-RS* is to be used by the first arriving company officer as well as *RECEO-VS* [Modern Fire Behavior 2014].

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In his book *Fire Fighting Tactics*, Lloyd Layman used S-RECEO-VS. The “S” is for size up. The first arriving officer or fire department resource should size up or provide an estimate of the situation upon arrival. Chief Layman promoted the importance of size up just as SLICE-RS supports this process today [Layman 1953]. This information is important to the fire service when discussing fireground tactics (See Diagram 7).

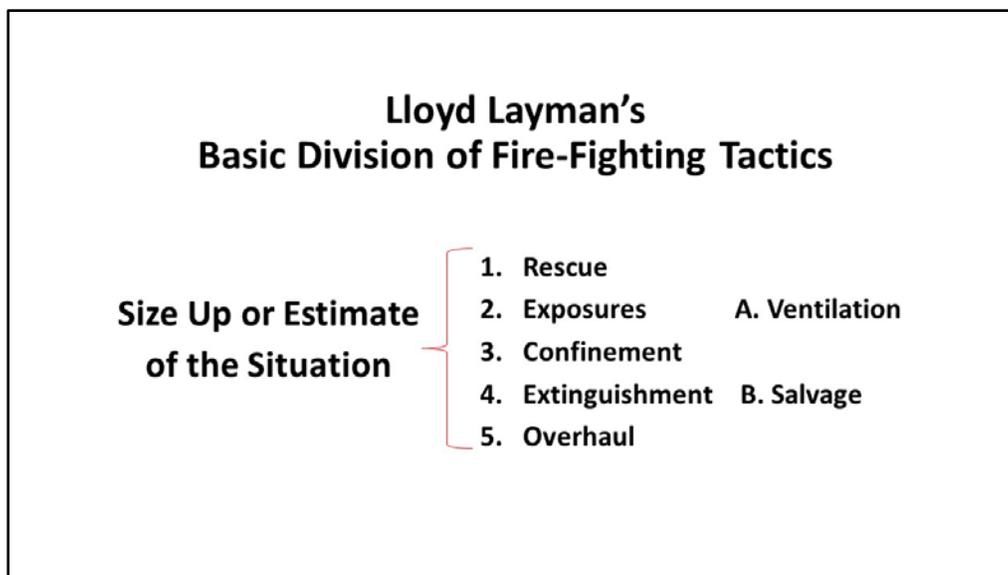


Diagram 7. Lloyd Layman's "Basic Division of Fire-Fighting Tactics"

S-RECEO-VS is:

- **S**ize up or estimate of the situation
- **R**escue
- **E**xposures
- **C**onfinement
- **E**xtinguishment
- **O**verhaul
- **V**entilation
- **S**alvage [Layman 1953].

A flow path is composed of at least one inlet opening, one exhaust opening, and the connecting volume between the openings. The direction of the flow is determined by difference in pressure. Heat and smoke in a high pressure area will flow through openings toward areas of lower pressure. Based on varying building configurations, several flow paths may be within a structure. The importance of identifying and using flow path information cannot be underestimated. While trying to locate the fire, cooling the heated space from a safe location while ensuring for the safety of the fire fighters is important. Operations conducted in the flow path, between where the fire is and where the fire wants to go, places fire fighters at significant risk due to the increased flow of fire, heat, and smoke toward their

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positions. This risk is true for natural-ventilation cases with or without wind. In cases with the potential for wind to affect the heat release rate and the movement of the fire, it is important to keep the wind at your back and to attack the fire from the upwind side. Once the fire is under control, the fire can be completely extinguished. The rescue and salvage operations are self-explanatory—if anything can be saved, save it. These two actions are always active, right from sizing up to extinguishing. The identification of flow path is critical during initial fireground operations and communicated to the incident commander. In addition, this issue should find its way into every after-action review of an incident.

Establishing a continuous and uninterrupted water supply is vital and one of the most critical elements of fireground operations. This must be done before or in conjunction with committing crews to interior operations. To ensure a water supply is secured, many fire departments require, per standard operating procedure (SOP), that the 2nd due engine company and 4th due engine company should secure a water supply for the 1st due engine company and 3rd due engine company [Fire and Rescue Departments of Northern Virginia 2013].

Procedures developed for fireground operations should be flexible enough to allow the change due to:

- Life hazard (must be given first priority).
- Problems with water supply and water application.
- Volume and extent of fire, requiring large caliber streams.
- Location of the fire, inaccessible for hoseline operations.
- Materials involved in the fire and explosion potential compounding the problem.
- Exposure problems where further fire spread would be a major concern.
- Stability of the structure, which would be dependent on the condition of the structural components of the building and the intensity and duration of the fire [Brunacini 2002].

At this incident, initial information communicated to responding units stated there was a possibility of an elderly couple inside the home. Also, 9Com never communicated to the fire department that the police department was on-scene for a burglar alarm. Life safety became the focus of the fire department efforts, but the initial scene size-up was not completed (no view of conditions on Side Charlie or Side Delta), the 2nd floor access (exterior stairs) to the bedrooms was not assessed, and the rear entrance was not assessed. The officer of Quint 25 stated the smoke was in the front half of the house and nothing in the rear.

As outlined in this recommendation, a methodical process for the 1st arriving officer is to initiate the size-up process, risk assessment, and initial fireground operations. Also, resources should be deployed to Side Charlie during the initial response. This officer must communicate this information to all responding companies.

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Recommendation #2: Incident commanders should ensure that the strategy and tactics (incident action plan) match the conditions encountered during initial operations and throughout the incident.

Discussion: Fireground operations are very dynamic and fast-paced. The incident commander must determine a strategy and then develop the incident action plan (IAP) to ensure that the proper actions take control of the incident. The incident commander must follow the decision making model that includes identifying incident critical factors (through a situational evaluation or “size up”), consider the standard risk management plan, declare the strategy (offensive or defensive), and then set tactical objectives. This model will lead to the development of the IAP, which serves as the tactical road map to effectively manage the incident. The IAP defines where and when resources will be assigned throughout the incident, along with tasks and objectives [NFPA 2014a].

To ensure a standard outcome of each incident, the incident commander should match the standard conditions to standard actions. This is the core of the incident command system and is the basis for all operations. Standard conditions are identified as the incident’s **current** critical factors:

- Identify the incident’s critical factors before taking any action.
- Initial and ongoing size-up of the incident’s critical factors must produce the information that becomes the basis for the current incident strategy and IAP.
- Current, accurate, and relevant information provides the foundation for effective initial and ongoing action.
- The goal of this systematic evaluation process continually produces standard, safe, well-managed incident outcomes [MABAS 2015]

The IAP should match the defined strategy established by the incident commander for a particular incident. The defined strategy describes the overall approach to incident operations and drives the IAP. The IAP provides the tactical assignments required to achieve the offensive/defensive objective. The order of occurrence is key—the strategic goals are developed first and then followed by the tactical objectives. At each incident, the incident commander should start with a standard placement-oriented operational plan that develops a strong, dependable beginning for command and control of the incident. While developing the strategic goal for the incident is the first component, the incident commander needs to produce detailed tactical objectives that can be assigned to responding companies. This is the purpose of the IAP [Brunacini 2002; Fire and Rescue Departments of Northern Virginia 2013].

The initial incident commander, most often, is a company officer who arrives on-scene prior to a chief officer. The company officer should provide a detailed size-up, which is communicated to all responding resources including the dispatch center. The company officer assumes command and makes a decision regarding the strategy and IAP. The company officer may not have the ability or time to record the IAP on paper and provide documentation when transferring command. In this case, a verbal IAP is appropriate. As with this or any incident, events can occur very quickly before a detailed tactical worksheet or written IAP is developed [Brunacini 2002].

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The IAP can be as simple as a verbal transmission to all units assigned to an incident. Once an officer assumes command, the mode of command (Investigative Mode, Fast Attack Mode, or Command Mode) is determined, and the overall strategy offensive or defensive is communicated. Command can make specific assignments to arriving companies along with tactical objectives such as search, rescue, fire attack, ventilation, utility control, and exposure protection. The responding chief officer should be monitoring radio communications and documenting tactical objectives on a tactical worksheet if possible. When the chief officer arrives on-scene, an update from the initial incident commander can occur (face-to-face or by radio). The chief officer will then assume command at a stationary location. By following this process, the initial and subsequent incident commanders will be in a stronger position to manage an incident should an emergency event occur [NFPA 2014a].

NFPA 1561 defines an IAP as a verbal plan, tactical worksheet, written plan, or combinations thereof that reflects the overall incident strategy, tactics, risk management, and member safety that are developed by the incident commander. NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety* [NFPA 2014a] requires the following regarding an incident action plan:

- 5.3.12.1 The incident commander shall be responsible for developing and/or approving an incident action plan (IAP).
- 5.3.12.2 This IAP shall be communicated to all staged and assigned members at an incident.
- 5.3.20 the incident commander shall be responsible for reviewing, evaluating, and revising the IAP and overall strategy of the incident (*See Diagram 8*).

The following are guidelines for developing an IAP for offensive and defensive operations.

Offensive Incident Action Planning

When an incident's critical factors and the risk management plan indicate an offensive strategy, Command will define the tactical objectives for entering the structure (hazard zone) to attempt to control the incident hazards. An offensive IAP is based on the standard offensive tactical priorities.

Offensive strategy tactical priorities and their corresponding completion benchmarks are:

- Fire Control (F/C)—“Under Control”
- Life Safety—Primary and Secondary “All Clear”
- Property Conservation—“Loss Stopped”
- Customer Stabilization—Short term

The offensive tactical priorities establish the major operational activities required for a complete, integrated effort, and they identify the three major functions needed to establish the overall incident response [MABAS 2015].

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DEVELOPING an INCIDENT ACTION PLAN

The Incident Action Plan is defined as the strategic goals, tactical objectives, and support requirements for the incident. All incidents require an action plan. For simple incidents, the action plan is not usually in written form. Large or complex incidents will require that the action plan be documented in writing.

After the size-up is completed, the officer begins the process of developing an Incident Action Plan, which should be used at all incidents. The Incident Action Plan (IAP) will assist the Incident Commander in completing two significant incident management tasks – identifying the incident strategy and the assignment of tasks that accomplish the strategy. During structural firefighting, the IAP will be verbal and communicated to all responders operating on the incident scene.

The acronym **SLICE-RS** was created to guide initial engine company operations. It is effective as an initial attack sequence for the initial arriving officer to determine tactical priorities. As the incident commander arrives, **RECEO-VS** is an effective acronym to use for overall strategic objectives guiding the incident.



Diagram 8. A guide for developing an incident action plan at Type V and Type IV incidents. For these types of incidents, the incident action plan is most often communicated verbally.

*Note: A larger diagram is found in Appendix Two.
(Courtesy of FireFighterCloseCalls.com.)*

Defensive Incident Action Planning

A defensive situation is where the incident problem has evolved to the point that lives and property are no longer savable and offensive tactics are no longer effective or safe. The entire defensive strategy is based on protecting fire fighters.

Fire fighter safety is the No. 1 defensive priority.

Defensive strategy tactical priorities and their corresponding completion benchmarks:

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- Define the hazard zone
- Establish cut-offs—Forward progress stopped
- Search exposures—Primary and Secondary “All Clear”
- Protect exposures—“Fire Control”—Loss Stopped

Defensive operations represent a standard organizational response to situations that cannot be controlled with offensive tactics. When conditions go beyond the safety systems required for interior operations, Command must conduct defensive operations from outside the hazard area. Command must write off lost property and decide where the cut-off will take place. If defensive operations are conducted from the onset of the incident, a primary search will not be completed for the involved structure(s). During defensive campaign operations, Command will coordinate the rotation of crews. A basic defensive IAP includes the following tasks:

- Identify critical fireground factors.
- Determine the need for additional resources.
- Evaluate fire spread/write-off lost property.
- Search exposures.
- Protect exposures.
- Prioritize master streams; provide big, well-placed streams.
- Surround and drown [MABAS 2015].

As an incident progresses, Command needs to continually review and update the IAP. The following list serves as a guide for Command to consider. This continuous review and evaluation should occur when benchmarks are met or conditions change and benchmarks have not been achieved.

- Fire fighter safety
- Does the current strategy match the current conditions
- Location of fire attack
- Effect of the fire attack
- All affected areas searched (“All clear”)
- Timing and support
- Adequate back-up
- Adequate staffing and resources
- What is Plan B
- Corrective actions to the current conditions (Fire Control, All Clear, Loss Stopped) [MABAS 2015].

At this incident, the communications from 9Com and the police officer regarding the possible victims in the house redirected the focus of fireground operations. Obviously, life safety is the initial priority at an incident. The incident commander must consider this information in order to develop and implement proper tactics. All incidents are dynamic, unpredictable and can change at any time. As described in the diagram, the incident commander must consider all factors in developing an effective IAP, regardless of the compressed time frame. This process will continue throughout the duration of the incident.

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Recommendation #3: Fire departments should develop and implement a standard operating procedure, training programs, and tactics for wind-driven fires.

Discussion: Based on the analysis of this incident and results from current research and NIOSH fire fighter fatality investigation reports, adjusting fire-fighting tactics to account for wind conditions in structural fire-fighting is critical to enhancing the safety and the effectiveness of fire fighters. A wind-driven fire may be one of the most dangerous operations fire fighters will encounter. The term “wind-driven” fire is used to describe a fire in which the wind has the potential to, or is already –causing, a dramatic and sudden increase in fire, heat, and smoke conditions. Experienced fire officers and fire fighters who have survived wind-driven fires have all described the following:

- Upon arrival, conditions appeared to be routine.
- Within seconds, fire, heat, and smoke conditions changed without warning “from routine to life-threatening.”
- An operating 2½-inch hoseline flowing from the downwind position or into the exhaust portion of the flow had little or no effect on the incredible heat being produced; flowing water into the intake or inlet side of the flow path is very effective.
- Directly attacking these fires with one or even two 2½-inch hoselines proved ineffective and ultimately led to fire fighters incurring serious injuries [FDNY 2013a].

When responding to a reported structure fire, an overriding consideration concerning size-up must be wind conditions and its potential effect on the fire. The key to successfully operating at wind-impacted fires in a structure depends on recognizing the wind-impacted fire conditions that may change a seemingly routine fire into a “blowtorching” fire. “Blowtorching” is the appropriate description of what will occur when fire conditions are impacted by wind conditions.

The impact of the wind will be affected by the size of the window opening, the fuel load, and the stage of the fire when the window failed. **When wind-impacted fire conditions exist in a structure, the incident commander should notify the dispatcher so this information can be relayed to all responding units. In addition, the incident commander needs to make an announcement on the tactical channel as well.** Once the contributing factors are identified, steps can be taken to minimize the hazards to fire fighters [FDNY 2013a].

Fire departments should develop a standard operating procedure for incidents with high-wind conditions and for areas where high-wind conditions are likely. It is important that fire officers and fire fighters develop an understanding of how wind conditions influence fire behavior. This greatly impacts the fireground tactics under wind-driven conditions. Wind conditions can have a major influence on structural fire behavior. When wind speeds exceed 10 mph (16 km/hr), the incident commander, division/group supervisors, company officers, and fire fighters should use caution and take wind direction and speed into account when selecting a strategy and developing tactics. The National Institute of Standards and Technology (NIST) has determined that wind speeds as low as 10 mph (16 km/hr) are sufficient to create wind-driven fire conditions if the flow path is uncontrolled [Madrzykowski and Kerber 2009]. NIST, in a recent study on wind-driven fires in structures, has

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shown that wind speeds as low as 10 mph can turn a routine “room and contents fire” into a floor to ceiling fire storm or “blowtorch effect,” generating untenable conditions for fire fighters, even outside of the room of origin. Temperatures in excess of 600°C (1,100°F) and total heat fluxes in excess of 70 kW/m² were measured at 4 feet above the floor along the flow path between the fire room and the downwind exit vent. These conditions were attained within 30 seconds of the flow path being formed by an open vent on the upwind side of the structure and an open vent on the downwind side of the structure [Madrzykowski and Kerber 2009].

Fire departments are encouraged to develop and implement a standard operating procedure addressing such issues as obtaining the wind speed and direction, considering the possible fuel load associated with a particular occupancy, determining proper strategy and tactics for fireground operations, consideration of ventilation, and establishing possible scenarios associated with the wind speed based upon risk assessment. Under wind-driven conditions, an exterior attack from the upwind side of the fire may be necessary to reduce fire intensity to the extent that fire fighters can gain access to the involved compartments [Madrzykowski and Kerber 2009].

The strategy and tactics of an incident are dictated by the size-up, initial risk assessment, and situational report by the first arriving officer. If physical barriers make the 360-degree size-up impractical for the first arriving officer, the size-up of Side Charlie may be delegated to another fire department unit. However, unless an obvious life safety issue exists (e.g., visible victims requiring immediate assistance), interior fire-fighting operations should not commence until a report from Side Charlie is received [Fire and Rescue Departments of Northern Virginia 2013].

In simulations and in previous full-scale experiments, it has been demonstrated that wind can increase the thermal hazards of a structure fire [Madrzykowski and Kerber 2009]. Therefore, wind must be considered as part of the initial size-up of the fire conditions and must be monitored and reported throughout the fire incident. It is critical that fire fighters not be in the exhaust portion of the fire flow path. The directional nature of the fire gas flow path results in temperatures higher than the area adjacent to the flow path or upwind of the fire. The flow path can be controlled by limiting ventilation. Previous studies demonstrated that applying water from the exterior into the upwind side of the structure can have a significant impact on controlling the fire prior to beginning interior operations [ISFSI 2013; NIST 2009].

Some current fire control training guides state, “Whenever possible, approach and attack the fire from the unburned side to keep it from spreading throughout the structure.” It should be made clear that in a wind-driven fire, it is most important to use the wind to your advantage and attack the fire from the upwind side of the structure, especially if the upwind side is the burned side. The unexpected ventilation from a broken window can suddenly change the interior thermal conditions. Interior operations must be aware of potentially rapidly changing conditions.

A fire department should incorporate the following into their training and education component on wind-impacted fires:

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- Ensure that an adequate initial size-up and risk assessment of the incident scene is conducted before beginning interior fire-fighting operations.
- Conduct a 360-degree size up to determine the best attack/entry point.
- Ensure that fire fighters, company officers, division/group supervisors, and the incident commander have a sound understanding of fire behavior and the ability to recognize indicators of fire development and the potential for extreme fire behavior (such as smoke [color, velocity, and density], visible fire, and heat).
- Ensure that fire fighters and company officers are trained to recognize the potential impact of windy conditions on fire behavior and implement appropriate tactics to mitigate the potential hazards of wind-driven fire.
- Ensure the incident commander's strategy considers high-wind conditions, if present.
- Ensure that fire fighters understand the influence of ventilation on fire behavior and effectively apply ventilation and fire control tactics in a coordinated manner.
- Ensure that fire fighters and officers understand the capabilities and limitations of thermal imagers.
- Ensure a thermal imager is used as part of the size-up process.
- Ensure that fire fighters are trained to check for fire in overhead voids upon entry and as charged hoselines are advanced.
- Develop, implement, and enforce a comprehensive Mayday standard operating procedure and train and educate fire fighters to ensure they understand the process and know how to initiate a Mayday.
- Ensure fire fighters are trained in fireground survival procedures.
- Ensure all fire fighters on the fireground are equipped with radios capable of communicating with the incident commander and the dispatch center [FDNY 2013b; IFSTA 2013; NIOSH 2014].

At this incident, the wind (12 mph with gusts to 30 mph) was blowing against the fire building on Side Charlie. One basement door on Side Charlie was left open prior to the arrival of the fire department. When the front door was opened and the fire fighter from Quint 25 fell through the floor, enough air (oxygen) was provided for the fire to ignite the basement and the 1st floor of the house.

Recommendation #4: Fire departments should integrate current fire behavior research findings developed by the National Institute of Standards and Technology (NIST) and Underwriter's Laboratories (UL) into operational practices by developing standard operating procedures, conducting live fire training, and revising fireground tactics.

Discussion: The National Institute of Standards and Technology (NIST) and Underwriters Laboratories (UL) have conducted a series of live-burn experiments designed to replicate conditions in modern homes and residential structures and to validate previous testing done in laboratory settings. The results of these experiments will enable fire fighters to better predict and react to effects of new materials and construction on fire. The fire research experiments were conducted in cooperation with the Fire Department of New York; Chicago Fire Department; Spartanburg, South Carolina, Fire and

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Rescue; and other agencies. The live-burn tests are aimed at quantifying emerging theories about how fires are different today, largely due to new building construction and the composition of home furnishings and products. In the past, these products were mainly composed of natural materials, such as wood and cotton, but now contain large quantities of petroleum-based products and synthetic materials that burn faster and hotter and generate large volumes of fuel-rich smoke. Where a fire in a room once took approximately 20 minutes to “flashover”—igniting all the contents—this can happen with today’s furnishings in as little as 4 to 5 minutes [NIST and UL 2013].

In addition, modern living spaces tend to be more open, to be less compartmentalized, and are better insulated than homes built years ago. As a result, an interior residential fire can generate an oxygen-depleted, fuel-rich environment within minutes. This fire condition of hot, fuel-rich smoke is highly reactive to the introduction of oxygen. Introducing oxygen to this environment by opening a door or venting a window may result in a rapid transition to flashover. These same conditions can occur in commercial structures as seen in the Charleston, South Carolina, Sofa Super Store fire [NIOSH 2009a].

The NIST and UL experiments evaluated individual and combinations of methods for strategically ventilating and isolating fires to prevent flashover—or at least delay it. In contrast, kicking a door open or breaking a window without knowledge of conditions inside could create a portal for air that can literally fan the flames by introducing oxygen into an oxygen-limited fire environment.

Traditionally, fire suppression operations were conducted from the interior of the structure as a means to reduce water damage and limit fire damage to structures. These operations must be coordinated with the ventilation operations. Previous research and examinations of line-of-duty deaths have shown that ventilation events occurring with fire fighters in the structure prior to suppression have led to tragic results [NIOSH 2012a, 2013a, 2013b]. One method of eliminating the possibilities of this occurrence would be a transitional attack. Water is directed into the structure from the exterior to cool the fire gases and reduce the heat-release rate of the fire, prior to the fire fighters entering the building. The major concern with this type of operation is the potential harm that might occur to people trapped in the structure or the amount of water damage to the structure. Therefore, measurements are needed to document the changes of the thermal environment within the structure and the impact on the viability of people, who might be trapped in the structure [NIST and UL 2013].

Based upon the NIST and UL research, the following fireground operations should be considered for implementation.

- **Size-Up**

Size-up must occur at every fire. Consideration must be given to the resources available and situational conditions, such as weather, fire location, size of the fire and building, and the construction features. Ensure a 360-degree size-up is conducted whenever possible. A tactical plan for each fire must be developed, communicated, and implemented.

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- **Ventilation**

Fire departments should manage and control the openings to the structure to limit fire growth and spread and to control the flow path of inlet air and fire gases during tactical operations. All ventilation must be coordinated with suppression activities. Uncontrolled ventilation allows additional oxygen into the structure, which may result in a rapid increase in the fire development and increased risk to fire fighters due to increased heat-release rates within the flow path.

- **Fire-fighting Operations**

Given the fuel-rich environment that the fire service operates in today, water should be applied to the fire as soon as possible. In many cases, water application through an exterior opening into a fire compartment may be the best first action, prior to committing fire-fighting resources to the interior. Fire departments should cool the interior spaces of a fire building with water from the safest location possible, prior to committing personnel into spaces with, or adjacent to, fully developed or smoldering (ventilation-limited) fire conditions.

- **Rapid Intervention**

Fire department rapid intervention procedures should be updated to provide water on the fire as soon as possible and ventilation openings controlled during fire fighter Mayday incidents [NIST and UL 2013].

This information is presented to educate the fire service and to ensure that fire departments consider a change in fireground tactics based upon the current research presented by NIST and UL. Much of this research has been directed toward developing a better understanding of the characteristics of the modern fire. This modern research provides members of the fire service with the information and knowledge needed to modify essential fire-fighting tactics. While fire-fighting will never be without risk, this research represents a vital contribution to overall efforts to reduce risks and to save lives.

A flow path is composed of at least one inlet opening, one exhaust opening, and the connecting volume between the openings. The direction of the flow is determined by difference in pressure. Heat and smoke in a high pressure area will flow through openings toward areas of lower pressure. Based on varying building designs and the available ventilation openings (doors, windows, etc.), several flow paths can exist within a structure. Any operation conducted in the exhaust portion of the flow path will place members at significant risk due to the increased flow of fire, heat, and smoke toward their position. Operations conducted in the flow path, between where the fire is and where the fire wants to go, places fire fighters at significant risk due to the increased flow of fire, heat, and smoke toward their positions. This risk is true for natural-ventilation cases with or without wind. In cases with the potential for wind to affect the heat release rate and the movement of the fire, it is important to keep the wind at your back and to attack the fire from the upwind side [FDNY 2013a; NIST 2013a].

Fire fighters must be aware and understand that the critical first step in evaluating the potential for a wind-impacted fire is recognition of any smoke movement in the flow path, wind speed, smoke being forced under doors, and/or pulsing smoke or fire. The incident commander and company officers must be notified immediately when any of these conditions are observed. **The communication of this**

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critical information to the incident commander and company officers operating inside the building must be acknowledged.

At this incident, prevailing winds were blowing toward Side Charlie at 12 miles per hour with gusts up to 30 miles an hour. Prior to the arrival of law enforcement and the fire department, one of the Bilco® doors to the basement was open. The first arriving police officer radioed 9Com and stated: “Also heavy smoke coming from the basement. There is an open basement door in the back.” This information was relayed to the fire department on the dispatch channel but not the tactical channel. During the fireground operations, Engine 26 opened the other Bilco® door.

Recommendation #5: Fire departments should develop and implement a standard operating procedure for tactical operations involving cellar or basement fires.

Discussion: One of the most dangerous and most difficult fire locations in a structure for a fire fighter is a below-grade area. Below-grade fires can include basements, cellars, and sub-cellars. A basement or cellar is defined as a section of a structure either partially or fully below grade. The difference between a basement and a cellar can be defined as a cellar is more than 50% below grade or ground level. A basement is less than 50% below grade. Another way to define a cellar and a basement is by use. If the room is unfinished, the term used is a cellar. If the room is finished, the room is called a basement. Regardless of the term, either requires some type of descent to reach. This can be interior steps and an exterior entrance [Smith 2002]. In this incident, the only access was through the Bilco® doors and steps into the basement (**See Photo 2**).

Recognizing a cellar or basement fire is essential to ensuring the proper strategy and tactical objectives are developed for the incident. These types of fires are low-frequency/high-risk events for several reasons. Cellar or basement fires may be difficult to initially detect; may be difficult to access; and requires adequate staffing for hoseline placement, operation, and ventilation; and fire fighters may be working over the fire. Additionally, the increased risk to fire fighters is due to:

- Limited entry and egress into a basement
- Working above the fire
- Weakened floor joists and rafters
- Being caught in the fire’s exhaust portion of the flow path
- Unknown fire loading
- Ventilation concerns
- Utility panels and meters plus connections
- Hanging wires
- Furniture and appliances

Key factors in recognizing a below-grade fire are:

- Fire or smoke venting from a cellar window, smoke pushing from the chimney (especially during warmer weather).
- Heavy smoke with no visible fire on the 1st floor.

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- Hot floorboards on the 1st floor or smoke showing from baseboard areas on the 1st floor. Floorboards may not be hot. Smoke from attic windows or louvered vents especially in older homes with balloon frame construction [Kerber et al. 2012; Madrzykowski and Kent 2011].

Basement fires in dwellings with balloon construction may extend to the attic via hidden voids. Units operating above the cellar must stretch enough hoseline to reach the upper floors. Intermediate floors must be checked for fire before a hoseline is committed to the top floor because floor construction can isolate the fire. Flooring systems and floor coverings are good insulators and may not transfer a significant amount of heat from a basement fire. Experiments have shown that post-flashover basement fires, even after starting to lose the structural integrity of the floor supports:

- May not generate high heat conditions on the floor above.
- May not provide clear information on the level of hazard to a thermal imager.
- May hold up to a strike from a tool during sounding but may not be able to carry the weight of a fire fighter, or fire fighters [Kerber et al. 2012; Madrzykowski and Kent 2011].

Standard operating procedures must consider numerous factors that affect fire-fighting operations. This will ensure essential strategic-, tactical-, and task-level functions are performed by the incident commander, division/group supervisors, company officers, and fire fighters. Additionally, this process compliments the defined knowledge, skills, abilities, competencies, and fireground experience to assist:

- The incident commander to plan and implement an effective strategy and incident action plan.
- Division/group supervisors to formulate and follow tactics.
- Company officers to successfully carry out assigned tasks.
- Fire fighters to effectively perform their duties and functions [FDNY 2013c].

The fire department's standard operating procedure on cellar or basement fires needs to include the following topics:

- Community risk assessment
- Scene size-up
- Building construction
- Strategy and tactics
- Use of a thermal imager
- Ventilation considerations
- Proper size and adequate hoselines

The strategy and tactics of an incident are dictated by the size-up, initial risk assessment, and situational report by the first arriving officer. The priority is to get a fire department unit to the rear of the structure on Side Charlie. However, unless an obvious life safety issue exists (e.g., visible victims requiring immediate assistance), interior fire-fighting operations should not commence until a report from Side Charlie is received. If physical barriers make the 360-degree size-up impractical for the 1st arriving officer, the size-up of Side Bravo, Side Charlie, and Side Delta may be delegated to another engine company on the 1st Alarm. Even if a 360-degree can be conducted, the 2nd due engine company

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or 3rd due engine company and the 2nd due truck company should be assigned to Side Charlie [Fire and Rescue Departments of Northern Virginia 2013].

Cellar or basement fires are one of the most challenging situations fire fighters encounter. As with all fires, a risk assessment and an occupant survivability profile should be conducted to evaluate what is at risk, lives or property. Fire departments should conduct a post incident analysis for significant incidents, especially cellar or below-grade fires. Also, fire departments should periodically update their community risk assessment program and standard operating procedures based on recommendations from post incident analysis reports.

At this incident, the fire department did not have a standard operating procedure for fighting basement fires. The fire in the basement was not identified until the fire fighter from Quint 25 fell into the basement.

Recommendation #6: Fire departments should ensure that a communication standard operating procedure is in place for dispatchers to support fireground operations and the incident commander.

Discussion: Effective fireground radio communication is an important tool to ensure fireground command and control as well as helping to enhance fire fighter safety and health. The radio system must be dependable, consistent, and functional to ensure that effective communications are maintained, especially during emergency incidents. Fire departments should have a “Communications” standard operating procedure (SOP) that outlines the communication procedures for fireground operations. This SOP should be periodically reviewed and updated. Fire departments should ensure that the Communication or Dispatch Center is part of this revision process. Another important aspect of this process is an effective education and training program for all members of the department and the dispatchers [Kunadharaju et al. 2010].

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety* provides basic requirements for fireground communications in Chapter 6, “Communications and Information Management” [NFPA 2014a]. The chapter addresses the key components for effective fireground communications, such as the requirements for a dispatch radio channel, a command radio channel, and a tactical radio channel; use of plain text for transmitting strategic modes of operation and situational reports; emergency traffic including Mayday; and telecommunicator (dispatcher) support [NFPA 2014a].

One of the consistent factors, defined in line-of-duty death investigation reports is the incident commander can be overwhelmed with fireground radio communications. This is especially true if the incident commander has to monitor the dispatch channel and the fireground tactical channel. Fire departments need to ensure that fireground radio communication systems are designed and operated to take this issue into account. Among the reasons an incident commander may miss messages include being engaged in face-to-face communications, operating the command board and tactical worksheet, reviewing or preparing incident documentation, ambient noise conditions, radios accidentally being

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turned down, radio failure, simultaneous transmissions on separate channels, or simply being distracted with other tasks [NFPA 2014a; Varone 2003].

There are several ways to ensure that the incident commander can effectively manage fireground communications. The best solution is to have a trained dispatcher monitoring the fireground radio channel. Dispatchers should meet the requirements of NFPA 1061, *Professional Qualifications for Public Safety Telecommunications Personnel* [NFPA 2014b]. The dispatcher is in a secure environment, isolated from fireground distractions and noise. The dispatcher should have access to playback technology with the ability to listen to hard-to-understand messages. The dispatcher should also have access to "identifier" information, which identifies the portable radio making the transmission. Like any other aspect of the fire service, all personnel need to be properly trained before being assigned to a critical task. In the world of fireground operations today, effective radio communications are critical, and the dispatcher is one of the most critical components in the radio communications systems. Proper training of a dispatcher involves more than teaching which buttons to push and how to figure out what companies to send where. Dispatchers need a thorough understanding of the incident management system, fireground strategy and tactics, and fire-fighting vernacular. Most important is to define the dispatcher's role during emergency operations with such responsibilities as fireground benchmarks, notifying the incident commander of lapsed time intervals for a personnel accountability report, emergency traffic, a Mayday, roll calls, or building evacuations. Dispatchers understand the critical role they play in the incident management system [NFPA 2014a; Varone 2003].

Another important function for the dispatcher is to communicate with the incident commander about critical incident benchmarks. One responsibility of the dispatcher is to ensure that a personnel accountability report is conducted every 10–15 minutes during the incident. The dispatcher should prompt the incident commander every 10–15 minutes to conduct a personnel accountability report. Other responsibilities are to ensure that the incident commander communicates critical fireground benchmarks during the incident, such as a complete scene size-up with declared strategy, water is on the fire, a primary search is completed with outcome, command is being transferred, a Mayday has occurred and a request has been made for additional tactical channels and emergency traffic, fire is knocked down, and fire is out. This is not an all-inclusive list, but an idea of critical fireground benchmarks [NFPA 2014a]. The job of dispatching should not be assigned to a new fire fighter or to a police dispatcher who does not have adequate training in fireground radio communications. Numerous line-of-duty death reports are of incidents in which the dispatcher had information that a fire fighter was in distress yet failed to act on that information [NFPA 2014b]. Effective communication involves a thorough understanding of the message. The sender (dispatcher) transmits a clear message and the receiver (incident commander) must acknowledge the transmission so the sender (dispatcher) knows that the transmission was understood. This process would work the same way if the incident commander transmits a message to the dispatcher (**See Diagram 9**).

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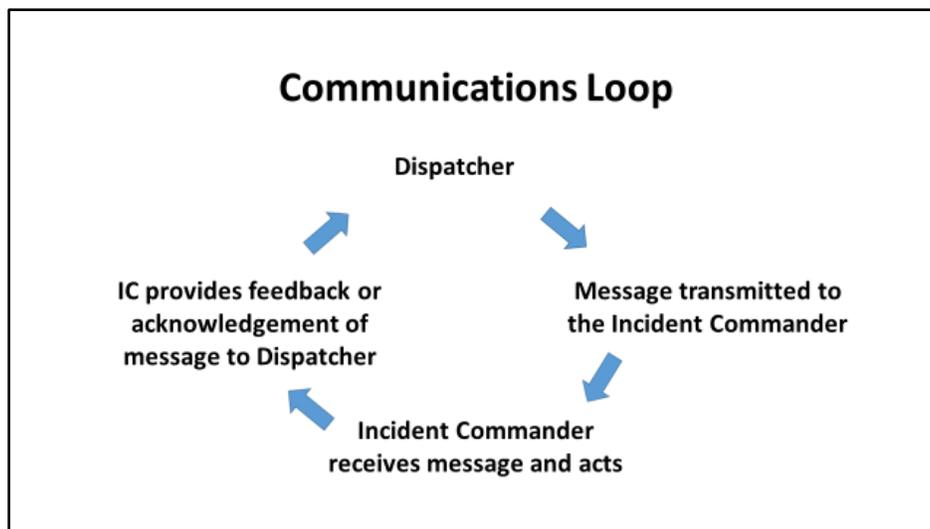


Diagram 9. Communications loop between the dispatcher and the incident commander.

Dispatching is not a job that should be left to just one person who may be called away from monitoring the fireground radio to field telephone calls or dispatch runs. Dispatchers who monitor a fireground radio channel must be able to put 100% of their concentration into listening for missed messages and providing support to resources on-scene. Ideally, one dispatcher should be assigned to each fireground channel in use [Varone 2003]. Many fire departments assign a tactical radio operator or dispatcher to the assigned fireground tactical channel. This dispatcher is assigned the incident until Command clears the tactical channel.

Another solution is to provide the incident commander with a staff assistant or staff aide. A battalion chief or district chief must monitor and comprehend radio traffic while enroute to the incident and then on-scene. Additionally, a battalion chief or district chief must address deployment issues, develop a strategy for the incident based upon communications from the first arriving resource, and develop an incident action plan for the incident. A staff assistant or staff aide can assist the battalion chief or district chief with processing information without distraction. Once on-scene, the staff assistant or staff aide can maintain fireground communications with the dispatcher. For fire departments that do not have a staff assistant or staff aide, another officer or fire fighter can be designated to function in this position [NFPA 2014a].

Every fire fighter and company officer should take responsibility to ensure their portable radio is turned on and on the correct channel. A company officer's responsibility is to ensure that all members of the crew comply with these requirements [IAFF 2010].

At this incident, the protocol for the county fire dispatch center (9Com) was to monitor the fire dispatch channel and not the fireground tactical channel. The Mayday was transmitted on the

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fireground tactical channel only. This prevented the fire dispatcher from sending an automatic response of resources to the incident scene per the fire department's *standard operating procedure SOP 1.10 - Radio System Procedures*. The information regarding law enforcement on-scene prior to their arrival was not communicated to the fire department. This and other information needs to be simulcast over both the dispatch channel and the assigned fireground tactical channel.

Recommendation #7: Fire departments should ensure that the incident commander uses a tactical worksheet during initial fireground operations and maintains the tactical worksheet throughout the incident.

Discussion: The tactical worksheet is a vital piece of equipment because it helps the incident commander organize the incident from the initial onset of the incident. The benefit of using a tactical worksheet is that critical information is documented and that it provides reminders, prompts, and a convenient workspace for tracking companies and apparatus. For fire departments that provide a staff assistant or incident command technician, the district chief or battalion chief has the ability of starting the tactical worksheet while responding to the incident. The incident commander has the ability to record vital information that may help them make future operational decisions. By documenting the assignments of division/group supervisors and division/group resources, the incident commander creates a visual reference of the overall fireground organization and deployment [NFPA 2014a].

The use of a tactical worksheet can assist the incident commander in tracking various task assignments on the fireground. It can be used along with preplan information and other relevant data to integrate information management, fireground operations, and decision-making. The tactical worksheet should record unit status and benchmark times and include a diagram of the fireground, occupancy information, activities checklist(s), and other relevant information. The tactical worksheet can also help the incident commander in continually conducting a situation evaluation and maintaining personnel accountability [NFPA 2014a].

The advantages of using a tactical worksheet are:

- Includes a location to quickly note individual assignments.
- Provides prompts for the incident commander, such as time, air management, and strategy.
- Provides tactical benchmarks, such as “primary search complete,” “fire under control,” and “loss stopped.”
- Facilitates consistent, organized information.
- Documents assignments and responsibilities.
- Expedites passing of command or support for the incident commander.
- Provides and maintains resource status [NFPA 2014a].

The tactical worksheet is also an excellent tool when the "passing of command" must occur. On the fireground, the officer taking over command can quickly check the worksheet and obtain a strong understanding of the initial deployment of resources, the need for additional apparatus and equipment, and the status of units in the staging area.

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The tactical worksheet is a vital resource because it helps the incident commander organize fireground operations. Also, the tactical worksheet provides reminders, prompts, and a convenient workspace for tracking companies and apparatus. It allows the incident commander to slow down during an incident (although the worksheet can be used for fires big and small, as well as EMS incidents, to help develop proficiency) and record vital information that may help make future operational decisions.

In order to effectively command and control an incident, fire departments should ensure that the incident commander be in or operates from a command vehicle. The command vehicle should include radio and communication capabilities, a tactical worksheet, and accountability board.

Recommendation #8: Fire departments should ensure the personnel accountability system is properly used to account for all resources assigned to an incident. The personnel accountability system should be managed by a dedicated accountability/resource status officer.

Discussion: A personnel accountability system is a system that readily identifies both the location and function of all members operating at an incident scene [NFPA 2013a, 2014a]. The philosophy of the personnel accountability system starts with the same principles of an incident management system—company unity and unity of command. Unity can be fulfilled initially and maintained throughout the incident by documenting the situation status and resource status on a tactical worksheet.

One of the most important functions of command safety is for the incident commander to initiate an accountability system that includes the functional and geographical assignments at the beginning of operations until the termination of the incident. It is very important for the first on-scene resource to initiate an accountability system. This initial system allows the passing or transfer of information to the next officer who assumes command upon arrival [NFPA 2014a].

A functional personnel accountability system requires the following:

- Development and implementation of a departmental SOP
- Necessary components and hardware
- Training all members on the operation of the system
- Strict enforcement during emergency incidents

Many different methods and tools can be used for resource accountability. Some examples are:

- Tactical worksheets
- Command boards
- Apparatus riding lists
- Company responding boards
- Electronic bar-coding systems
- Accountability tags or keys (e.g., PASSPORT System) [NFPA 2014a]

Resource accountability should be assigned to personnel who are responsible for maintaining the location and status of all assigned resources at an incident. As the incident escalates, resource status

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would be placed under the Planning Section. This function is separate from the role of the incident commander. The incident commander is responsible for the overall command and control of the incident. Due to the importance of responder safety, resource status should be assigned to a dedicated member as the size and complexity of the incident dictates. A number of positions could function in this role, including an incident command technician, staff assistant, chief officer, or other defined member. This position should be maintained throughout the incident preferably by the same individual to ensure consistency and effectiveness of operations.

As the incident escalates and tactical-level management components (e.g., divisions or groups) are assigned, the resource status officer (accountability officer) works with the division or group supervisors to maintain an on-going tracking and accountability of members [FIREScope 2012]. A properly initiated and enforced personnel accountability system enhances fire fighter safety and survival. It is vital that resources can be identified and located in a timely manner.

An important aspect of a personnel accountability system is the personnel accountability report (PAR). A PAR is an organized on-scene roll call in which each supervisor reports the status of their crew when requested by the incident commander [NFPA 2014a]. The PAR should be conducted every 10–15 minutes or when benchmarks are met.

In order for the personnel accountability system to properly function, the process should include a standard operating procedure that defines each function's responsibility in making this process successful on the fireground. Also a training component—both classroom and practical—should occur to ensure this process operates properly during emergency incidents.

At this incident, the fire department did not have a staff assistant for the battalion chief. The battalion chief utilizes a driver from a piece of apparatus or medic unit to function as the personnel accountability officer. The driver of Medic 22 started as the personnel accountability officer, but the function was abandoned when the collapse occurred. A personnel accountability report was not conducted until 0138 hours.

Recommendation #9: Fire departments need to incorporate the principles of Command Safety into the incident management system during the initial assumption of command. This ensures that the strategic-level safety responsibilities are being incorporated into the command functions throughout the incident.

Discussion: The purpose of command safety is to provide the incident commander with the necessary resources on how to use, follow, and incorporate safety into the incident management system at all incidents. Command safety is used as part of the eight functions of command developed by Fire Chief Alan V. Brunacini (Retired). The principles of command safety describe how the incident commander must use the regular, everyday command functions to complete the strategic-level safety responsibilities during incident operations. Using the command functions creates an effective way to ensure a close connection between incident safety and incident command.

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The eight functions of command are:

- Assumption/confirmation/positioning
- Situation evaluation
- Communications
- Deployment
- Strategy/incident action planning
- Organization
- Review/revision
- Transfer/continuation/termination [Brunacini 2002; NFPA 2014a].

A vital command function involves the incident commander using the initial scene size-up, consideration of critical factors (building type, occupancy, life safety, fire conditions, and available resources), the standard risk management plan, the forecast of incident conditions, and a standardized decision-making process. The choice of strategy is independent of location (inside or outside) as it relates to the hazard area or hazard zone. The strategy may change over the course of an incident, but only one of the two strategies can be in use at any one time [MABAS 2015].

An offensive strategy means that personnel are actively and directly attempting to correct the identified problem. This might mean that they are doing CPR on the pulseless patient, directing water streams into the burning structure, or trying to plug the leaking vessel. A defensive strategy is where the incident commander decides the best course of action is to contain the problem. Fire fighters might build containment around a leak or only put water on threatened exposures. Any change of strategy must be the result of deliberate defensible thought and must be communicated.

The two separate strategies create a simple, *understandable* plan that describes in primitive terms how close the emergency responders will get to the incident's hazards. The incident's overall strategic decision is based on the incident's critical factors weighed against the risk management plan (**See Diagram 10**). Declaring the incident strategy up front, as part of the initial radio report will:

- Announce to everybody the overall incident strategy.
- Eliminate any question on where fire fighters will be operating on the incident scene inside the structure [MABAS 2015].

Offensive and defensive strategies should not be combined.

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Diagram 10: This model conforms the decision-making process into a standard sequence. The incident commander identifies the incident’s significant critical factors and develops a risk management plan. The incident commander then bases the strategy and incident action plan on the evaluation of those factors. This leads to the tactical priorities for the incident *(Diagram courtesy of MABAS Division 201[MABAS 2015].)*

Once the overall incident strategy has been determined and the incident action plan developed, the incident commander should manage the completion of the tactical priorities for the chosen strategy. Each strategy has a different set of tactical priorities to complete. Tactical priorities provide the incident commander with a simple, short list of major categories that are designed to act as a practical guideline during the difficult initial stages of fireground planning. The incident action plan must be short and simple. A complicated incident action plan tends to break down during this critical time.

Generally, the incident commander tries to achieve the same basic objectives from one incident to the next. Tactical priorities offer a regular set of tools on which the incident commander can utilize for tactical activities in order to develop a standard approach to solving incident problems. With this standard approach, the incident commander can manage the basic work sequence at every incident, in the same manner.

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In this incident, the 1st arriving officer was the incident commander, but he never formally assumed command of the incident. Based upon his size-up and risk assessment, the officer of Quint 25 decided to operate in the fast-attack mode. This mode is applied when quick, immediate action can prevent life loss or injury. These situations require immediate action to stabilize the incident and require the company officer's direct involvement in the attack. In this mode, the company officer accompanies the crew to provide the appropriate level of supervision. Command may be passed to the next arriving officer, upon their arrival. Command shall not be passed to an officer who is not on-scene. Where fast intervention is critical, use of a portable radio will permit the company officer's involvement in the attack without neglecting incident commander's responsibilities. The fast-attack mode can only be used for a rescue attempt or when 2-in and 2-out is established. The fast-attack mode should not last more than a few minutes.

Dispatch centers should contact the incident commander every 10–15 minutes on the assigned fireground tactical channel with elapsed-time reminders. These 10–15 minute notifications reminders serve as cues for the incident commander to re-evaluate conditions, restate the current strategy, and consider the length of time fire fighters have been operating in the hazard zone. The incident commander develops the strategy and the incident action plan based on the initial size-up of the incident's critical factors. These critical factors are very dynamic. Incident operations are either getting better or they are getting worse, but they never stay the same. The incident conditions drive the strategy, the incident action plan, and the risk-management plan [MABAS 2015; NFPA 2014a].

When a change occurs in the strategic mode—going from offensive mode to defensive mode—the incident commander needs to ensure that the accountability system or resource status accounts for all assigned resources. Assigned resources are fire fighters who have been entered into the accountability system and assigned work tasks on an incident. The system is designed to ensure that fire fighters do not become lost or missing in the hazard zone. An integral part of the personnel accountability system is to make sure that all assigned resources working in the hazard zone are initially accounted for based upon the system that a fire department uses for accountability (e.g., PASSPORT System). Periodically throughout the incident, a personnel accountability report is conducted to ensure that all assigned resources are accounted for by the accountability officer.

The accountability officer should request a personnel accountability report from each division or group supervisor whenever there is a change in conditions that could create an unsafe operation such as an “emergency traffic” announcement to “all companies evacuate the building.” When a tactical-level management component supervisor is requested to conduct a personnel accountability report, this supervisor is responsible for reporting on the accountability of all companies or members working within their area of responsibility [NFPA 2014a]. With a strategic mode change, a personnel accountability report should occur to ensure that all assigned resources are accounted for and are out of the hazard zone. Defensive operations should not start until the personnel accountability report is completed and all members are accounted for by the accountability officer.

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Following this incident, the fire department should address command safety issues as part of their recovery process. The eight functions of command serve as the foundation for addressing command safety issues. The incident commander must follow each of these functions in order without skipping or missing any function. Automatically connecting and integrating safety with command becomes a simple and essential way that the incident management system protects assigned resources at an incident. These functions serve as a practical performance foundation for how the incident commander completes their responsibility as the strategic-level incident manager and the overall incident safety manager [Brunacini 2002].

Recommendation #10: Fire departments should provide a checklist for the incident commander regarding procedures in the event of Mayday.

Discussion: When a Mayday is transmitted for whatever reason, the incident commander has a very narrow window of opportunity to locate the lost, trapped, or injured member(s). The incident commander must restructure the strategy and incident action plan (tactics) to include a priority rescue [NFPA 2014a].

Some departments have adopted the term “LUNAR”—location, unit assigned, name, assistance needed, and resources needed—to gain additional information in identifying a fire fighter who is in trouble and in need of assistance. The incident commander, division/group supervisors, company officers, and fire fighters need to understand the seriousness of the situation. It is important to have the available resources on-scene and to have a plan established prior to the Mayday [Brunacini and Brunacini 2004; NFPA 2014a].

A checklist is provided in “**Appendix Three: Incident Commander’s Tactical Worksheet for Mayday.**” This checklist can assist the incident commander to ensure the necessary steps are taken to clear the Mayday as quickly and safely possible. This checklist serves as a guide and can be tailored to any fire department’s Mayday procedures. The intent of the checklist is to provide the incident commander with the essential actions to be taken in the event of Mayday. This format allows the incident commander to follow a structured worksheet. This process is too important to operate from memory and risk missing a vital step that could jeopardize the outcome of the rescue of a fire fighter who is missing, trapped, or injured.

At this incident, when the Mayday occurred, the incident commander contacted 9Com to request additional resources. The incident commander then conducted a personnel accountability report to determine if any other members were lost or missing. The intent of this Mayday worksheet, like the tactical worksheet, is to assist the incident commander during a very difficult and stressful time on the fireground.

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Recommendation #11: Fire departments should ensure that a safety officer is appointed and utilized at working structure fires.

Discussion: With the advent of the Incident Command System, the goal is to ensure that the incident commander is responsible for the safety and welfare of all members and other first responders who are on-scene at an incident [NIMSC 2008].

The following items shall be considered regarding the appointment of a safety officer:

- The safety officer must be assigned as early in the incident as possible.
- The safety officer reports directly to the incident commander.
- The safety officer reconns the incident to identify existing or potential hazards or risks and informs the incident commander.
- The safety officer recommends to the incident commander any changes to the incident action plan as a result of the ongoing surveys.
- At an emergency incident where the safety officer judges activities unsafe or an imminent hazard, the safety officer shall have the authority to alter, suspend, or terminate those activities. The safety officer shall immediately inform the incident commander of any actions taken to correct imminent hazards at the emergency scene.
- At an emergency incident where a safety officer identifies unsafe conditions, operations, or hazards that do not present an imminent danger, the safety officer should take appropriate action through the incident commander to mitigate or eliminate the unsafe condition, operations, or hazard at the incident scene.
- When operating in forward or otherwise hazardous positions, the safety officer must be attired in appropriate personal protective equipment—including self-contained breathing apparatus and radio communication equipment—and be accompanied by another responder [NFPA 2014a; NIOSH 2012b].

Upon arrival at the incident, the designated safety officer should meet with the incident commander to confirm the safety officer assignment and to be integrated into the personnel accountability system.

Upon confirmation, the safety officer should obtain the following information:

- Overall situation status and resource status.
- Incident action plan.
- Identification of known hazards and concerns plus the establishment of control zones especially collapse zone(s).
- Status and location of rapid intervention crews.

Additionally, the safety officer should:

- Ensure the establishment of the rehabilitation group.
- Confirm that radio communication channels have been established (command channel, tactical channels) [NFPA 2014a, 2015a; NIMSC 2008].

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Based upon the size and complexity of the incident, such as a commercial structure with accessibility problems, the incident commander should consider the appointment of assistant safety officers. Types of incidents that might require expansion of the safety officer role include the following:

- Incidents covering a large geographical area (e.g., commercial structure fire) that include numerous divisions or groups.
- Incidents where significant acute or chronic responder health concerns require coordination and input to the Planning Section (responsible for accounting for the organizational structure, availability of resources, deployment of resources, and the situation status reports).
- Incidents requiring interface with local, state, federal, or other health and safety representatives.
- Multi-agency incidents where Unified Command is established.
- Incidents where Area Command is established [FIREScope 2012; NFPA 2015a; NIMSC 2008; NIOSH 2012b].

Assistant safety officers assigned to branches, divisions, or groups can be addressed according to their area of responsibility. For example, an assistant safety officer assigned to Alpha Division can be addressed as "Alpha Division assistant safety officer." The assistant safety officers assigned to divisions or groups report to and follow direction from the safety officer who is part of the command staff. The assistant safety officer works with the supervisory person in the assigned division or group to ensure safety conditions are being met [FIREScope 2012; NFPA 2015a; NIMSC 2008; NIOSH 2012c].

At this incident, the incident commander requested the response of the safety officer at 0120 hours. The shift commander was off duty. He heard the Mayday and responded to the scene. He arrived as the fire fighter from Quint 25 was prepared for transport in Medic 22. Upon arrival, he functioned as the safety officer.

Recommendation #12: Fire departments need to ensure that members who function as acting officers have the necessary training and competencies.

Discussion: NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, Chapter 5, "Training, Education and Professional Development," states in paragraph 5.1.9, "As a duty function, members shall be responsible to maintain proficiency in their skills and knowledge and to avail themselves of the professional development provided to members through department training and education programs" [NFPA 2013a]. Fire departments should develop and implement a written training program that ensures members are trained and competencies are maintained in order to effectively, efficiently, and safely execute all responsibilities [NFPA 2000]. This is consistent with the organizational statement for the fire department, which establishes the existence of the fire department, the services the fire department is authorized and expected to perform, and the organizational structure.

An important component of the training program is to ensure that fire fighters and fire officers who function in acting positions receive the proper education, training, and competencies. Fire departments need to prepare fire fighters and fire officers through the same education and training programs used

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for members who are promoted to these positions. NFPA 1021, *Standard for Fire Officer Professional Qualifications* serves as the foundation to ensure that fire fighters and fire officers possess the knowledge, skills, and abilities to perform in various positions as fire officers [NFPA 2014c]. The intent of this standard is to provide clear and concise job performance requirements, which are used for evaluation and certification [NFPA 2014c].

One of the best methods for ensuring the competency of members functioning in acting positions is the use of a training and education program coupled with position task book. This system is one in which the primary criteria for qualification is individual performance as observed by an evaluator using approved standards. The position task books are the primary tool for observing and evaluating performance. The position task book contain the “approved standards” in the form of tasks, which have been established by experts from various fire agencies and organizations. After members complete the necessary education and training programs as defined and provided by the fire department, a member is given a task book to be completed. The task book lists the performance requirements (tasks) for a specific position in a format that allows the member to be evaluated against written procedures and policies. Successful completion of all tasks, as observed and recorded by evaluators, will result in a recommendation that member be issued certification [SMFD 2006].

Position task books are designed with a specific focus on a particular position. Therefore, they contain a more narrow set of skills and knowledge than may be necessary to be successful in that position. As a result, each position task book includes a presumption that the member has the requisite knowledge of the position subordinate to the position task book being initiated. For example, the member who initiates a Lieutenant Task Book must have the knowledge, skills, and abilities contained in the Fire Fighter Position Task Book in order for successful completion of Lieutenant Position tasks [SMFD 2006].

In order for a fire fighter or fire officer to become certified at a specific level, the member should successfully complete the job performance requirements in sequence. Before a job performance evaluation can be taken, all requisite knowledge and skills must be satisfied. The job performance requirements covered in the position task book should meet or exceed all NFPA published standards for the particular certification level at the time of completion.

At this incident, the fire department did not have a program in place to certify fire fighters and fire officers as acting officers. Fire fighters and fire officers who are detailed to acting positions must be adequately prepared to function in these various positions. Fire departments should develop a training and education program, coupled with the position task book program, to ensure fire fighters and fire officers have the necessary knowledge, skills, abilities, and competencies to function as acting officers.

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Recommendation #13: Fire departments should ensure that all members engaged in emergency operations receive annual proficiency training and evaluation on fireground operations.

Discussion: In order to ensure for the proficiency and competency of fire department members, the fire department should conduct annual skills evaluations to verify minimum professional qualifications. This annual evaluation should address the qualifications specific to the member's assignment and job description. This process should be structured in a manner where skills are evaluated on a recurring cycle with the goal of preventing the degradation of skills and abilities and ensuring for the safety of members. Proficiency evaluation and training provides an opportunity to ensure that all fire officers and fire fighters are competent in the knowledge, skills, and abilities of fireground operations. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program* requires a fire department to establish and maintain a training, education, and professional development program with the goal of preventing occupational deaths, injuries, and illnesses. This ensures members are trained and competencies are maintained in order to effectively, efficiently, and safely execute all responsibilities [NFPA 2013a].

This process is consistent with the organizational statement that establishes the existence of the fire department. The services the fire department is authorized and expected to perform, the organizational structure, and the job descriptions and functions of fire department members are essential in defining a structured training program [NFPA 2013a]. The primary goal of all training, education, and professional development programs is the reduction of occupational injuries, illnesses, and fatalities. As members progress through various job duties and responsibilities, the department should ensure the introduction of necessary knowledge, skills, and abilities to members who are new in their job titles as well as ongoing development of existing skills [NFPA 2013a].

NFPA 1410, *Standard on Training for Emergency Scene Operations* defines basic evolutions that can be adapted to local conditions and serves as a method for the evaluation of minimum acceptable performance during initial fireground operations [NFPA 2015d]. Proficiency training for fireground operations and emergency incidents should be conducted annually. This training should include, but not be limited to, scene size-up, situational awareness, use of the incident management system, personnel accountability system, strategy and tactics, search and rescue, hoseline operations, ladder operations, ventilation, thermal imaging cameras, fireground communications, use of rapid intervention teams, and Mayday operations.

At the time of this incident, the department was not conducting annual proficiency training for fireground operations.

Recommendation #14: Fire departments should review the standard operating procedure on the use and operations of thermal imagers.

Discussion: Another valuable tool that enhances situational awareness is the thermal imager. The thermal imager provides a technology with potential to enhance fire fighter safety and improve the

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ability to perform tasks such as size-up, search and rescue, fire attack, and ventilation. Thermal imagers should be used in a timely manner. Fire fighters should be properly trained in the use of a thermal imager and be aware of their limitations [NFPA 2015c; NIOSH 2009b; SAFE-IR 2013].

The application of thermal imaging on the fireground may help fire departments accomplish their primary mission, which is saving lives. This mission can be accomplished in many ways. First and foremost, in near-zero visibility conditions, primary searches may be completed quickly and with an added degree of safety. The use of thermal imaging technology may also be invaluable when fire fighters are confronted with larger floor areas or unusual floor plans [SAFE-IR 2013]. Searching for trapped civilians is part of a fire department's primary mission. Thermal imagers may provide a method for fire fighters to track and locate other fire fighters in very-limited-visibility conditions. This process can enhance fire fighter accountability before an issue arises [SAFE-IR 2013].

Thermal imagers are used in a wide variety of thermal environments. For example, a fire fighter might encounter high temperatures, open flames, pools and sprays of water, and thick smoke; therefore, it is important that thermal imagers are capable of seeing in these obstructive conditions with a minimum amount of interference from the surrounding environment. Fire service thermal imagers are generally designed to detect radiant thermal energy in the 8 μm –14 μm spectral range. This energy is radiated from solid surfaces, particulates, and some gases. A characteristic of the radiating surfaces and gases called *emissivity* affects how the thermal radiation intensity relates to the actual temperature in a way that can make the surface or gas appear to have a temperature that is different from reality. A surface or gas having an emissivity of 1 is said to be a *blackbody*, meaning that it absorbs and re-emits all energy incident upon it and thus is representative of its actual temperature. A surface or gas having an emissivity of 0 reflects all energy, making the surface or gas appear colder than it actually is. In general, surfaces that are flat black in color and somewhat rough in texture tend to have high emissivities, and surfaces that are shiny and smooth tend to have low emissivities. Most thermal imagers are designed to use a constant emissivity value of 0.95 to convert the radiant energy signal to a temperature value. The further an object's emissivity is from 0.95, the less accurate that object's surface temperature will appear to be. The term *apparent temperature* is used to account for temperature deviations caused by differences in emissivity [NFPA 2015c].

Thermal imagers typically sense energy radiated from a surface of a solid. If the solid object is a good insulating material such as a wood floor or an insulated wall or ceiling, the apparent temperature might not be representative of the thermal hazard on the other side of the solid object [NFPA 2015c].

In other situations, the fire environment could change, resulting in rapidly increasing smoke temperatures. With a thermal imager looking through smoke at a wall, the apparent temperature could be significantly less than the actual temperature of the gas. In other words, a thermal imager is an unreliable thermometer. It should be used to look for thermal contrasts, movement, and heat signatures. It should not be relied on to determine the temperature of a compartment, through either a digital readout or a color scale [NFPA 2015c].

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While the use of a thermal imager is important, research by Underwriters Laboratories has shown that there are significant limitations in the ability of these devices to detect temperature differences behind structural materials, such as the exterior finish of a building or outside compartment linings (i.e., walls, ceilings, and floors) [NIOSH 2009b]. The most common misconception about temperature measurement is that it estimates air temperatures. Thermal imagers do not read air temperature. Thermal imagers read surface temperature. Thermal imagers operate solely based on differences in surface temperatures. Although occasionally a thermal imager may show superheated or cryogenic gases, in general, thermal imagers do not "see" or measure gases. Fire fighters should not be lulled into a mistaken sense of security because the temperature measurement on the thermal imager seems relatively low or has not reached its scale maximum.

At a structure fire, the thermal imager may help identify the location of the fire or the extent of fire involvement prior to fire fighters being deployed into a structure. Knowing the location of the fire may help fire fighters determine the best approach to the fire. The thermal imager may provide additional information for a crew(s) making the fire attack that they would not previously have had due to poor visibility and building construction. Using this information, fire fighters may be able to locate the fire more quickly and should also ensure that the water application is effective. From a ventilation perspective, fire fighters can use the thermal imager to identify areas of heat accumulation, possible ventilation points, and significant building construction features. This helps ensure proper and effective ventilation that successfully removes smoke and heat from a building [SAFE-IR 2013].

At this incident, Engine 24A used the thermal imager to check the basement after the collapse while operating from the foyer. The thermal imager "whited" out when pointed at the basement. A thermal imager was not used during any other fireground operations.

Recommendation #15: Fire departments should ensure adequate incident scene rehabilitation is established in accordance with NFPA 1584, Standard on the Rehabilitation Process for Members during Emergency Operations and Training Exercises.

Discussion: NFPA 1584, *Standard on the Rehabilitation Process for Members during Emergency Operations and Training Exercises* establishes the minimum criteria for developing and implementing a rehabilitation process for fire department members at incident scene operations and training exercises while operating within an incident management system [NFPA 2015b]. The physical and mental condition of personnel should be monitored as part of the overall assessment. This ensures a fire fighter's health does not deteriorate to the point it affects the safety of other fire fighters or endangers the safety and integrity of the operation. An incident commander should consider the circumstances of each incident and make suitable provisions for rest and rehabilitation for personnel. This process should include medical evaluation and treatment, food and fluid replenishment, and rest and relief from extreme climatic conditions.

NFPA 1584 states that an incident commander should establish rehabilitation operations when emergency operations pose a safety or health risk to fire fighters and other responders. Rehabilitation

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operations should be provided in accordance with fire department SOPs, NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program* and NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety* [NFPA 2013a, 2014a, 2015b].

Incident scene rehabilitation (“Rehab”) is a term often used for the care given to fire fighters and other responders while performing their duties at an emergency scene. When the size of the operation or geographic barriers limit member’s access to the rehabilitation area, the incident commander should establish more than one rehabilitation area. The site should be a sufficient distance from the effects of the operation where members can safely remove their personal protective equipment and can be afforded physical and mental rest [USFA 2008]. Once “Rehab” area(s) have been established, this information must be communicated over the radio so all members know the location of “Rehab” or know where to report when assigned to “Rehab.”

Several considerations for rehabilitation sites are as follows:

- Should be in a location that will provide physical rest by allowing the body to recuperate from the demands and hazards of the emergency or training evolution.
- Should be far enough away from the scene that personnel may safely remove their turnout gear and SCBA and be afforded physical and mental rest from the stress and pressure of the emergency or training evolution. Provisions should be available to have SCBA cylinders refilled.
- Should provide suitable protection from the prevailing environmental conditions. During hot weather it should be in a cool, shaded area, and during cold weather it should be in a warm, dry area.
- Should enable personnel to be free of exhaust fumes and noise from apparatus, vehicles, or equipment, including those involved in the rehabilitation group operations.
- Should be large enough to accommodate multiple crews based on the size of the incident.
- Should be easily accessible by emergency medical service units.
- Should allow prompt re-entry back into the emergency operation upon complete recuperation.
- Crews assigned to rehab will be instructed to turn portable radios off and/or have radio and thermal imager portable batteries recharged or exchanged [USFA 2008] (**See Diagram 11**).

The Rehab Group Supervisor should secure all necessary resources required to adequately staff and supply the rehabilitation area. The supplies should include the following items:

- Fluids: water, activity beverage, oral electrolyte solutions, and ice
- Food: soup, broth, or stew in hot/cold cups
- Medical devices: blood pressure cuffs, stethoscopes, oxygen administration devices, cardiac monitors, intravenous solutions, and thermometers
- Other: awnings, fans, tarps, fans, heaters, dry clothing, extra equipment, floodlights, blankets and towels, traffic cones, and fire line tape (to identify the entrance and exit of the rehabilitation area)
- Hygiene facilities to decontaminate all exposed skin surfaces
- Restroom facilities [USFA 2008].

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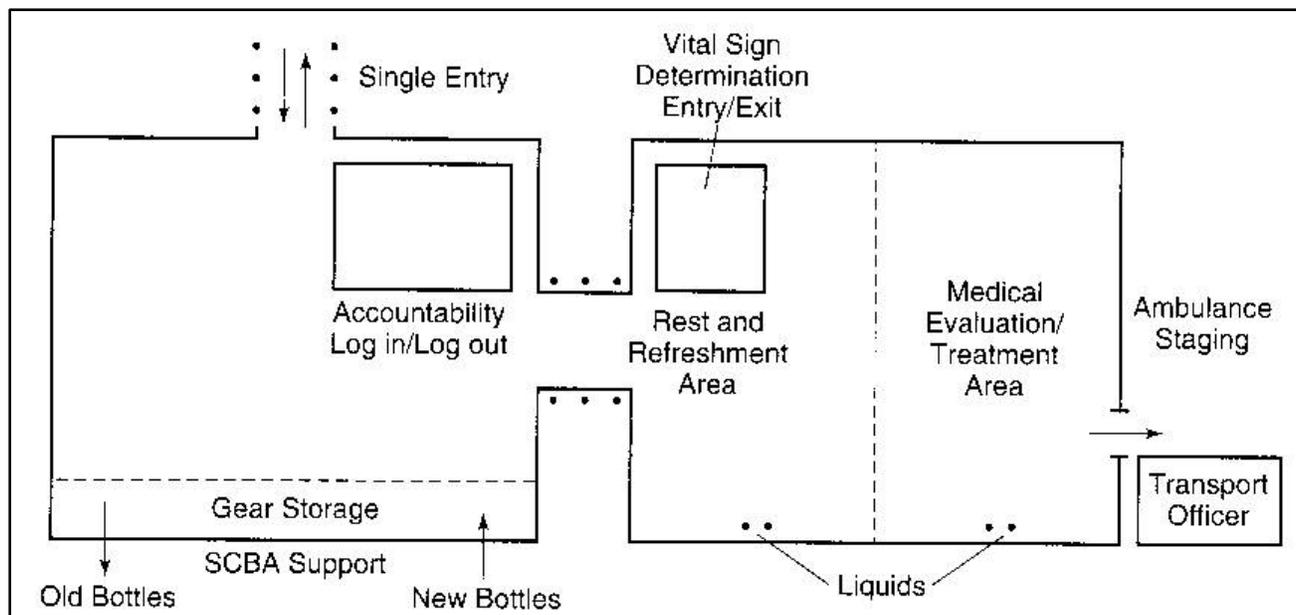


Diagram 11. An example of how a “Rehab” area can be organized. There are many ways to establish an effective “Rehab” area.

At this incident, no formal rehab process was established. It is essential at any incident to have rehab established. At this incident, the weather conditions required the ability to get fire fighters out of the environment, provide medical monitoring, and provide rest. Add the mental stress of this incident; this supports the need for a formal rehab process during fireground operations that would continue into the investigation phase.

Recommendation #16: Fire departments should consider upgrading SCBA to the current edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*.

Discussion: Fire departments should develop a plan for the replacement or upgrades to their SCBA for two reasons: when SCBA reaches the end of its service life and new requirements and technology improvements are made to NFPA 1981.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services* underwent significant revisions in the 2013 edition. Key revisions included a new radiant heat panel test for the facepiece and increased heat and flame requirements for the SCBA harness and components [NFPA 2013b].

Other significant improvements to the 2013 edition of NFPA 1981 included testing for emergency breathing safety systems (EBSS) or buddy breather connections, enhanced communication testing

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(electronic and mechanical), and additional testing for electronic accessories such as integrated PASS alarms and other electronic components. A significant change was in the end-of-service-time indicator (EOSTI) that increased the emergency reserve air from 25% +/- 2% to 33% to give fire fighters more emergency reserve air [NFPA 2013b].

Additionally, with each new SCBA standard, most manufacturers offer upgrade kits to existing SCBA to take advantage of some of these benefits.

The integrated PASS devices on SCBA were significantly improved in the 2007 edition of NFPA 1982, *Standard on Personal Alert Safety System (PASS)*, which included enhanced heat and moisture protection and sound levels [NFPA 2013c]. Additionally, some of the changes in the 2007 edition of NFPA 1982 include the following:

- New testing requirement where the PASS is exposed to 350°F for 15 minutes and then submerged in 1.5 meters (4.9 feet) of water, also for 15 minutes, for each of six cycles. The PASS is then examined to determine no water ingress.
- All PASS signals must function properly, and electronic data logging functions must operate properly. Following this, the PASS is re-immersed in the test water for an additional 5 minutes with the power source compartment(s) open.
- After 5 minutes, the PASS is removed from the water and wiped dry, and then the electronics compartment is opened and examined to determine no water ingress.
- Revised high-temperature resistance requirements, added new high-temperature functional requirements, and testing procedures where the PASS is mounted in a circulating hot-air oven at 500°F for 5 minutes.
- The PASS alarm signal must function at or above the required 95-dBA sound level, electronic data logging functions must operate properly, and no part of the PASS can show evidence of melting, dripping, or igniting.
- New tumble-vibration requirements and testing in which the PASS is "tumbled" in a rotating drum for 3 hours. The PASS alarm signal must function at the required 95-dBA sound level, and electronic data logging functions must operate properly.
- New "muffling" of the alarm signal requirements and testing in which the PASS is mounted on a test subject and evaluated in five positions (face down with arms extended, supine left, supine right, fetal right with knees drawn to chest, fetal left with knees drawn to chest), and the alarm signal must function at or above the required 95-dBA sound level at 3 meters.
- Data-logging (time stamping the power on, pre-alarm, alarm, and reset functions) is to be a new requirement for all PASS devices in the 2013 edition of NFPA 1982 [NFPA 2013c].

Fire departments should contact their PASS device manufacturers and ask if there are any reported problems with the devices and what upgrades they may be offering, if any, that can be made to allow current devices to meet the most current edition of NFPA 1982.

The SCBA involved in this incident was a Survivair Panther 30-minute, 4500 psi with NIOSH Approval Number TC-SU-5134-310, certified to 2002 edition of NFPA 1981, *Standard Open-Circuit*

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Self-Contained Breathing Apparatus (SCBA) for Emergency Services. This SCBA was evaluated and tested by the National Personal Protective Testing Laboratory at the NIOSH facility in Morgantown, West Virginia. The SCBA passed all NIOSH certification tests and the NFPA airflow performance test. This SCBA was equipped with a heads-up-display (HUD) mounted on the second-stage regulator.

The NIOSH investigation team believes fire departments should consider upgrading SCBA to the latest edition of NFPA 1981 based upon the significant improvements including the heat and flame tests [NFPA 2013b].

References

Brannigan F, Corbett G [2007]. *Brannigan's building construction for the fire service*. 4th edition. Quincy, MA: National Fire Protection Association.

Brunacini AV [2002]. *Fire command*. Quincy, MA: National Fire Protection Association.

Brunacini AV, Brunacini N [2004]. *Command safety*. Phoenix, AZ: Across the Street Publications.

Fire and Rescue Departments of Northern Virginia [2013]. *Engine company operations*. 2nd ed. Fairfax, VA: Fire and Rescue Departments of Northern Virginia, Firefighting and Emergency Operations Manual, <http://www.fairfaxcounty.gov/fr/>.

FDNY [2009]. *Taxpayer fires*. Firefighting Procedures Vol. 1. June 2009; New York, NY: Fire Department of New York, <http://www1.nyc.gov/site/fdny/index.page>.

FDNY [2013a]. Wind impacted fires in fireproof multiple dwellings, Addendum 3. In: Firefighting procedures. Vol. 1. New York, NY: Fire Department of New York, <http://www1.nyc.gov/site/fdny/index.page>.

FDNY [2013b]. Training bulletin, *search*. New York, NY: Fire Department of New York, October 17, <http://www1.nyc.gov/site/fdny/index.page>.

FDNY [2013c]. Private dwellings. *Engine company operations*. New York, NY: Fire Department of New York, December 7, <http://www1.nyc.gov/site/fdny/index.page>

FIRESCOPE [2012]. Field operations guide. Riverside, CA: FIRESCOPE, ICS 420-1, <http://firescope.org/>.

IAFF [2010]. IAFF Fire Ground Survival Training Program. Washington, DC: International Association of Fire Fighters, <http://www.iaff.org/HS/FGS/FGSIndex.htm>.

ISFSI [2013]. International Society of Fire Service Instructors position statement—*fire dynamic research in tactical operations*. Press release, October 30, <http://isfsi.org/>.

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

IFSTA [2013]. *Essentials of Fire Fighting*. 6th ed. Stillwater, OK, Fire Protection Publications, International Fire Service Training Association,

Kerber S, Madrzykowski D, Dalton J, Backstrom B [2012] Improving fire safety by understanding the fire performance of engineered floor systems and providing the fire service with information with tactical decision making. Northbrook, IL: Underwriters Laboratories, <http://www.globalfiresearch.com/reports/research/improving-fire-safety-by-understanding-the-fire-performance-of-engineered-floor-systems-and-providing-the-fire-service-with-information-for-tactical-decision-making>.

Kunadharaju K, Smith TD, DeJoy DM [2010]. *Line-of-duty deaths among U.S. firefighters: an analysis of fatality investigations*. Athens, GA: University of Georgia, College of Public Health, Workplace Health Group, <https://www.ncbi.nlm.nih.gov/pubmed/21376916>.

Layman L [1953]. *Firefighting tactics*. Boston, MA: National Fire Protection Association.

MABAS [2015]. MABAS Division 201, Operations manual. Mishawaka, IN: Mutual Aid Box Alarm System, <http://pennfire.org/mabas>.

Madrzykowski D, Kerber S [2009]. *Fire-fighting tactics under wind driven conditions: laboratory experiments*. Gaithersburg, MD: National Institute of Standards and Technology, NIST Technical Note 1618; <http://www.fire.nist.gov/bfrlpubs/firecurr/key/key856.html>.

Madrzykowski D, Kent J [2011]. *Examination of the thermal conditions of a wood floor assembly above a compartment fire*. Gaithersburg, MD: National Institute of Standards and Technology, NIST Technical Note 1709.

Modern Fire Behavior [2014]. *S.L.I.C.E. – R.S.*, <http://modernfirebehavior.com/s-l-i-c-e-r-s/>.

NFPA [2000]. NFPA 1201, *Standard for developing fire protection services for the public*. Quincy, MA: National Fire Protection Association.

NFPA [2013a]. NFPA 1500, *Standard on fire department occupational safety and health program*. Quincy, MA: National Fire Protection Association.

NFPA [2013b]. NFPA 1981, *Standard on open-circuit self-contained breathing apparatus (SCBA) for emergency services*. Quincy, MA: National Fire Protection Association.

NFPA [2013c]. NFPA 1982, *Standard on personal alert safety systems*. Quincy, MA: National Fire Protection Association.

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

NFPA [2014a]. NFPA 1561, *Standard on emergency services incident management system and command safety*. Quincy, MA: National Fire Protection Association.

NFPA. [2014b]. NFPA 1061, *Professional qualifications for public safety telecommunications personnel*. Quincy, MA: National Fire Protection Association.

NFPA. [2014c]. NFPA 1021, *Standard for fire officer professional qualification*. National Fire Protection Association.

NFPA [2015a]. NFPA 1521, *Standard for fire department safety officer professional qualifications*. Quincy, MA: National Fire Protection Association.

NFPA [2015b]. NFPA 1584, *Standard on the rehabilitation process for members during emergency operations and training exercises*. Quincy, MA: National Fire Protection Association.

NFPA [2015c]. NFPA 1408, *Standard for training fire service personnel in the operation, care, use, and maintenance of thermal imagers*. Quincy, MA: National Fire Protection Association.

NFPA [2015d]. NFPA 1410, *Standard on training for emergency scene operations*. Quincy, MA: National Fire Protection Association.

NIMSC [2008]. National Incident Management System Consortium *Incident Command System (ICS) model procedures guide for incidents involving structural fire-fighting, high-rise, multi-casualty, highway, and managing large-scale incidents using NIMS ICS, Book 1*. Stillwater OK: Fire Protection Publications, Oklahoma State University, <http://nimsc.org/>.

NIOSH [2009a]. *Nine career fire fighters die in rapid fire progression at commercial furniture showroom—South Carolina*. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2007-18, <http://www.cdc.gov/niosh/fire/pdfs/face200718.pdf>.

NIOSH [2009b]. *Workplace solutions: preventing deaths and injuries of fire fighters working above fire-damaged floors*. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2009-114, <http://www.cdc.gov/niosh/docs/wp-solutions/2009-114/default.html>.

NIOSH [2012a]. *Volunteer fire fighter caught in a rapid-fire event during unprotected search, dies after facepiece lens melts—Maryland*. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2011-02, <http://www.cdc.gov/niosh/fire/pdfs/face201118.pdf>.

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

NIOSH [2012b]. *Volunteer lieutenant killed and two fire fighters injured following bowstring roof collapse at theatre fire—Wisconsin*. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2012-08, <http://www.cdc.gov/niosh/fire/pdfs/face201208.pdf>.

NIOSH [2012c]. *A career captain dies and 9 fire fighters injured in a multistory medical building fire—North Carolina*. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2011-18, <http://www.cdc.gov/niosh/fire/reports/face201118.html>.

NIOSH [2013a]. *Career fire fighter dies during fire-fighting operations at a multi-family residential structure fire—Massachusetts*. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2011-31, <https://www.cdc.gov/niosh/fire/pdfs/face201131.pdf>.

NIOSH [2013b]. *Career captain sustains injuries at a 2½ story apartment fire then dies at hospital—Illinois*. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2012-28, <http://www.cdc.gov/niosh/fire/pdfs/face201228.pdf>.

NIST [2013]. Report on high-rise fireground field experiments. By Averill JD, Moore-Merrell L, Ranellone Jr. RT, Weinschenk CG, Taylor N, Goldstein R, Santos R, Wissoker D, Notarianni K, Butler KM. Gaithersburg, MD: National Institute of Standards and Technology, <https://www.nist.gov/>.

SMFD [2006]. *Task book for the position of captain*, Mather, CA: Sacramento Metropolitan Fire District, <http://www.metrofire.ca.gov/>.

SAFE-IR [2013]. Thermal imaging training for the fire service. New York, NY: SAFE-IR, Inc., <http://www.safe-ir.com/index.php/about-the-thermal-imager>.

Smith JP [2002]. *Strategic and tactical considerations on the fireground*. Upper Saddle River, NJ: Prentice Hall.

TSFRS [2013]. *Initial fireground assessment standard operating procedure, Section 3: Response to Alarms, Subsection 3.00.01*. West Lawn, PA: Township of Spring Fire & Rescue Services, <http://www.tsfrs.com/>.

USFA [2008]. *Emergency incident rehabilitation manual for firefighters and other emergency responders*. Washington, DC: U.S. Department of Homeland Security, U.S. Fire Administration, https://www.usfa.fema.gov/downloads/pdf/publications/fa_314.pdf.

Fire Fighter Falls Through Floor and Dies at Residential Structure Fire—Ohio

Varone JC [2003]. Firefighter safety and radio communication. *Fire Engineering* 156(3), <http://www.fireengineering.com/articles/print/volume-156/issue-3/features/firefighter-safety-and-radio-communication.html>.

Weather Underground [2015]. Weather history for KHAO, Monday, December 28. Atlanta, GA: The Weather Channel Interactive, Inc., https://www.wunderground.com/history/airport/KHAO/2015/12/28/DailyHistory.html?req_city=Hamilton&req_state=OH&req_statename=Ohio&reqdb.zip=45011&reqdb.magic=1&reqdb.wmo=99999.

Weinschenk CG, Overholt KJ, Madrzykowski D [2015]. *Simulation of a residential wind driven basement fire—Riverdale Heights, MD*. Gaithersburg, MD: National Institute of Standards and Technology, NIST Technical Note 1870, <http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1870.pdf>.

Investigator Information

This incident was investigated by Murrey E. Loflin, an investigator with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, West Virginia and Dr. Tom Hales (MD, MPH) Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) in Cincinnati, Ohio. An expert technical review was provided by Robert Callahan, Deputy Fire Chief, District of Columbia Fire and EMS. Also, an expert review was provided by Dan Madrzykowski, Research Engineer with the UL Fire Safety Research Institute and Stephen Kerber, Director of the UL Fire Safety Research Institute. The NFPA Division of Public Fire Protection also provided a technical review of this report.

Additional Information

Modern Fire Behavior

This site is meant to serve as a clearinghouse of news and training information related to modern fire behavior and modern building construction research, tactics, and practices, along with actual street experiences. <http://modernfirebehavior.com/>

National Institute for Standards and Technology (NIST) and Underwriters Laboratories (UL)

These two agencies provide information including training videos showing the findings from NIST and UL research conducted in cooperation with the Fire Department of New York on Governor's Island in 2012. <http://www.firecompanies.com/modernfirebehavior/governorsislandonlinecourse/story.html>. Flashover TV, sponsored by FireRescue.com, includes a series of training presentations by NIST researcher Dan Madrzykowski. <http://flashovertv.firerescue1.com/videos/1875870-nist-and-ul-research-on-fire-dynamic-case-studies-part-4/>. Information on completed fire-fighting research studies is available at the NIST website at http://www.nist.gov/el/fire_research/firetech/index.cfm. The information on completed fire-fighting research studies is available at the UL Firefighter Safety Research Institute website at www.ULfirefightersafety.com.

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International Association of Fire Fighters (IAFF) Fire Ground Survival Program

The purpose of the IAFF Fire Ground Survival Program is to ensure that training for Mayday prevention and Mayday operations are consistent between all fire fighters, company officers, and chief officers. Fire fighters must be trained to perform potentially life-saving actions if they become lost, disoriented, injured, low on air, or trapped. Funded by the IAFF and assisted by a grant from the U.S. Department of Homeland Security through the Assistance to Firefighters (FIRE Act) grant program, this *comprehensive fireground survival training program* applies the lessons learned from fire fighter fatality investigations conducted by the National Institute for Occupational Safety and Health (NIOSH) and has been developed by a committee of subject matter experts from the IAFF, the International Association of Fire Chiefs (IAFC), and NIOSH. <http://www.iaff.org/HS/FGS/FGSIndex.htm>.

NFPA 1561, Standard on Emergency Services Incident Management System and Command Safety (2014 edition)

The primary focus of the revision to NFPA 1561 in the 2014 edition is to develop requirements directly aimed at reducing and eliminating fireground injuries and fireground deaths of fire department members. The most apparent change to this edition is the inclusion of “Command Safety” in the document title and the creation of a new chapter, “Command Safety.” This chapter is intended to provide a foundation on how to incorporate the incident management system at all emergency incidents, especially *Type V* and *Type IV* incidents.

The chapter on Command Safety clearly defines the requirements for the incident commander to meet, including establishing a fixed command post, personnel accountability, the use of staff aides, rapid intervention crews, the appointment of a safety officer and assistant safety officer(s)(as needed), plus the expectations and authority of the safety officer. Annexes cover *Functional Assignments for High-Rise Building Incidents*, *Development of Subordinate Officers or Implementing a More Efficient Management System*, *Incident Management for the Fire Service on Type 5 or Type 4 Incidents*, and *Structural Fire-Fighting—Risk Assessment and Operational Expectation*.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety (2014 edition)* can be purchased from the National Fire Protection Association at <http://www.nfpa.org>.

Disclaimer

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH). In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

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Appendix One

Summary of Personal Protective Equipment Evaluation

**Status Investigation Report of one
Self-Contained Breathing Apparatus
Submitted by the
NIOSH Division of Safety Research
for the Fire Department**

NIOSH Task Number 20731

(Note: Full report is available upon request)

Background

As part of the *National Institute for Occupational Safety and Health (NIOSH), Fire Fighter Fatality Investigation and Prevention Program (FFFIPP)*, the National Personal Protective Technology Laboratory (NPPTL) agreed to examine and evaluate a self-contained breathing apparatus (SCBA) unit identified as a Survivair Panther 30-minute, 4500 psi unit.

This SCBA status investigation was assigned NIOSH Task Number 20731. The NIOSH Division of Safety Research (NIOSH DSR) and the Fire Department were advised that NIOSH NPPTL would provide a written report of the inspection and any applicable test results.

The SCBA unit was delivered, in a cardboard box, to the NIOSH facility in Morgantown, West Virginia on January 13, 2016. The SCBA unit was taken to the H building and locked in the evidence cage located in laboratory 1513 until the inspection was conducted on March 3, 2016. The unit was placed back into the locked evidence cage until the testing evaluations on May 3, 2016.

SCBA Inspection

The unit was removed from the packaging in the Testing Lab 1513 and inspected on March 3, 2016 by Jay Tarley, Karis Kline, and Jeremy Gouzd. The SCBA was identified as a Survivair Panther 30 minute, 4500 psi with NIOSH Approval Number TC-SU-5134-310 and the unit submitted by the Fire Department. The SCBA unit was extensively examined, component by component, in the condition received to determine how well the SCBA conformed to the NIOSH-approved configuration. The visual inspection process was documented photographically. Once all the inspections were completed, the SCBA unit was repackaged and placed back in the evidence cage in laboratory 1513.

SCBA Testing

The purpose of the testing was to determine how well the SCBA conformed to the approval performance requirements of Title 42, *Code of Federal Regulations*, Part 84 (42 CFR 84). Further testing was conducted to provide an indication of the SCBA's conformance to the National Fire

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Protection Association (NFPA) Air Flow Performance requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, 2013 Edition.

NIOSH SCBA Certification Tests (in accordance with the performance requirements of 42 CFR 84):

1. Positive Pressure Test [§ 84.70(a)(2)(ii)]
2. Rated Service Time Test (duration) [§ 84.95]
3. Static Pressure Test [§ 84.91(d)]
4. Gas Flow Test [§ 84.93]
5. Exhalation Resistance Test [§ 84.91(c)]
6. Remaining Service Life Indicator Test (low air alarm) [§ 84.83(f)]

National Fire Protection Association (NFPA) Tests (in accordance with NFPA 1981, 2013 Edition):

7. Air Flow Performance Test [Chapter 7, 7-1.1]

Summary and Conclusions

One SCBA unit was submitted to NIOSH NPPTL by NIOSH DSR for the Fire Department for evaluation and testing. The SCBA unit was delivered to NIOSH in one shipment on January 13, 2016 and extensively inspected on March 3, 2016. The unit was identified as a Survivair Panther model, 4500 psi 30 minute SCBA with NIOSH Approval Number TC-SU-5134-310. After inspection, the unit was deemed testable, having suffered only slight damage from the incident on December 28, 2015.

The corresponding cylinder was also found to be in testable condition, however, it was missing a date for hydrostatic testing. Under the applicable U.S. Department of Transportation (DOT) exemption, the air cylinder is required to be hydro tested every five years. For the air cylinder on this unit, the hydro date was not found, therefore, a hydrostatic test would need to take place before it would be deemed safe to test this unit. The cylinder with the unit had some scratches and dirt present. The cylinder was open and it was empty. This unit passed the NIOSH tests and NFPA airflow test.

The unit did come with a corresponding facepiece. The overall condition of the unit and facepiece was fair to good with some dirt and debris. There was visible heat damage to the straps on the unit. In light of the information obtained during this investigation, NIOSH has proposed no further action on its part at this time. The SCBA unit has been returned to Fire Department.

If this unit is to be placed back in service, the SCBA must be repaired, tested, cleaned, and any damaged components replaced and inspected by a qualified service technician, including such testing and other maintenance activities as prescribed by the schedule from the SCBA manufacturer. Typically, a flow test is required on at least an annual basis, at a minimum.

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Appendix Three Incident Commander's Tactical Worksheet for Mayday

INCIDENT COMMANDER'S TACTICAL WORKSHEET FOR "MAYDAY"

- MAYDAY - MAYDAY - MAYDAY Message is Transmitted;**
- Announce *EMERGENCY RADIO TRAFFIC* only;**
- Acknowledge Company/Member transmitting the Mayday – Obtain LUNAR information:**

LOCATION _____
UNIT _____
NAME _____
ASSIGNMENT AND AIR SUPPLY _____
RESOURCES NEEDED _____

- If no answer after two attempts conduct a PAR of all operating companies on the fire ground to isolate company/member;**
- Deploy RIC to reported or last known location/assignment;**
- Request an additional alarm;**
- Request an additional TAC channel for fire operations TAC ____**
- Assure that companies not assigned to the rescue or near the rescue change to the new fire operations channel and conduct a PAR;**
- Maintain fire-fighting positions. Withdraw only if necessary;**
- Establish a Rescue Group with a Safety Officer;**
- Review the Building Pre-Plan if available;**
- Establish a Backup RIC to replace the deployed RIC;**
- Establish a forward staging area for the Rescue Group and provide support with adequate staffing and equipment;**
- Request additional EMS Resources/ALS Ambulances;**
- Request Specialized Resources if needed – Technical Rescue;**
- Conduct a PAR if an emergency evacuation is ordered (due to structural stability or fire conditions);**
- Conduct a PAR after the rescue operation is completed;**
- Announce the end of the Mayday;**