

LINE OF DUTY DEATH REPORT

REPORT 2019-03 • November 1, 2023

1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

Brick Gable End Collapses at a Residential Fire Killing a Fire Captain and Seriously Injuring Three Other Firefighters – Illinois

Executive Summary

On March 5, 2019, a brick gable end (rafter) collapsed during a residential structure fire, killing a 37-year-old career fire captain. Three other firefighters were seriously injured during the collapse. At 1615 hours, the county 9-1-1 received a telephone call from the homeowner stating their home was on fire. Engine 2311 (E2311) and Engine 2312 (E2312) were dispatched from county fire protection district (FPD) 23. The fire chief from the volunteer FPD 23 drove E2311 to the incident. While enroute the fire chief requested automatic aid from two independently operated county fire departments: county FPD 16 (volunteer) and fire department (FD) 22 (career).



Firefighters flowing water through a window on Side Alpha. The roof had partially collapsed, but no collapse zone had been established. *(Photo courtesy of the fire department.)*

At 1627 hours, E2311 arrived on scene. Flames and smoke were venting through the roof on Side Bravo, with a partial roof collapse. Both the occupants were out of the house upon arrival of the fire department, but multiple caged animals remained in the Side Alpha/Bravo corner of the home. The fire chief assumed Command as the incident commander (IC) and declared a defensive strategy, although this was not heard or received by dispatch or responding firefighters. Firefighters from FPD 23 pulled and began flowing water from a 1¾-inch handline from E2311 to the Alpha/Bravo corner (**Photo above**). E2312 laid a 5-inch supply line from the nearest hydrant to E2311. The captain from E2312 conducted an incomplete (270°) size-up in a counterclockwise direction (Side Alpha, Side Delta Side Charlie), but findings from this incomplete walk-around were not reported to the IC.

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At 1632 hours, the IC requested dispatch to send county FPD 14 to the scene. At 1633 hours, firefighters from E2311 initiated an interior attack through the front door on Side Alpha, but excessive storage in the foyer limited advancement to only 5 to 10 feet. They directed water into the Side Bravo first floor and Side Charlie ceiling and attic space.

County FPD 22 (E2211, fire chief via POV) arrived on-scene and were assigned to the Sides Bravo and Charlie with the fire chief from FPD 22 assigned as the Side Bravo/Charlie sector chief. After pulling a 2½-inch hoseline and a 1¾-inch handline from E2311 and flowing water, E2211 radioed E2311 they had no water pressure. The IC, and the lieutenant operating E2311, began to investigate the cause of the low water pressure.

At 1647 hours Engine 1412 (E1412) from county FPD 14 arrived on-scene and initially staged on Side Alpha. After a partial walk-around, the captain of E1412 discussed the possibility of a below grade Side Bravo walk out basement fire with the IC and the Side Bravo/Charlie sector chief. They discussed accessing the basement by cutting open the lower-level garage door with a K-12 saw (a saw fire departments frequently use to cut openings into a variety of materials). At 1656 hours, E1412 was at the lower-level garage doors with a K-12 saw.

At about 1655 hours, the assistant chief from FPD 16 became concerned that the entire roof could collapse. He told FD 22's assistant chief to "watch those guys" working on Side Bravo. The assistant chief from FD 22 then became concerned about the stability of the Side Bravo bricked gable rafter which extended to the roof ridge. The roof supporting the gable had burned away. These concerns were voiced to the Side Bravo/Charlie sector chief who felt the brick wall supporting the gable looked stable with no bulging, bowing, cracking, or spooling. Therefore, no collapse zone was established. NIOSH received conflicting information about whether these collapse concerns were voiced to the IC.

At 1656 hours, the IC radioed that the basement was about to be opened. It took a few minutes for the five firefighters operating and assisting with the K-12 saw to open the lower-level garage door. At 1703 hours, the roof's triangular brick gable rafter suddenly "tipped over" falling as a single sheet onto the driveway; a perimeter collapse. The gable fell approximately 21 feet before striking four firefighters from E1412 and E2212 working to open the garage door on Side Bravo. The fifth firefighter working on Side Bravo was not hit or injured.

A Mayday was called. On-scene firefighters rushed to assist as the IC radioed county 9-1-1 to send more ambulances to the scene. The captain from E1412 was unconscious and not breathing. He was brought out of the collapse zone where cardiopulmonary resuscitation (CPR) was initiated. At 1718 hours, the captain was transported to a local hospital with a police escort. At 1750 hours, the captain was pronounced deceased in the emergency department (ED) by the attending physician due to thoracic and cervicospinal trauma. On-scene paramedics stabilized the three remaining seriously injured firefighters who were subsequently transported to the ED. One was hospitalized, two were treated and released; these three firefighters survived.

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Contributing Factors

- *Lack of a collapse zone*
- *Lack of situational awareness*
- *Incomplete scene size-up*
- *Incomplete risk assessment and incident action plan*
- *Incomplete duties of command safety*
- *Task saturation of the IC*
- *Lack of an IC aide*
- *Lack of an incident safety officer*
- *Inadequate water supply*
- *Inconsistent live fire training among volunteer firefighters*
- *Lack of a personnel accountability system*

Key Recommendations

- *Fire departments should ensure the IC establish collapse zones including exclusion zones or no-entry zones at defensive fires as needed due to dangerous or hazardous conditions*
- *Fire departments should ensure firefighters are trained in situational awareness, personal safety, and accountability*
- *Fire departments should ensure the first arriving officer conducts a detailed scene size-up*
- *During initial fire ground operations, fire departments should ensure the IC conducts a risk assessment, develops a risk management plan, and incorporates these into an incident action plan (IAP). The IAP needs to be clearly communicated to responding personnel and, for more extensive incidents, a tactical worksheet may be required*
- *Fire departments should ensure their IC incorporates the principles of command safety into the incident management system*
- *Fire departments should develop a process to prevent task saturation of ICs during complex or multi-alarm incidents*
- *Fire departments should make available an IC aide during working structure fires*
- *Fire departments should ensure that an incident safety officer, independent of the IC, is appointed at working structure fires*
- *Fire departments should ensure that an adequate sustainable water supply is established and maintained. Firefighters should have periodic training on hydrant operations*

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- *Fire departments should ensure that all members engaged in emergency operations receive annual training and evaluation on fireground operations including live fire training to improve proficiency during fireground operations*
- *Fire departments should utilize a functional personnel accountability system, requiring a check-in and check-out procedure with the designated accountability officer or IC.*

The National Institute for Occupational Safety and Health (NIOSH) initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of fire fighters in the line of duty so that fire departments, fire fighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future fire fighter deaths and are completely separate from the rulemaking, enforcement, and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim.

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



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Introduction

On March 5, 2019, the perimeter collapse of a bricked gable rafter during a residential structure fire killed a 37-year-old career fire captain. The collapse also seriously injured three other firefighters. On March 6, 2019, the United States Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. NIOSH investigators with the Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) contacted the fire department involved in this incident to arrange an investigation. On May 15, 2019, two investigators from the NIOSH FFFIPP and one investigator from the NIOSH Fatality Assessment and Control Evaluation program traveled to Illinois to initiate the investigation. During this investigation, the NIOSH representatives met with the fire chief of the affected FPD and fire chiefs and responding firefighters from the mutual aid departments. The NIOSH investigators also met with representatives of the International Association of Fire Fighters (IAFF) local, an investigator from the Illinois Office of the State Fire Marshal (OSFM), and members of the private ambulance company. The NIOSH investigators visited County 9-1-1 dispatch and the incident site. The NIOSH investigators conducted interviews with the officers and firefighters who responded to the fire scene from various FD and FPD. The NIOSH investigators inspected and photographed the victim's personal protective clothing and self-contained breathing apparatus. The NIOSH investigators reviewed training records and standard operating procedures from the deceased firefighter's department. NIOSH contacted the county medical examiner's office to obtain an official cause of death. NIOSH also reviewed the Illinois Department Labor (OSHA) report.

Fire Department

The county operates 55 different FD and/or FPD. One of these districts is county FPD 14 which operates 2 fire stations with 31 firefighters (18 career and 13 paid on-call) serving a city of 18,000 citizens covering 36 square miles. The 18 career personnel are comprised of the fire chief, three assistant chiefs, three captains, three lieutenants, and eight firefighters. The fire chief reports to the elected board of trustees and the appointed fire commission board. The FPD operates three 24-hour shifts (0700 hours to 0700 hour). Firefighters work a 24-hour shift followed by 48-hours off. Minimum staffing is 2 firefighters per station per shift. Paid on-call firefighters supplement as needed.

In 2018, the department responded to 1,973 emergency incidents. Approximately 85% of the incidents were emergency medical service calls. In addition, the district conducts over 300 fire inspections annually. All 18 career firefighters are certified by the Illinois Department of Public Health at the level

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of emergency medical technician (EMT)-Basic and three members are advanced life support (ALS) providers (paramedics). Transport capabilities are provided by two ambulance providers, one private, and one hospital based.

The FPD operates the following apparatus:

- Station 1
 - Command Vehicle (2009 Ford Explorer)
 - Rescue Engine (2009 Spartan/Toyne)
 - Tender (2005 Freightliner/Midwest Fire)
 - EMS Unit (2009 Ford F-150)
 - Brush Unit (2011 Dodge 4500)
- Station 2
 - Reserve Engine (1998 KME)
 - Rescue Engine (1998 KME)
 - EMS Unit (1996 Ford F-350)
 - Brush Unit (2012 Dodge 4500)
 - Air and Technical Rescue Trailer

There is no specific truck staffing, rather station personnel respond with appropriate apparatus based on dispatch information, staffing, and standard operating procedures. Table 1 lists the apparatus assignment for initial alarms.

Table 1: Apparatus Assignment for Initial Alarms

Structure Fire – no hydrants	2 pumpers, 1 tender
Structure Fire – hydrants	2 pumpers
Brush Fire	1 st due brush*
Cardiac Arrest	1 st due rescue, 2 nd due apparatus
Medical	1 st due rescue
Lift Assist	1 st due rescue
Vehicle Accident - with injuries	2 pumpers
Vehicle Accident – no injuries	1 st due pumper*
Technical Rescue	1st due pumper*
Lines Down	1st due pumper*
Alarm Sounding	1st due pumper*
Investigation	1st due pumper*
Smell of Smoke in Building	1st due pumper*
Smell of Gas	1st due pumper*
Carbon Monoxide	1st due rescue

*Shift commander or the initial IC has the discretion to modify assignments as necessary.

Career Firefighter Hiring Process

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Interested candidates must be at least 21 years of age, have a high school diploma or general education diploma (GED), a valid Illinois driver's license, pass a written test, and pass the oral interview conducted by the fire commissioners and the fire chief. A candidate must then pass the candidate physical ability test. In addition, the Illinois OSFM requires a 35-foot ladder climb. A preliminary candidate list is developed giving candidates the opportunity to claim preference points [e.g., veteran status, EMT-paramedic]. The district's board of fire commissioners finalizes the eligibility list which remains in effect for two years.

When a position(s) becomes available, the fire chief offers eligible candidates a condition of employment contingent on the candidate passing a criminal background check, passing a complete medical evaluation, and producing a valid Illinois EMT-Basic license.

A recruit must then successfully complete the 7-week "Basic Firefighter Academy" training at the state fire academy. Upon completion of this training, recruits are assigned to a company for the remainder of their 12-month probationary period. Probationary firefighters are required to establish primary residency in the district within 12 months. During the probationary period, the recruit must participate in weekly in-house training. In-house examinations, both written and practical with minimum passing scores of 75-80% are administered at months 3, 4, 8, and 11 to ensure the probationary firefighter grasps and understands the presented material. At the end of the 12-month probationary period, the firefighter must become certified in Hazardous Materials Operations, Basic Operations Firefighter, and state licensed EMT-Basic, EMT-Paramedic, or pre-hospital registered nurse.

Paid On-Call Firefighter Hiring Process

Paid on-call applicants must be at least 19 years of age, have a high school diploma or GED, a valid Illinois driver's license, pass a background check, and be in excellent physical condition. Paid on-call firefighter applications are accepted year-round and applicants are encouraged to attend an orientation session to learn more about the position. Once hired as a probationary member, over 20 probationary training sessions/classes are required, each session/class lasting from three to eight hours. Upon completion of an initial series of training sessions, the probationary paid on-call firefighter can respond with career members. The probationary position requires a minimum of 30 training hours per month, or 90 hours per quarter. After completing the probationary period, training continues for the paid-on call firefighter.

Mutual Aid Box Alarm System ([MABAS](#))

County FPD 14 is a member of an organization known as MABAS. MABAS is a mutual aid system designated to assist with mutual aid response of fire, emergency medical services (EMS), specialized response teams, and station coverage during a state declared disaster or when an incident overwhelms the available resources of a participating community. This allows a fire chief and an IC to focus on the operational needs during a significant incident. The IC knows that a predetermined set of resources is responding upon issuance of a single order by command.

Established in the 1960s and expanded in 2001, MABAS is a partnership with the Illinois Emergency Management Agency, the Cook County Department of Homeland Security and Emergency

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Management, the Illinois OSFM, the Illinois Department of Public Health – EMS Division, and the Illinois Fire Chiefs Association. Members must sign a contract to ensure uniform standards of operation, incident management procedures, minimal staffing requirements, fireground safety, and on-scene operations. As of 2019, MABAS is present in all 102 Illinois counties and includes approximately 1,175 of Illinois's 1,246 (94%) fire departments organized within 69 divisions.

County FPD 14 belongs to MABAS Division 35. In addition to MABAS, FPD 14 has a written mutual-aid agreement with all FD and FPD in the county, and two other FPD in another county. The district also has an agreement with county FD 12 for structure fires and incidents involving other high-risk occupancies (e.g., schools, churches, hospitals).

Training and Experience

The Illinois OSFM does not mandate minimum training requirements for firefighters. However, the Office does maintain and oversee a Division of Personnel Standards and Education (DPSE) which promotes, encourages, and assists local governments to improve the levels of education and training standards for local firefighters. While this program is strictly voluntary, the OSFM and the DPSE highly encourage local governments to adopt and complete firefighter certification programs. This encouragement includes a reimbursement program for firefighter training costs. Additional information about the DPSE's programs can be found at the [Division's website](#), and the [General Assembly's Illinois Administrative Code](#) which includes training facilities, examinations and certifications, and a [current list of certifications](#).

Maintaining Training Records

The student is responsible for maintaining their training log and documenting any training they attend. It is the responsibility of the authority having jurisdiction to validate the training and maintain all training records.

Illinois Department of Labor, Division of Occupational Safety and Health ([IL-OSHA](#))

Being a State Plan State, Illinois fire departments must comply with various occupational safety and health standards such as 1910.120 *Hazardous Waste Operations and Emergency Response*, 1910.132 *Personal Protective Equipment Standard*, 1910.134 *Respiratory Protection*, 1910.156 *Fire Brigades*, 1910.157 *Portable Extinguishers*, and the 1910.1030 *Bloodborne Pathogens*.

County FPD 14

NIOSH obtained the training records from the five members who responded to the fireground from the department suffering the fatality (FPD 14). All five completed annual burn (live fire) tower training in May 2018. From 1/1/2000 to 3/5/2019 these five members completed:

Captain: 2,959 hours of training

Lieutenant: 2,813 hours of training

Firefighter 1: 2,750 hours of training

Firefighter 2: 2,426 hours of training

Firefighter 3: 600 hours of training (employed by FPD 14 since 2017).

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Equipment and Personnel

The county dispatch center (county 9-1-1) is located at the county sheriff's office. County 9-1-1 dispatches for fire and law enforcement. Fire is dispatched on VHF frequencies. There are 14 public safety answering points (PSAP) throughout the county that answer 9-1-1 calls. The telecommunicators are civilian employees of the sheriff's office. Telecommunicators work an 8-hour shift with a minimum staffing of two dispatchers. In 2018, the sheriff's office answered 26,500 9-1-1 calls out of the 120,000 9-1-1 calls received in the county. Each PSAP can assign MABAS Red, White, and Blue tactical channels, all of which are non-repeater channels (operate on line-of-sight).

The initial response to the structure fire on March 5 was:

County FPD 23

- Engine 2311: 2 members (1 fire chief and 1 firefighter)
- Engine 2312: 1 member: (1 captain)
- Privately Owned Vehicles (POVs): 9 members (1 lieutenant, 3 engineers, 5 firefighters)

County FPD 16

- Engine 1610: 2 members (1 assistant chief and 1 captain)
- POVs: 6 personnel (1 fire chief, 1 assistant chief, 2 captains, and 2 firefighters)

County FD 22

- Engine 2211: 2 members (1 captain and 1 firefighter)
- POVs: 2 members (1 fire chief and 1 assistant chief)

Medic 74: 2 members (1 EMT-paramedic, 1 EMT-Basic)

Three additional fire departments were requested and dispatched to the scene:

County FPD 14

- Engine 1412: 3 member (1 captain, 2 firefighters)
- Tender 1460: 2 members (1 lieutenant, 1 firefighter)

County FPD 48

- Tender 4861: 2 members (1 captain and 1 firefighter)
- Tender 4862: 2 members (1 deputy chief and 1 captain)
- Chief's car: 1 member (1 chief)
- POVs: 1 member (1 lieutenant)

County FD 37

- Tender 1535: 2 members (2 firefighters)

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Structure

The residential structure was single-story ranch-style brick home of approximately 1,536 square feet located on 11.2 acres. The structure was built in 1970. The structure consisted of a first floor with a kitchen, family room, two bedrooms, one and a half baths, closets, and a large work/living area (See **Diagram 1**). The Side Alpha/Bravo corner contained an area with animal crates and cages.

The structure was wood construction with brick veneer. The roof consisted of wood truss covered with plywood with asphalt shingles. The gable roof ran east-to-west with the brick running up to the ridge on gabled end rafters on both Sides Bravo (east) and Delta (west).

On Side Bravo (east) there was a below grade unfinished partial basement utilized as a two-car garage. The walkout basement/garage did not run the length of the house. An exterior set of steps led from Side Charlie down to the entrance of the basement/garage on the Side Charlie/Bravo corner. The entrance to the garage consisted of a man door and two single garage doors. The entrance was flanged by two retaining walls each being approximately 6 feet in height and about 15 feet long on the Side Charlie/Bravo corner and the Side Bravo/Alpha corner. Sitting in the driveway, just outside the garage doors, were a parked car, a large acetylene tank, a large air conditioner, equipment for repairing heat pumps, and many other items, both large and small, cluttering the area.

Side Alpha (north) consisted of a large front yard that ran about 180 feet from a frontage (feeder) road to the front door. A covered porch sheltered the front door and the middle two-thirds of the home. Side Charlie (south) included a back door with a few small steps leading down to the backyard where a horse trailer was parked. The brick siding and gable on Side Delta (east) did not have any doors or windows. The Side Delta yard contained a large chicken coop (**Diagram 1**). The nearest fire hydrant was located approximately 250 feet to the north-east.

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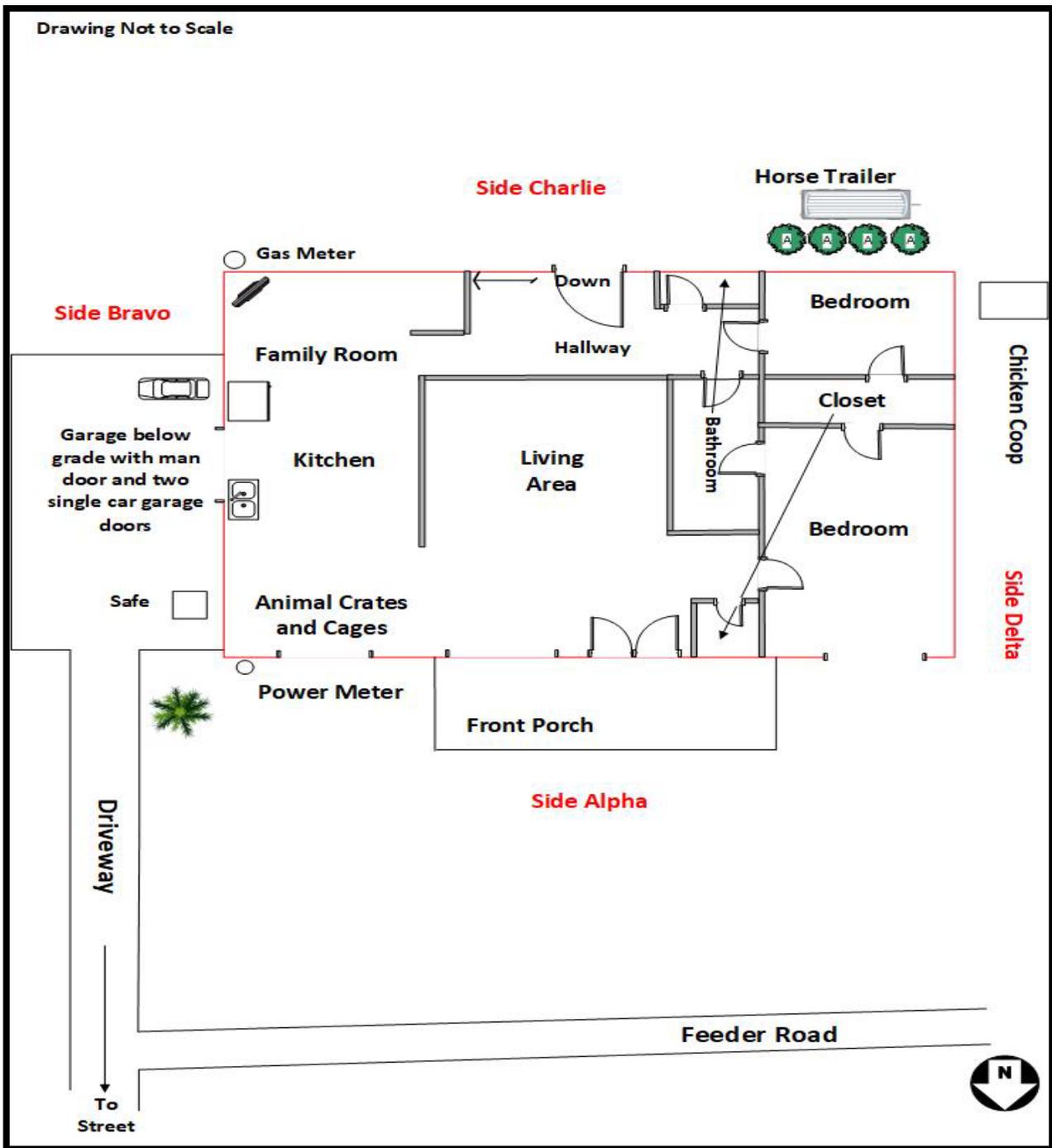


Diagram 1. A diagram of the fire building’s first floor and its position on the property. Dimensions are approximate. The home’s square footage was 1,526 feet.

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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 obtained by reviewing the dispatch records, audio recordings, witness statements, and other available information. All times are approximate and rounded to the closest minute. The timeline is not intended, nor should it be used, as a formal record of events.

Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Tuesday, March 5, 2019		
Homeowner returns home and finds fire in the kitchen area and calls 9-1-1.	1615 Hours	
County FPD 23 dispatched to a report of a structure fire.	1616 Hours	
County 9-1-1 dispatched a deputy sheriff to ensure the homeowners remained outside.	1618 Hours	
E2311 (PAR 2) enroute. E2312 (PAR 1) enroute. E2311 requested county FPD 16, and county FD 22 be dispatched.	1619 Hours	
County FPD 16 dispatched. Medic 74 self-dispatched to structure fire.	1620 Hours	
The county 9-1-1 notified county FD 22's public safety answering point (PSAP) to dispatch county FD 22 to the structure fire.	1621 Hours	
Dispatch requested an ambulance to the address.	1622 Hours	Medic 74 arrived on-scene and reported heavy smoke and fire showing from the structure.

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
<p>1600 (PAR 1–fire chief) enroute via privately owned vehicle (POV).</p> <p>E2211 (PAR 2) enroute.</p> <p>FD 22’s fire chief and assistant chief enroute by POV.</p>	1623 Hours	
<p>A county deputy sheriff on scene advised the county 9-1-1 that both homeowners were out of the house.</p>	1624 Hours	<p>Medic 74 advised county 9-1-1 that fire was coming out of the east side of the house (Side Bravo).</p>
<p>E2311 arrived on-scene. E2311 advised county 9-1-1 they had a “single-story wood frame structure with heavy fire involvement.”</p>	1627 Hours	<p>The fire chief from FPD 23 assumed role as the Incident Commander (IC) and called for an initial defensive strategy.</p> <p><i>No one reported hearing the IC state he had assumed Command or a defensive strategy on the radio.</i></p> <p><i>IC was also performing engineer duties on E2311.</i></p>
<p>E1610 (PAR 2) enroute.</p> <p>1603 (PAR 1) responded via POV.</p>	1628 Hours	<p>E2311’s probationary firefighter stretched 1¾-inch hoseline from E2311 to Side Alpha.</p> <p>Flames and smoke were emitting from Side Bravo roof with partial roof collapse.</p>
<p>E2312 arrived on-scene as well as 2 firefighters from FPD 23 in their POVs.</p> <p>1600 (chief) arrived by POV.</p>	1629 Hours	<p>Two firefighters from FPD 23 flowed water from the 1¾-inch hoseline from E2311 into the Side Alpha picture window.</p> <p>1600 (chief) assigned to Side Alpha.</p> <p>As FPD 23 firefighters arrived in their POVs. They were told report to Side Alpha.</p>

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
	1629-1631 Hours	<p>E2312 laid a 5-inch supply to E2311. The hose lay was approximately 250 feet.</p> <p>A firefighter/EMT from Medic 74 made the hydrant connection and charged the hydrant.</p> <p><i>Medic 74 was unaware that the hydrant was NOT completely open.</i></p>
<p>IC requested that county FPD 14 respond.</p> <p>County 9-1-1 dispatched county FPD 14 to the structure fire.</p>	1632 Hours	<p>On Side Alpha, firefighters from FPD 23 moved from the picture window to the front door with the 1¾-inch hoseline.</p> <p>The captain from E2312 conducted a 270° incomplete walk-around of Sides Alpha, Delta, and Charlie.</p> <p><i>The IC was not informed about the finding of this walk-around size-up.</i></p> <p>FD 22's fire chief arrives and was assigned Side Bravo/Charlie sector chief.</p>
<p>E1610 (PAR 2) arrived.</p> <p>E2211 (PAR 2) arrived.</p>	1633 Hours	<p>Firefighters from FPD 23 initiated an interior attack through the front door but could only advance 5-10 feet due to excessive storage in the foyer. A water stream was directed to Side Bravo and the Side Alpha/Bravo corner.</p>

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
E1412 (PAR 3) enroute.	1634 Hours	<p>1600 (chief) advised IC that there was ammunition stored in the foyer area of the home.</p> <p>1600 (chief) conducted a 270° incomplete walk-around size-up. <i>Findings from the walk-around were not reported to the IC.</i></p> <p>E2211 was told to report to their chief who was the Side Bravo/Charlie sector chief. E2212 positioned a 2½-inch hoseline from E2311 to the Side Bravo/Charlie corner and began to flow water.</p> <p>E1610 could not find the IC for an assignment. FPD 23's captain assigned E1610 to Side Alpha to assist FPD 23's crew.</p>
Lieutenant from FPD 23 arrived by POV and took over E2311 pump operations.	1635 Hours	<p>FPD 23 lieutenant noted weak pressure on the intake gage and questioned whether the hydrant was completely open. The lieutenant asked an engineer to check the hydrant.</p>
1604 (PAR 1) enroute.	1636 Hours	<p>E2211 notified IC regarding low water pressure in the 2½-inch line. E2211 shut down the 2½-inch line and pulled a 1¾-inch from E2311. Water pressure fell again.</p>

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
<p>The IC moved fireground communications to MABAS Red tactical channel.</p> <p><i>The MABAS Red channel is a non-repeater channel, that transmits and receives only within a limited area.</i></p>	1637 Hours	<p>Front door attack team (FPD 23) advised IC regarding low water pressure in their 1¾-inch line. IC became involved in addressing the water supply issue on E2311.</p>
<p>The County 911 advised all members operating at the structure fire to switch to MABAS Red tactical channel.</p>	1638 Hours	<p>The lieutenant on E2311 ran an additional 3-inch water line from E2312 to 2311.</p>
<p>E1412 switched to MABAS Red channel</p>	1640 Hours	<p>Someone transmitted on the main dispatch channel that the occupancy was a hoarder house.</p> <p>FPD 16 firefighters arrived in their POVs and were told to report to their chief on Side Alpha.</p> <p>FDP 16's chief assigned district 16's assistant chief and captain to help FD 22 on Side Bravo/Charlie.</p>
<p>The IC requested a tender response due to water supply issues.</p> <p><i>County 911 had difficulty with this request due to MABAS Box Alarm assignment being incomplete.</i></p>	1643 Hours	<p>Front door attack team (FPD 23) become low on air. They left the structure and stage at E2311. They were replaced by FPD 16's firefighters.</p>
<p>Engine 1412 arrived.</p>	1647 Hours	<p>E1412 captain checked in with IC.</p> <p>E1412 was given an initial assignment on Side Alpha.</p> <p>E1412 captain conducted brief size-up.</p>

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
IC directed 2 ½-hoseline from Side Bravo/Charlie corner to basement door.	1650 to 1654 Hours	<p>E1412 captain, Side Bravo/Charlie sector chief, and IC discussed possibility of this being a basement fire on Side Bravo.</p> <p>Decision was made to open basement garage door with a K-12 saw to potentially put water on seat of the fire.</p> <p>K-saw retrieved from E1412.</p>
911 advised IC that they were 35 minutes into the incident and requested a status. The IC advised that they were still containing the fire.	1655 Hours	<p>Firefighters kicked open Side Bravo lower-level man door. Some lazy grey smoke escaped with minimal heat. A thermal imaging camera (TIC) showed a slight increase in temperature.</p> <p>Firefighters did not enter. They flowed water through the man door, but large amounts of clutter blocked water streams.</p>

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
<p>The IC advised the first-floor attack teams that the basement was about to be opened.</p>	<p>1656 Hours</p>	<p>FPD 16’s assistant chief was concerned that the entire roof could collapse. He told FD 22’s assistant chief to “watch those guys’ working on Side Bravo.</p> <p>FD 22’s assistant chief was concerned about the stability of the Side Bravo bricked gable rafter and notified his chief who is the Side Bravo/Charlie sector chief.</p> <p>The Side Bravo/Charlie sector chief felt the brick wall supporting the gable looked stable with no bulging, bowing, cracking, or spooling. Therefore, no collapse zone was established.</p> <p><i>NIOSH received conflicting information about whether the collapse concerns were voiced to the IC.</i></p>
	<p>1658 Hours</p>	<p>Firefighters from FPD 14 and FD 22 were positioned with hoses in front of the garage door. The E1412 captain utilized a TIC to direct water streams. E1412 opened the garage door with K-12 saw.</p>
<p>IC requested the power company respond to the scene to shutoff gas and disconnect electricity.</p>	<p>1659 Hours</p>	<p>Power line entering the home on the Side Alpha/Bravo corner, fell across the driveway.</p> <p>IC assigned firefighters from FPD 23 to safeguard the area.</p>
<p>IC to County 9-1-1, “We’ll need more ambulances at the scene, building collapse.”</p>	<p>1703 Hours</p>	<p>Approximate time of Side Bravo brick gable end collapse.</p>

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
County 9-1-1 dispatched four ambulances to the structure fire.	1704 Hours	Rescue efforts initiated. Four firefighters were pulled out of the collapse zone (E1412's captain and firefighter, E2211's captain and firefighter).
County 9-1-1 advised all county fire departments that the dispatch channel was "emergency traffic only."	1705 Hours	CPR started on E1412's captain.
Two air ambulances dispatched to the structure fire.	1708 Hours	
	1709 Hours	IC informed on-scene firefighters about downed electrical line and to use caution.
<p>County 9-1-1 requested a one-hour incident status.</p> <p>IC: "We have building collapse with multiple injured firefighters."</p> <p>County 9-1-1 acknowledged and requested a personnel accountability report.</p> <p>IC stated all firefighters accounted for at this time.</p>	1714 Hours	
Medic 74 was enroute to the hospital with the captain of E1412. CPR was in progress.	1718 Hours	
<p>Power company on-scene.</p> <p>County FPD 48 assumed IC duties.</p>	1724 Hours	
Medic 74 arrived at the hospital.	1728 Hours	

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Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
	1732 Hours	Power company cut power to house.
The IC requested County 9-1-1 to contact the OSFM.	1738 Hours	
Air ambulance departed the scene enroute to a trauma center with a firefighter from E1412.	1745 Hours	
The attending physician at the hospital emergency room pronounced the captain of E1412 deceased.	1750 Hours	
Two firefighters from E2212 transported to the hospital. The IC (fire chief from FPD 23) transported for chest pains.	1758 Hours	The deputy chief from FPD 48 assumed Command as the IC.
A fire marshal from the IL OSFM arrived on-scene.	1853 Hours	Defensive fireground operations were re-started. Cellar nozzles used to control and knockdown the fire.
	2028 Hours	Approximate time the fire was declared under control.
IC advised County 9-1-1 that the fire was out.	2300 Hours	

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Personal Protective Equipment

At the time of the collapse, all firefighters were wearing full turnout gear and self-contained breathing apparatus (SCBA). NIOSH investigators inspected the SCBA worn by the captain and the injured firefighter from E1412. The turnout gear was not inspected. NIOSH investigators determined the turnout gear and SCBA were not a contributing factor in the fatality and injuries at this incident.

Weather Conditions

On March 5, 2019, at 1533 hours, the temperature was 21 degrees Fahrenheit (°F), the relative humidity was 55%, and the wind was from the west/north-west at 12 miles per hour. There were scattered clouds with 10 miles of visibility and no precipitation [Weather Underground, 2019].

Investigation

At approximately 1445 hours on March 5, 2019, the homeowners left their home to run some errands. They returned approximately an hour and a half later, finding a significant portion of their home on fire. Using a cellphone, they immediately called 9-1-1 (1615 hours), but the county telecommunicator couldn't understand the caller's panicked speech and directed a county deputy sheriff to a nearby address. Less than a minute later, the homeowners called 9-1-1 again, and relayed that smoke and fire was coming from their home and gave their address. The caller confirmed that the residents were out of the house. The dispatch mapping system could not locate the exact location of the address, and the street was the dividing line between two separate FPDs. The telecommunicator dispatched county FPD 23 as first due, rather than the actual first due of county FPD 16.

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Photo 1. Firefighters from county FPD 23 operating a hoseline into the picture window near Side Alpha and near the Side Alpha/Bravo corner. Time is approximately 1630 hours.
(Photo courtesy of the fire department.)

Two engines from district 23 responded at 1619 hours: E2311 (PAR 2 – chief and probationary firefighter) and E2312 (PAR 1 - captain). While E2311 was enroute, the fire chief requested county FPD 16 (volunteer), and FD 22 (career) respond to the structure fire. In addition to sending these units, an ambulance was dispatched to the address. Medic 74, who happened to be in the area, self-dispatched. Arriving at 1622 hours, Medic 74 reported heavy smoke and fire. The county deputy sheriff arrived at the same time and reported the homeowners were out of the home at 1624 hours.

At 1627 hours, E2311 arrived on-scene and parked in the driveway close to the Slide Alpha/Bravo corner. The fire chief reported a “single story, wood frame structure with heavy fire involvement.” The fire chief assumed Command as the IC and declared a defensive strategy. Neither dispatch nor the responding firefighters received this message over the radio. E2311’s probationary firefighter pulled a 1¾-inch hoseline from E2311 to Side Alpha of the structure. Two firefighters from county FPD 23 arrived in their personally owned vehicles (POV). Both firefighters put on their turnout gear and went to E2311 to don their SCBA. They proceeded to Side Alpha and operated the 1¾” hoseline flowing water into the Side Alpha picture window (**Photo 1**). The fire had caused a partial collapse of the roof over the kitchen (Side Bravo) and the fire was spreading toward Side Charlie and Delta. The homeowners were very concerned about eight caged and crated dogs inside the Side Alpha/Side Bravo corner.

At approximately 1629 hours, the captain driving E2312 arrived on-scene followed by the chief from county FPD 16 arriving by POV. The captain laid a 5-inch supply line from the nearest hydrant to E2311, which was approximately a 250-foot lay. The firefighter/EMT from Medic 74 made the hydrant connection and charged the hydrant. During the NIOSH interviews, the firefighter/EMT from Medic 74 stated ice might have been in the barrel. The firefighter/EMT from Medic 74 was unaware

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that the hydrant was NOT completely open. The time was approximately 1630 hours (**Photo 2**). The fire chief from district 23 was serving two functions: the IC and the engineer operating E2311.

At approximately 1632 hours, after laying the supply line, the captain from E2312 conducted an incomplete (270°) walk-around of Sides Alpha, Delta, and Charlie. Findings from the walk-around size-up were not communicated to the IC.

On Side Alpha, the two firefighters from district 23 relocated the 1¾-inch line from the picture window to the front door. At 1633 hours, firefighters from district 23, on air from their SCBAs, entered the front door into the foyer where they directed water to Side Bravo and the Alpha/Bravo corner. They could only advance 5-10 feet due to excessive storage in the foyer.

At 1629 hours the fire chief from FPD 16 was assigned chief of the Side Alpha sector. After speaking with the homeowners, the chief announced on the radio that a large amount of ammunition was stored to the right of the front door on Side Alpha. Since fire had not spread to the foyer area, attack crews continued to flow water in the foyer area and to Side Bravo.

At 1632 hours, the chief from FPD 16 conducted an incomplete (270°) walk-around of Sides Alpha, Bravo, and Charlie. Again, findings from this incomplete walk-around (270°) size-up were not communicated to the IC.

At 1633 hours, E2211 (PAR2) from county FD 22 and E1610 (PAR 2) from county FPD 16 arrived on-scene. E1610 was assigned to Side Alpha, while E2211 was assigned to the Bravo/Charlie sector where their chief was the sector chief. E2211 positioned a 2½-inch hoseline supplied by E2311 to Side Bravo/Charlie and began to flow water into the home (**Diagram 2**). Within a minute or two, the water pressure in the hoseline fell. E2211 notified the IC of the low water pressure situation. Firefighters operating on the Side Bravo/Charlie corner shut down the 2½-inch line and pulled a 1¾-inch line from E2311. The 1¾-inch line also had problems maintaining water pressure. The Side Bravo/Charlie sector crews would close the hose's nozzle, allowing the hose to recharge, then continued to flow water until the pressure dropped again. This cycle repeated several times.



Photo 2 the hydrant to E2311. E2311. The 5-inch hoseline connecting was parked in the resident's driveway on Side Bravo.
(Photo courtesy of the fire department.)

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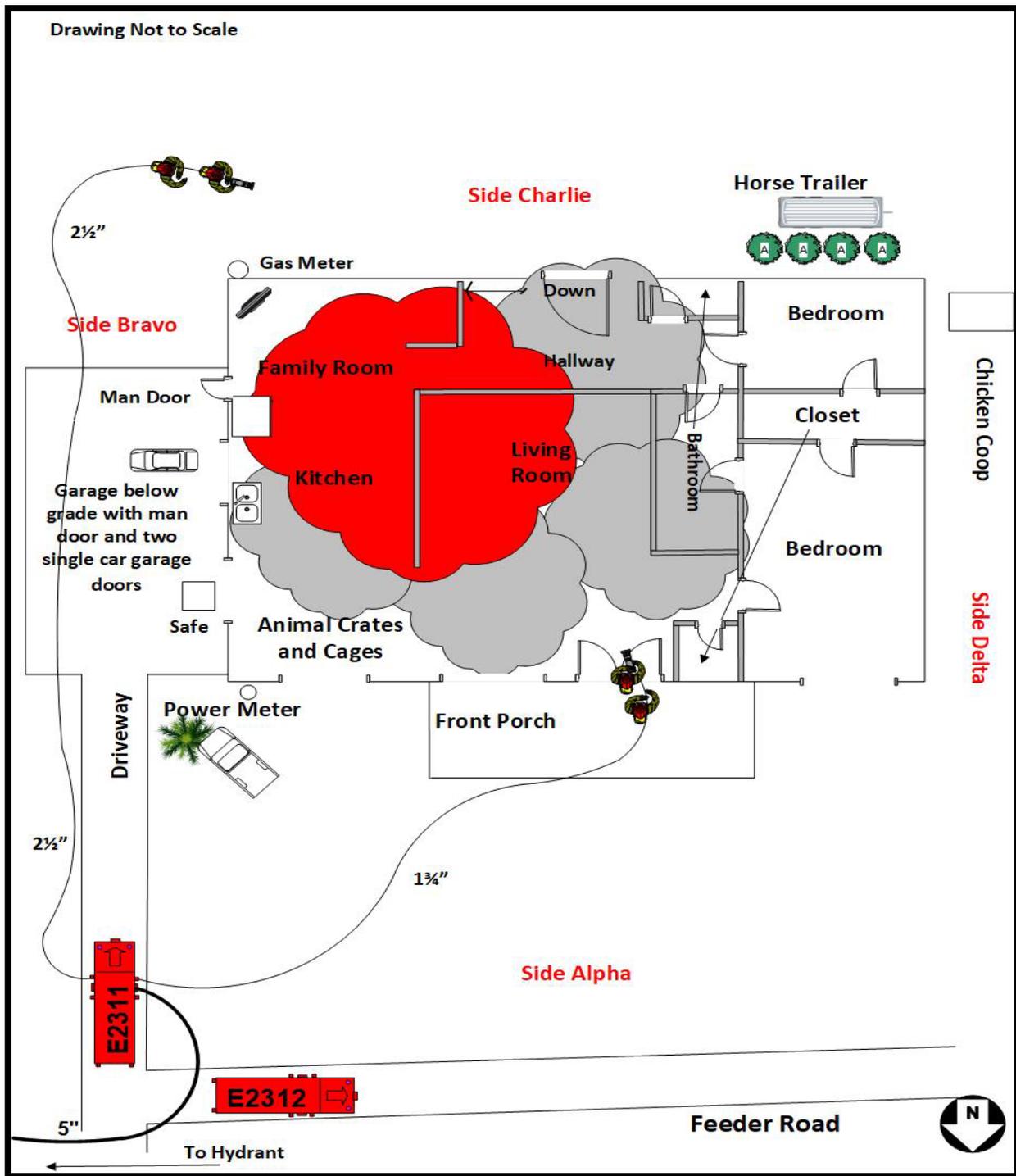


Diagram 2. Sketch of the fire suppression equipment and personnel on the nozzles of the hoselines.

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At 1635 hours a lieutenant from FPD 23 arrived in his POV and was assigned pump operations of E2311 (replacing the IC). The lieutenant noted weak pressure on the intake gage and questioned whether the hydrant was completely open. He asked an engineer from district 23 to check the hydrant.

At 1637 hours, firefighters from FPD 23 conducting interior fire suppression from the foyer experienced low water pressure in the 1¾-inch line and notified the IC. Though the fire was somewhat knocked down, flames were still showing from Sides Bravo and Charlie and the roof collapse was continuing to expand. At approximately 1643 hours, their end-of-service-time indicators started to sound from their SCBAs. They exited the front door and staged at E2311 after being replaced by county FPD 16 firefighters arriving in their POVs. At approximately 1642 hours, district 16 firefighters resumed the interior attack on Side Alpha via the front door.



Photo 3. Firefighters conducting interior operations thru the front door even though approximately 45 to 50% of the roof had collapsed into the 1st floor. Red arrow indicates the end of the bricked gable rafter that eventually collapsed onto the driveway on Side Bravo.

(Photo courtesy of the fire department.)

At 1637 hours, the IC contacted County 9-1-1 and requested a tactical channel. County 9-1-1 radioed all on-scene firefighters to switch to MABAS Red. This incident was assigned MABAS frequency

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Red. This is a non-repeater channel that operates line of sight. Once this change was made, the IC had to switch back to the dispatch channel to communicate with county 9-1-1. The IC was monitoring both radio channels and trying to help the lieutenant solve the water supply problem.

The roof on Sides Bravo and Side Bravo/Charlie corner roof continued to collapse onto the 1st floor (See **Photo 3**). Firefighters on the Side Bravo/Charlie corner could see the 1st floor starting to burn and collapsing into the lower-level garage/basement. This information was not reported to the IC.



Photo 4. Crews are operating interior and using an attic ladder to gain access to the attic. Crews are attempting to stop the fire from spreading to Side Delta via the attic.

(Photo courtesy of the fire department.)

On Side Alpha, firefighters placed a ladder in the foyer and used pike poles to pull down the ceilings with the goal of preventing fire spread to Side Delta via the attic (**Photo 4**). Side Alpha interior crews could see that the fire had burned through the 1st floor at the Side Alpha/Bravo corner.

When the lieutenant from FPD 23 arrived by POV, he was assigned to take over E2311 pump operations from the IC. E2311 was supplying water via 1 $\frac{3}{4}$ -inch lines to the attack crew on Side Alpha and the crew operating on the Sides Bravo and Charlie. Both crews experienced inadequate

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water flow and pressure. The lieutenant operating E2311 sent an engineer to check the hydrant. At the hydrant, the engineer met Medic 74 FF/EMT, who originally opened the hydrant. The Medic 74 FF/EMT reported that the hydrant was completely open. Without rechecking the hydrant, the engineer reported to the lieutenant that the hydrant was completely open. The lieutenant then ran an additional 3-inch water line from E2312 to E2311 with no change in the water pressure.

At 1643 hours, the IC contacted county 9-1-1 and advised they were having problems accessing enough water from the fire hydrant. The IC requested dispatch to contact/request neighboring FD and FPD to send tenders. At 1651 hours, a tender from county FD 37 (PAR 2) departed their station enroute to the fire scene.

At approximately 1645 hours, 18 minutes after arrival, the IC conducted the first complete (360°) walk-around of the structure. Firefighters from districts 16 and 23 were operating on Side Alpha, firefighters from department 22 were operating on Side Bravo and Charlie. Additional firefighters from district 16 were operating on Side Alpha, while officers from district 16 were operating on Side Bravo/Charlie corner. The IC was preoccupied with running E2311 and investigating the water supply issue without formulating a strategy, an incident action plan, or an accountability tracking process.

County FPD E1412 (PAR 3) arrived on scene at 1647 hours. The captain of E1412 checked-in with the IC. E1412 was initially assigned to Side Alpha and, when needed, to relieve the district 16 crew operating inside the structure on the 1st floor. Since district 16's crew had just relieved FPD 23's crew (1643 hours), the captain of E1412 was able to conduct a brief size-up evaluation. Shortly thereafter, during a face-to-face discussion with the IC and the Side Bravo/Charlie sector chief, the captain raised the issue of a possible basement fire. To flow water to the potential seat of the fire, the captain offered the use of their K-12 to cut an opening in the below grade garage doors (**Diagram 2**).

At 1652 hours, the IC ordered the 2½-inch hoseline moved from Side Charlie to Side Bravo near the below-grade garage door. While FD 22's crew move the 2½-inch hoseline, E1412's engineer retrieved the K-12 from E1412. Firefighters from FPD 14 and FD 22 operating on the Side Bravo corner opened the lower-level man door (**Diagram 2 and Photo 5**). When crews opened the door, some lazy grey smoke escaped with minimal heat. A thermal imaging camera (TIC) showed a slight increase in temperature. Crews flowed water from the door into the garage using a 1¾-inch line, but many belongings obstructed the flow to other areas of the basement/garage.

At approximately 1655 hours, FPD 16's assistant chief became concerned that the entire roof could collapse. He told FD 22's assistant chief to "watch those guys" working on Side Bravo. FD 22's assistant chief was also concerned about the Side Bravo bricked gable rafter. The assistant chief notified his chief who was the Side Bravo/Charlie sector chief. The Side Bravo/Charlie sector chief thought the brick wall supporting the gable looked stable with no bulging, bowing, cracking, or spooling. Therefore, no collapse zone was established. NIOSH received conflicting information whether these collapse concerns were reported to the IC.

At 1655 hours, county 9-1-1 requested a status update for being 35 minutes into the response. The IC responded that they were still containing the fire. At 1656 hours, the IC radioed that the basement was

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about to be opened. Upon opening the garage door, firefighters flowed water from the driveway into the garage; no one entered the garage. The captain from 1412 was standing in front of the left garage door next to the air conditioner (**Photo 5**). He was using a TIC to direct water flow into the hot spots of the garage as firefighters used pike poles to pull debris out of the garage onto the driveway.

At approximately 1703 hours, the triangular brick gable rafter tipped outward as one piece fell outward onto the driveway on Side Bravo. It fell approximately 21 feet striking four firefighters (a captain and one firefighter from 1412; a captain and one firefighter from E2211). The fifth firefighter from E1412 was not injured.



Photo 5. Side Bravo showing below grade man door on the Side Bravo/Charlie corner, as well as the left and right garage doors. The photo was taken after the brick gable had collapsed. The right side of the garage door has been cut open.
(Photo courtesy of the Office of the State Fire Marshal.)

At 1703 hours a Mayday is called. The IC radioed county 9-1-1 to send more ambulances to the scene. Firefighters from E1610 brought a 1¼-inch handline from Side Alpha to the Side Alpha/Bravo corner to extinguish the burning roof debris on the driveway. One firefighter from E2211 was conscious and

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able to self-extricate. The captain from E2211 was unconscious for about 60 seconds and then self-extricated. The firefighter from E1412 was knocked unconscious but regained consciousness when pulled out of the collapse zone by rescuing firefighters. The captain from E1412 was unconscious and not breathing. He was brought out of the collapse zone and cardiopulmonary resuscitation (CPR) was started. At 1707 hours, the IC requested county 9-1-1 for an air ambulance. At 1718 hours, the captain from E1412 was onboard Medic 74 and enroute to a local hospital with a police escort. CPR was in progress. Medic 74 arrived at the hospital's emergency department at 1728 hours. On-scene paramedics stabilized the three other injured firefighters.

At 1745 hours, the air ambulance departed the scene with the firefighter from E1412. This firefighter was admitted to the hospital and subsequently survived. The other two injured firefighters from FD 22 were transported by ambulance to a local hospital's emergency department where they were treated and released. At 1750 hours the captain from E1412 was pronounced deceased at local hospital.

At approximately 1659 hours, the electrical service line that entered the house on the Side Alpha/Bravo corner, fell across the driveway (**Photo 6**). The IC requested dispatch to send the power company to the scene. Pending arrival of the power company at 1724 hours, the IC radioed on-scene firefighters about the downed line and assigned two firefighters from FPD 23 to safeguard the area. Power to the house was disconnected at 1732 hours.

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Photo 6: Downed power line entering the home at the Side Alpha/Bravo corner.
(Photo courtesy of the Office of the State Fire Marshal.)

At 1710 hours, county FPD 48 arrived on-scene with two tenders: T4861 and T4862. At 1714 hours, a personnel accountability report (PAR) ensued. Each sector/departments conducted their own PAR and reported to the IC that all personnel were accounted for. At 1714 hours, IC informed county 9-1-1 that a building collapse has occurred with multiple injured firefighters.

After the gable collapse fire suppression operations essentially stopped allowing firefighters to assist with the rescue and recovery effort. At 1718 hours, the engineer of E2311 asked a firefighter from E2311 to recheck the hydrant. The firefighter was able to make five additional turns that completely opened the hydrant. Water was no longer an issue at this incident.

At 1758 hours the IC and an assistant fire chief from FPD 23 met with a deputy chief from county FPD 48. The district 48's deputy chief assumed Command as the IC. The fire chief from FPD 23 was experiencing chest pains and was transported to a local hospital for evaluation and treatment. Whatever fireground operations still occurring were stopped. A complete personnel accountability report was conducted by each fire department on-scene. This information was recorded and provided to the new

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IC. The IC met with all on-scene firefighters and ordered a defensive fire operation. A collapse zone was established on all sides of the structure.

At approximately 1845 hours, fire suppression operations were re-started using cellar nozzles. At 2000 hours, the IC advised county 9-1-1 that the fire was under control. The fire was declared out at approximately 2300 hours.

Cause of Death

The forensic pathologist with the Office of the County Coroner listed thoracic blunt trauma and cervicospinal trauma as the cause of death of the captain from E1412.

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:

- *Lack of a collapse zone*
- *Lack of situation awareness*
- *Incomplete scene size-up*
- *Incomplete risk assessment and incident action plan*
- *Incomplete duties of command safety*
- *Task saturation of the IC*
- *Lack of an IC aide*
- *Lack of an incident safety officer*
- *Inadequate water supply*
- *Inconsistent live fire training among the volunteer firefighters*
- *Lack of a personnel accountability system.*

Recommendations

Recommendation #1: Fire departments should ensure the IC establish collapse zones including exclusion zones or no-entry zones at defensive fires as needed due to dangerous or hazardous conditions.

Discussion: While the number of firefighters killed due to a fire-related structural collapse has dropped over the past 20 years, structural collapse remains a significant cause of injury and death to firefighters.

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In 2021, NFPA reported four structural collapse fatalities: two from a roof collapse, and two from floor collapses [Fahy and Petrillo 2022].

Four types of building collapse have been identified: roof, floor, perimeter wall, and building feature [Naum 2015]. Structural collapse or compromise can occur internally or externally to a building, with the external commonly occurring around its perimeter. The fireground perimeter has a high degree of risk due to factors such as building access and egress points, proximity of tactical operations, apparatus position, and staging of personnel.

The potential for fire-related collapse in single-family dwellings is related to two distinct factors: 1) the presence or absence of lightweight construction materials and 2) whether the fire is attacking the structural components. Accordingly, firefighters should be trained and understand building design, construction, and conditions. In addition, firefighters should be trained on how to identify, assess, and predict a structure's performance under fire conditions [Loflin et al. 2014; Naum 2015].

In many structure fires, the probability and anticipation of structural collapse or compromise are minimized, overlooked, or disregarded. This occurs until catastrophic conditions present themselves with little, or no, time to react. This loss of situational awareness can occur due to knowledge gaps in building and construction systems or to distracted attention to pre-collapse building indicators [Naum 2015].

Because fire-related structural collapse can be difficult to predict, the following factors can help identify and assess the risk:

- Construction type
- External load
- Age and condition of the building
- Pre-existing structural damage/deterioration
- Structural weakness caused by explosion or impact
- Presence of free-standing parapets
- Presence of wall anchor plates or stars
- Engineered load systems/lightweight construction
- Types of doors and windows
- Roof design and covering including HVAC units on fast food occupancy roofs
- Renovation/modifications to the structure
- Height of the building
- Fire duration, size, and location
- Fuel loads
- Fire behavior
- Fire protection features such as sprinkler systems and fire walls
- Weight of firefighters and water used for extinguishment [Loflin et al. 2014].

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A collapse zone should be established whenever the risk of structural collapse is identified. A collapse zone is defined as the area around the perimeter of a structure that could contain debris if the building collapsed. This area is often defined by establishing a perimeter at a distance from the building that is equal to 1½ times the height of the structure [Loflin et al., 2014; Naum 2015; NFPA 1500, 2021].

When conditions warrant, a collapse zone can be expanded to an exclusion zone or no-entry zone. An exclusion zone is defined as a zone established by the IC to prohibit specific activities in a specific geographic area. If the fire is not contained and an exterior (defensive) attack becomes necessary, the exclusion zone is moved far enough away from the structure to place the firefighters outside of the collapse zone [Loflin et al. 2014].

When established, a collapse zone should be identified by a fireground transmission, colored tape, signage cones, flashing beacons, fences, or other appropriate means. A “No Entry” policy should be enforced by the IC, Safety Officer, Division/Group Supervisors, and company officers. When it is not possible or practical to visually mark a collapse zone, the IC should verbally identify the collapse zone area to all fireground personnel via radio or other communication methods. During structure fires, the IC should initially evaluate and continually reevaluate risk factors, including the potential for structural collapse based on direct observations; reports from company officers, division/group supervisors, and/or the safety officer [Loflin et al. 2014].

At this incident the partial roof collapse on Side Bravo was clearly visible to all arriving units as they approached the home from Side Alpha. The loss of the roof support should have alerted approaching officers and firefighters of the potential for an interior, or perimeter, collapse. Furthermore, the risk of the brick gable rafter collapse from the progressive loss of roof support should have been identified during scene size-up or during fire suppression activities on Side Bravo or the Bravo/Charlie corner. These eminently dangerous conditions were recognized by two assistant chiefs from FPD 16 and FD 22 and voiced to the Side Bravo sector chief. NIOSH received differing accounts whether this information was also given to the IC during a face-to-face meeting.

Recommendation #2: Fire departments should ensure firefighters are trained in situational awareness, personal safety, and accountability.

Discussion: Situational awareness is defined as “...*your ability to perceive and understand what is happening in the environment (in the context of how time is passing), and then, in turn, to accurately predict future events in time to avoid bad outcomes*” [Gassaway 2017].

Situational awareness is a component of fireground safety and all firefighters operating at an incident should maintain situational awareness. Because fireground dangers and hazards are constantly evolving, situational awareness should be maintained by all firefighters throughout an incident. Any unsafe or changing conditions should be reported to the IC and other members in their environment.

Situational awareness is a 3-level process:

- Level 1 - Perception
- Level 2 - Comprehension

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- Level 3 - Prediction [Gassaway 2022].

Level 1 - Perception

In the fire service, perception, also referred to as sensing or observing, is often associated with size-up. While size-up typically focuses on visual observations, effective perception should involve all 5 senses (hearing, taste, touch, sight, and smell). This first level in the situational awareness process must be deliberate, accurate, and ongoing.

Level 2 - Comprehension

Properly interpreting one's perception on the fireground is the second level of situation awareness. Proper interpretation comes from education, knowledge, training, and experience. If firefighters have any doubts about what they are comprehending, they should re-evaluate, and when possible, seek the input of others. Different understandings of what is occurring on the fireground can arise due to misinterpretation, different frames of reference, or different perspectives. Thus, firefighters and officers with different grasps of the situation should not be simply dismissed. A shared understanding on the fireground at the task, tactical, and strategic level is critical for success.

Level 3 – Prediction

Projecting, forecasting, or visioning is the third and final level of situational awareness known as prediction [Gassaway 2022]. Since the fireground is constantly changing and evolving, plans must not be based solely on what is currently happening. Like comprehension, a firefighter and officer's ability to forecast fire progression relies on their education, knowledge, training, and experience. When firefighters are insufficient in this ability, they should seek input from others with the necessary skills for the situation.

Firefighters must be aware of and avoid the various obstacles to situational awareness such as:

- task fixation or tunnel vision
- distraction
- task saturation
- mind drift
- short term memory overload [Gassaway 2019].

Effectively utilizing these 3 levels of situational awareness increases the chances of a safe and successful operation [Gassaway 2017, 2019, 2022]. Even though a safety officer may be assigned during an incident, all personnel must maintain their situational awareness.

During this incident, various obstacles obscured the firefighters' and the IC's situational awareness. For the IC this included distraction due to managing the water supply issue, and task saturation due to the lack of a safety officer and the lack of an aide. It is unclear why seeing flames coming through a partial roof collapse did not trigger a concern about the stability of the roof, the brick gable, and the entire structure among other firefighters on scene.

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Recommendation #3: Fire departments should ensure the first arriving officer conducts a detailed scene size-up.

Discussion: The first two objectives of fireground operations in the International Association of Fire Chiefs' (IAFC) [Rules of Engagement for Structural Firefighting](#) recommends rapidly conducting, or obtaining, a scene 360° size-up and occupant survival profile [IAFC 2012]. The Rules of Engagement integrate several nationally recognized safety-related programs and principles. 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 another resource on the 1st Alarm. Subsequent scene size-up is an ongoing task that should be assigned to the safety officer. In addition to the 360° size-up, resources should be assigned to Side Charlie, preferably an engine company with a hoseline. [Fire and Rescue Departments of Northern Virginia 2013].

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

- Smoke and fire conditions
- Emphasis on identifying the seat of the fire
- Signal for a working fire, number of stories, type of occupancy, and location of fire
- Unusual building features such as a grade difference between Sides Alpha and Charlie.
- Presence of a basement and basement access
- Any other life or safety hazards [FDNY 2011].

Any change to operational priorities or responsibilities based on the above size-up should be clearly communicated to the IC, all responding units, and the dispatch center via the assigned tactical radio channel. Command should then re-broadcast and receive acknowledgement from all operating companies.

In this incident, the ambulance and county deputy sheriff were the first arriving units. They reported heavy smoke and flames with all human occupants out of the house. The IC was the first arriving officer followed by an officer driving E2312. The IC radioed dispatch that they had a single-story wood frame with heavy fire involvement. The IC confirmed that the occupants were out of the house and called for a defensive strategy. This defensive strategy was not communicated to dispatch or during face-to-face meetings for assignments and was not heard by other firefighters arriving on-scene.

Two separate initial 270° (not 360°) scene size-up walkarounds were conducted by two officers, but neither reported their findings to the IC or to dispatch. A complete scene size up should have been reported to the IC or, as the first arriving officer, the IC should have conducted the initial scene size up. In addition, the IC was preoccupied with running the engine and working on the water supply problem (discussed in subsequent recommendations in this report). At about 1645 hours, 18 minutes after the E2311 arrived on-scene, the IC conducted his own scene size-up of all Sides (Alpha, Bravo, Charlie, Delta).

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Finally, as mentioned in recommendation #1, the partial roof collapse on Side Bravo was clearly visible to arriving crews as they approached the home from Side Alpha. Given the loss of the roof support, this should have alerted approaching officers and firefighters of the potential for an interior or perimeter collapse. This finding should have been communicated to the IC as part of initial scene size-up.

Recommendation #4: During initial fire ground operations, fire departments should ensure the IC conducts a risk assessment, develops a risk management plan, and incorporates these into an incident action plan (IAP). The IAP needs to be clearly communicated to responding personnel and, for more extensive incidents, a tactical worksheet may be required.

Discussion: The third objective of the initial fireground operations involves conducting a risk assessment and developing an IAP [IAFC 2012]. NFPA has developed the following principles of risk assessment and risk management:

- (1) Activities that present a significant risk to the safety of members shall be limited to situations where there is a potential to save endangered lives
- (2) Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of members, and actions shall be taken to reduce or avoid these risks
- (3) No risk to the safety of members shall be acceptable when there is no possibility to save lives or property
- (4) In situations where the risk to fire department members is excessive, activities shall be limited to defensive operations [NFPA 1500, 2021].

The IC 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. Upon assigning resources to a location assignment, the IC should assign the objectives and tasks with that location such as search and rescue, fire attack, ventilation, utility control, and exposure protection. The IAP can be as simple as a verbal transmission to all units assigned to an incident. More extensive incidents may require the IAP to include a tactical worksheet, written plan, or combinations thereof [NFPA 1561, 2020].

Once the chief officer arrives on-scene, an update from the initial IC can occur (face-to-face or by radio). The command officer will then assume command at a stationary location. By following this process, the initial and subsequent ICs will be in a stronger position to manage an incident should an emergency event occur [NFPA 1561, 2020].

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

Defensive Incident Action Planning

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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 defensive strategy is based on protecting firefighters. Defensive strategy tactical priorities include:

- defining the hazard zone
- keeping firefighters out of the potential collapse zone(s)
- searching exposures
- protecting exposures
- establishing cut-offs where forward progress is halted.

A basic defensive IAP includes the following tasks:

- scene size-up
- identify critical fireground factors
- determine the need for additional resources
- evaluate fire spread/write-off lost property
- determine collapse zones and ensures no entry
- search exposures
- protect exposures
- prioritize water streams.

One of the most critical components of an IAP is anticipating a building's performance and risk of structural collapse, compromise, or failure. The fire service must recognize that when any of the structural components start to fail or collapse due to fire involvement, this changes the IAP and strategy. An effective risk management plan could mean that defensive operations may be the only safe option at a structure fire because of the risk of collapse [Loflin et al. 2014].

Communicating the IAP to all assigned and staged members at an incident is an important responsibility of the IC [NFPA 1561, 2020]. Due to the constantly changing risks on the fireground, the risk assessment must be a continuous process. As the risks change, and benchmark are met (or not met), the IAP will need to be continually reviewed and updated as necessary [NFPA 1561, 2020].

At this incident, the fire chief driving E2311 (the IC for this incident) was the first fire officer to arrive on scene and reported a "single story wood frame [with] heavy fire involvement." When he arrived on scene, the chief thought he had transmitted to dispatch that he assumed Command and declared a defensive strategy. The defensive strategy announcement was not heard or acknowledged by dispatch, and firefighters at, or enroute to, the fireground.

Two officers independently conducted 270° walk arounds as the initial size-up. The IC was not briefed on the findings of the size-ups, thus had very limited information to make a risk assessment or develop an IAP. As a result, when dispatched crews arrived on scene, the IC assigned them to various locations around the structure but did not assign any tactical or task objectives to their location. In addition, the IC experienced task saturation due to a water supply problem.

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Recommendation #5: Fire departments should ensure their IC incorporates the principles of command safety into the incident management system.

Discussion: Chapter 8 of NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*, addresses the responsibilities of the command safety in the context of the incident management system. The IC has responsibility for the following:

- initial and ongoing situational assessment of the incident
- establishing an effective communications plan
- developing incident objectives from the situational assessment and form an applicable strategy and tactics
- deploy and request additional resources based upon the needs of the incident
- develop an incident organization for the management of the incident
- reviewing, evaluating, and revising the strategy and tactics based upon the needs of the incident
- provide for the continuity, transfer, or termination of command [NFPA 1561, 2020].

Additional components of command safety include:

- establishing a stationary command post
- establishing an accountability system
- assigning an additional person (staff aide) to facilitate the tracking and accountability of the assigned companies or crews when the IC supervisory responsibility involves three or more companies or crews
- move to defensive operations when the risk to emergency service responders is excessive
- appoint a safety officer at all application emergency incidents [NFPA 1561, 2020].

At this incident, the command post was initially operated from E2311 while the IC ran the pumper and worked on establishing a water supply. While E2311 was “stationary,” it was noisy and full of distractions, which are conditions not conducive to effective command. NFPA suggests utilizing the rear of a sport utility or van-style vehicle as an alternative [NFPA 1561, 2020].

Recommendation #6: Fire departments should develop a process to prevent task saturation of ICs during complex or multi-alarm incidents.

Discussion: Since the inception of the IC, the duties and responsibilities of ICs have significantly increased. As an incident escalates, it is difficult for one individual to effectively manage a complex emergency operation. The IC needs to address issues dealing with situation evaluation, deployment management, strategy, the IAP, communications, personnel accountability, firefighter and responder safety, the tactical worksheet, RIC, and other essential job tasks. Asking one person to command and control a large and complex incident is unfair to this individual, their firefighters, and the citizens they have sworn to protect. Front loading the incident with support for the IC is essential, because the first hour of the incident is when most firefighters are seriously injured or killed [Brunacini and Brunacini 2004].

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Fire departments should have a process to support the IC during large, complex, or multi-alarm incidents. This is especially important when the command officer does not have an aide (e.g., staff aide, incident command technician, or chief's aide). The support process could include dispatching an additional battalion chief on the working alarm assignment. If this battalion chief is going to be assigned to supervise a division or group, then another battalion chief should be dispatched and function as the planning section chief. This will allow the IC to focus on operational issues.

In this incident, the IC did not have an aide or an incident safety officer. Because of the lack of an aide or safety officer, the IC had a tremendous number of tasks to attend to.

Recommendation #7: Fire departments should make an IC aide available during working structure fires.

Discussion: The staff aide (e.g., chief's aide, emergency incident technician, incident command technician, field incident technician, or staff assistant) is an essential component of the incident management system [Brunacini 2002]. Chapter 8 of NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety*, states that "an IC supervising three or more companies or crews under their command shall have an additional person (staff aide) assigned to facilitate the tracking and accountability of the assigned companies or crews" [NFPA 1561, 2020].

Some fire departments use firefighters as staff aides, other fire departments use fire officers. Regardless of the rank of the staff aide, the assigned personnel should be trained in the duties and responsibilities of an IC aide.

The IC aide has three primary responsibilities:

- resource and accountability status (discussed further in recommendation 12 of this report)
- situation status
- command post communications [Fire and Rescue Departments of Northern Virginia 2013].

Upon arrival at the fire scene, the staff aide should report to command. After conferring with the IC, the staff aide should set up the command post, allowing the IC to focus on the command and control of the incident. The IC will determine whether to operate from the front of the vehicle or to move to the rear. Once the command post is set up and ready to support communications and resource and situation tracking, both the IC and the staff aide may operate from the rear of the vehicle using the command board(s) and radio headsets for incident management.

Tasks required of the IC aide include:

- Determine and track status of resources
- Track units and members
- Anticipate the need for additional resources based upon assignments being made
- Manage command channel communications
- Provide progress reports
- Monitor secondary tactical channels if utilized in the operation

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- Anticipate and recommend logistical needs to support the operation
- Brief incoming chief officers as necessary [Fire and Rescue Departments of Northern Virginia 2013].

Depending on the scale and complexity of the incident, a single staff aide may not be able to manage all three of the primary responsibilities. IC needs to ensure these three responsibilities are being completed. If not, an additional aide, or aides, should be assigned.

In this incident, no staff aide was available or assigned. As a result, the responsibility of resource accountability was not performed until after the Mayday occurred.

Recommendation #8: Fire departments should ensure that an incident safety officer, independent of the IC, is appointed at working structure fires.

Discussion: The incident commander relies upon firefighters to report on fireground conditions which, in turn, allows the IC to make informed decisions regarding risk-versus-gain and offensive-versus-defensive operations. As incidents escalate in size and complexity, on scene firefighter health and safety are best preserved by delegating the function of safety and health oversight to an incident safety officer [NFPA 1500, 2022].

Fire departments should develop response procedures to ensure a pre-designated incident safety officer, independent of the incident commander, responds automatically to pre-designated incidents. The role and duties of a safety officer include:

- recon of the fireground and reporting pertinent information back to the incident command
- ensure the department's accountability system is in place
- monitor radio transmissions
- identify barriers to effective communications
- ensure established safety zones, collapse zones, hot zones, and other designated hazard areas are communicated and respected by all members on scene [NFPA 1521, 2020; NFPA 1561, 2020; NFPA 1026, 2024].

The requisite skills include:

- critical identification, analysis, and judgment abilities
- applying AHJ building fire preplan systems at actual incidents
- interpreting collapse hazards
- communicating hazard information to personnel via the incident safety plan, IAP, face-to-face, radio, and safety briefings
- determining boundaries and markings for control zones
- formulating recommendations for incident command action
- exercising authority to suspend imminent danger operations
- anticipating evolving site conditions that require IAP changes [NFPA 1521, 2020].

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Upon arrival at the incident, the designated safety officer should meet with the IC to confirm the safety officer assignment and become integrated into the personnel accountability system. The safety officer should obtain the following information:

- overall situation status and resource status
- the IAP
- the presence of known hazards
- concerns about the establishment of control zones
- confirmation of established radio communication channels (command channel, tactical channel)
- status of rapid intervention crews
- establishment of the rehabilitation [NFPA 1561, 2020].

Once the information is obtained, the safety officer should don the necessary personal protective equipment and wear a vest or helmet identifying themselves as the safety officer.

Larger fire departments may assign one or more full-time staff officers as safety officers who respond to working fires. In smaller departments, every officer should be prepared to function as the safety officer when assigned by the IC. The presence of a safety officer does not diminish the responsibility of individual firefighters and fire officers for their own safety and the safety of others. [NFPA 1561, 2021].

At this incident, an incident safety officer was not assigned.

Recommendation #9: Fire departments should ensure that an adequate sustainable water supply is established and maintained. Firefighters should have periodic training on hydrant operations.

Discussion: Establishing adequate water supply on the fireground is one of the most critical elements of firefighting. 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]. Before committing resources in the hazard zone, the IC must ensure a sustainable water supply is available. Thus, during size-up and risk assessment, the IC should consider the following information:

- fire load
- fire flows requirements for the incident
- key tactical areas needing water
- units needing a continuous water supply
- number of handlines a pumper(s) can charge and pump
- number of large diameter openings the pumper(s) charge and pump
- water sources
- staffing [NFPA 1142, 2022; Wieder 2019].

At this incident, the IC was also operating E2311. E2312 laid a 5-inch supply line from the hydrant to E2311, which was about 250-foot lay. A firefighter/EMT from Medic 74 made the hose connection to

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the hydrant and charged the supply line. The firefighter/EMT from Medic 74 did not realize the hydrant was not completely open, which caused the inadequate water supply. The intake pressure dropped to zero and the pump started to cavitate when all three lines (the 2½-inch hoseline and the two 1¾ -inch hoselines) were flowing.

One of the first issues when dealing with a loss of water is to ensure that the fire hydrant is completely open. The lieutenant who took over pump operations on E2311, asked an engineer from FPD 23 to check the hydrant. Instead of checking the hydrant himself, the firefighter asked the firefighter/EMT from Medic 74 who originally opened the hydrant if it was completely open. The firefighter/EMT from Medic 74 responded that the hydrant was completely open. Given that inaccurate information, the lieutenant and the IC began making other arrangements for water, contacting dispatch to send tenders from other fire departments. At 1718 hours, about 15 minutes after the gable collapse, the lieutenant operating E2311, asked another engineer to check the fire hydrant again. The firefighter went to the hydrant and opened it using 5 additional turns, which provided an adequate water supply for this incident.

Recommendation #10: Fire departments should ensure that all members engaged in emergency operations receive annual training and evaluation on fireground operations including live fire training to improve proficiency during fireground operations.

Discussion: NFPA 1500, *Standard for a Fire Department Occupational Safety, Health, and Welfare Program*, requires a fire department to establish and maintain a training, education, and professional development program commensurate with the duties and functions that they are expected to perform [NFPA 1500, 2021]. Members who engage in structural firefighting should meet the qualification requirements of NFPA 1001, *Standard for Fire Fighter Professional Qualifications* [NFPA 1001, 2019]. NFPA 1410, *Standard on Training for Initial 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 1410, 2020]. 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. Finally, live-fire training should be conducted in compliance with NFPA 1403, *Standard on Live Fire Training Evolutions* [NFPA 1403, 2018].

At this incident, NIOSH confirmed live fire training within the past year for all five members who responded to the fireground from county FPD 14. However, several of the responding fire departments did not require annual live fire training. NIOSH did not request live fire training completion dates for all the responding firefighters.

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Recommendation #11: Fire departments should utilize a functional personnel accountability system, requiring a check-in and check-out procedure with the designated accountability officer or IC.

Discussion: The NIOSH FFFIPP has identified the lack of accountability to be an important contributing factor in many line of duty deaths [NFPA 1561, 2020]. A personnel accountability system is an important function of command safety. This system identifies the functional and geographical assignments from the beginning to the end of operations. Documenting the situation and resource status can occur on the tactical worksheet or other methods such as:

- accountability tags or keys (e.g., PASSPORT system)
- command boards
- apparatus riding lists
- company personnel boards
- electronic bar-coding systems [NFPA 1561, 2020].

Accountability should be separate from the role of the incident commander when 3 or more companies or crews are operating. In addition, fire departments should develop an accountability SOP, train members on its use, and enforce its use during emergency incidents [NFPA 1500, 2021]. In addition, 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 IC [NFPA 1561, 2000]. In their SOP, fire departments should establish their own PAR frequency. Some departments conduct PARs every 15–20 minutes or when benchmarks are met.

At this incident, all dispatched fire departments carried accountability tags. However, as crews approached the IC, with no aide to assist, no effort was made to track their functional and geographical assignments. The first PAR was conducted after the Mayday, approximately 30 minutes after units arrived on scene.

The following recommendations are provided as a reminder of a good safety practices. There is unlikely any of these recommendations would have prevented this fatality.

Recommendation #12: County communication centers (dispatch) should consider announcing an incident clock at 10-, or 15-minute intervals to the IC.

Discussion: Chapter 8 of NFPA 1500, *Standard for a Fire Department Occupational Safety, Health, and Welfare Program*, has a section on communications during emergency operations. The standard recommends communication centers start an incident clock when the first arriving unit is on-scene of a working structure fire or hazardous materials incident. Then, at 10-minute increments, dispatch notifies the IC with an announcement such as, “incident clock is 10 minutes,” “incident clock is 20 minutes,” “incident clock is 30 minutes,” and so forth [NFPA 1500, 2021]. NFPA 1561 suggests the transmission be in 15-minute intervals [NFPA 1561, 2020]. For incidents with long travel times, some fire departments want elapsed time-from-dispatch announcements. This method can be more appropriate where significant incident progress could have occurred prior to the first unit arrival. Fireground

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conditions allow the IC to cancel or change the intervals of the incident clock notifications [NFPA 1500, 2021].

At this incident, the communication center's first incident clock notification was at 1655 hours, 44 minutes from time-from-dispatch and 27 minutes from time-from-arrival. Subsequent incident clock announcements were appropriately cancelled due to the Mayday.

Recommendation #13: Fire departments should ensure that all firefighters and fire officers are trained in managing a Mayday.

Discussion: Chapter 8 of NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program* and chapter 6 of NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety* addresses the use of the term Mayday [NFPA 1561, 2020]. Mayday is an internationally known radio distress signal used by firefighters who are in, or about to become in, a life-threatening situation. Any member in a potentially life-threatening situation can issue a "Mayday, Mayday, Mayday" on their portable radio. The communications center should clear all radio traffic to give priority to emergency messages.

The rescue of a lost, missing, trapped, or injured firefighter is time sensitive. A very narrow window of survivability exists for a firefighter who is out of air or trapped in a hazardous environment. The two most important rescue tasks are protecting the downed firefighter from fire and getting air to the downed firefighter. The IC is responsible for ensuring these two tasks are completed and must revise the incident's strategy, tactics, and tasks accordingly. In addition, as part of its Fire Ground Survival manual, the IAFF has developed a Mayday checklist [IAFF 2023].

The fire service has developed several Mayday training courses that are available at conferences or as standalone training programs. NIOSH recommends fire departments take advantage of these trainings to ensure their members are familiar with what to do if, or when, a Mayday strikes.

Recommendation #14: Fire departments should develop and implement a standard operating procedure/guideline on the deployment and use of rapid intervention crew(s) [RIC].

Discussion: In 1988 the Occupational Safety and Health Administration's (OSHA) issued the [respiratory protection](#) standard. Since Illinois operates as an OSHA-approved State Plan covering state and local government workers, fire departments operating in Illinois must comply with 29 CFR 1910.134 [OSHA 2023]. Relevant to the fire service, 29 CFR 1910.134(g)(4) outlines the rescue requirements for interior structural firefighting operations [OSHA 1988]. Commonly referred to as "2 in 2-out," the standard requires:

- at least two employees enter the immediately dangerous to life and health (IDLH) atmosphere together [note: interior structure fires have an IDLH atmosphere]
- at least two employees are located outside the IDLH atmosphere to provide rescue activities
- the two employees entering the hazard zone must always remain in visual or voice contact with one another and with the rescue employees outside the IDLH atmosphere

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- the employees located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue
- all employees engaged in interior structural firefighting use SCBA
- all employees located outside the IDLH atmosphere are equipped with SCBA
- the employer or designee is notified before an emergency rescue operation is initiated
- firefighters can perform emergency rescue activities before an entire team has assembled
- one of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as IC in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

The fire service calls these rescue teams either rapid intervention crews (RIC), rapid intervention teams (RIT), or firefighter assist and search teams (FAST). Several NFPA standards have expanded on the policies and procedures of OSHA's 2-in 2-out regulation [NFPA 1407, 2020; NFPA 1500, 2021; NFPA 1521, 2020; NFPA 1710, 2020; NFPA 1720, 2020].

In this incident a RIC team was not in place prior to a first-floor attack crew entering the structure. This did not result or contribute in any way to the tragic death of the firefighter during this response, nor did it delay any of the heroic efforts to extract, resuscitate or transport the injured firefighters. Nonetheless, NIOSH recommends fire departments follow the relevant section of the above NFPA standards for RIC teams.

Recommendation #15: During significant structure fires, fire departments should ensure that power is disconnected to the structure early in the incident to reduce the risk of electrocution.

Discussion: Firefighters are at risk of electrocution when working around downed power lines [NIOSH 2006]. In 2021, one firefighter died due to electrocution [Fahy and Petrillo 2022]. Chapter 8.6 of NFPA 1500 addresses the procedures when firefighters are operating near hazardous energy sources including downed power lines [NFPA 1500, 2021]. During a structure fire locating and shutting off the electric service is typically tasked very early during the response to reduce the risk of firefighters being electrocuted [Bush 2022].

In this incident, a crew was not tasked with locating and shutting off the power. When a live power line fell across the driveway, the power company was notified, and a firefighter was posted to warn and keep firefighters away from the downed line. The power company cut power to the line approximately 30 minutes later (1724 hours).

Recommendation #16: Fire departments should document when hydrants in their jurisdiction are tested and flushed.

Chapter 4 of NFPA 291, *Recommended Practice for Water Flow Testing and Marking of Hydrants*, provides flow testing requirements for hydrants [NFPA 291, 2022]. For public hydrants, this NFPA standard recommends:

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- flow testing at least every 5 years to verify capacity and marking of the hydrant
- flushing at least annually to verify operation, address repairs, and verify reliability.

At this incident, the agency having jurisdiction was not able to provide NIOSH investigators with the most recent flow testing or flushing of the hydrant used at this incident.

Recommendation #17: 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 [NFPA 1584, 2022]. The physical and mental condition of personnel should be monitored to ensure a fire fighter's health and judgement is not negatively impacted which could affect the safety and integrity of the entire operation. The circumstances of each incident should determine the need for the following:

- medical evaluation and treatment
- food and fluid replenishment
- rest and relief from extreme climatic conditions.

Despite essentially being a defensive strategy, the long duration of the incident (approximately eight hours) suggests a role for establishing rehab.

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Investigator Information

This incident was investigated by Thomas Hales, Medical Officer, and Murrey Loflin, Investigator, with the Firefighter Fatality Investigation and Prevention Program, and Jennifer Lincoln, Investigator, with the Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH. An expert technical review was provided by Michael Barakey. A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division.

Additional Information

IAFC Rules of Engagement for Firefighter Survival

The International Association of Fire Chiefs (IAFC) is committed to reducing firefighter fatalities and injuries. As part of that effort, the nearly 1,000 member IAFC Safety, Health and Survival Section has developed the DRAFT “Rules of Engagement for Structural Firefighting” to provide guidance to individual fire fighters and ICs, regarding risk and safety issues when operating on the fireground. The guidance provides a set of “modern procedures” for structural firefighting made available by the IAFC to fire departments as a guide for their own standard operating procedure development process.

IAFF Fire Ground Survival Program

The International Association of Fire Fighters (IAFF) Fire Ground Survival Program provides training for Mayday prevention and Mayday operations for 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 firefighter 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, and NIOSH.

Underwriters Laboratories (UL) Firefighter Safety Research Institute

UL’s Fire Safety Research Institute (FSRI) advances fire safety knowledge to address the world’s unresolved fire safety risks and emerging dangers. Through advanced fire science, rigorous research, extensive outreach, and education in collaboration with our international network of partners, we impart stakeholders with the information, tools and resources that enable them to make better, more fire-safe decisions that ultimately save lives and property.

Brick Gable End Collapses at Residential Structure Fire Killing a Fire Captain and Injuring Three Fire Fighters – Illinois

Disclaimer

The information in this report is based upon dispatch records, audio recordings, witness statements, and other information that was made available to the National Institute for Occupational Safety and Health (NIOSH). Information gathered from witnesses may be affected by recall bias. The facts, contributing factors, and recommendations contained in this report are based on the totality of the information gathered during the investigation process. This report was prepared after the event occurred, includes information from appropriate fire service subject matter experts, and is not intended to place blame on those involved in the incident. Mention of any company or product does not constitute endorsement by NIOSH, Centers for Disease Control and Prevention (CDC). 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.