



Volunteer Fire Fighter Dies from Injuries Sustained at a Residential Structure Fire—New York

Executive Summary

On December 19, 2014, a 42-year-old, male, volunteer fire fighter was injured at a residential structure fire and died 4 days later at a metropolitan trauma center. At 0408 hours, Truck 313 was dispatched to a working residential structure fire as the third-due truck company. Truck 313 responded at 0414 hours and arrived on-scene at 0420 hours. The crew of Truck 313 was five fire fighters including an *acting officer*. The chauffeur of Truck 313 stayed with the apparatus. The crew of Truck 313 was assigned as the RIC/FAST company, but the assistant chief from Fire Department 310 advised Command Truck 313 didn't have the tools for that assignment. Command advised them to use the tools on Ladder 352 for the RIC/FAST assignment. Truck 313



The 2½ story colonial style home where a volunteer fire fighter was found unconscious in the basement. The basement is located on Side Alpha going from Side Bravo to Side Delta.
(NIOSH photo.)

proceeded to Side 3 (Side Charlie) and entered the house without leaving their personnel accountability tags with Command. *Note: The fire departments involved in this incident define the sides of a structure by number [e.g., Side 1 (front of the building), Side 2, Side 3, and Side 4] instead of the phonetic alphabet (e.g., Side Alpha, Side Bravo, Side Charlie, and Side Delta).* The Truck 313 outside vent man (OVM) had an issue with his SCBA, notified the Truck 313 acting officer, and returned to Truck 313 for another SCBA. The Truck 313 acting officer assigned the probationary fire fighter riding on Truck 313 to stay at the rear sliding glass door on Side Charlie. The Truck 313 acting officer and the Truck 313 Irons fire fighter proceeded into the house with Engine 304. Truck 313 was going to conduct a search of the first floor. The Truck 313 acting officer assumed that the Truck 313 Irons fire fighter was still behind him in addition to three or four other fire fighters who were behind him. The Truck 313 acting officer got to the entrance of the dining room and met a chief from a mutual aid department. The chief advised the Truck 313 acting officer that the dining room floor on Side Alpha/Bravo had collapsed and not to enter the room. The Truck 313 acting officer met the Ladder 325 officer in the

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hallway and also Truck 313 OVM fire fighter, who had returned to the interior of the house. The Truck 313 acting officer and Truck 313 OVM went to the second floor to conduct a search. At this point, the location of Truck 313 Irons fire fighter was unknown. Truck 313 went by a hole in the front foyer (caused by the fire), which the initial fire attack crews had discovered when they entered the front door. After they searched the second floor, they returned to the first floor. As Truck 313 got to the first floor, a Mayday was transmitted from the basement by the Engine 304 officer for a “fire fighter down.” The Truck 313 Irons fire fighter was found face down in several inches of water. The fire fighter was removed from the basement in cardiac arrest and transported to a local hospital by Ambulance 3591. After extensive resuscitation efforts, the medic crew of Ambulance 3591 was able to restore a heartbeat in the hospital. The fire fighter was later transported to a trauma center but died on December 23, 2014.

Contributing Factors

- *Combustible materials left in hallway of home under renovation*
- *Lack of crew integrity*
- *Ineffective span of control*
- *Ineffective personnel accountability system*
- *Lack of assigned rapid intervention crew (RIC) or fire fighter assist and search team (FAST)*
- *Lack of training between automatic aid fire departments*
- *Hole in the first-floor foyer from the fire*

Key Recommendations

- *Fire departments should ensure that crew integrity is maintained when operating in an immediately dangerous to life and health (IDLH) atmosphere*
- *Fire departments should review their personnel accountability system standard operating procedure/guideline to ensure that the system is staffed, functions properly, and all resources are accounted for at an incident*
- *Fire departments should ensure that the incident commander establishes a dedicated rapid intervention crew(s) (RIC) and that the RIC is available throughout the incident.*

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

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



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Introduction

On December 19, 2014, a 42-year-old, volunteer fire fighter was injured during a residential structure fire. The fire fighter died on December 23, 2014, at a metropolitan trauma center. On December 24, 2014, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On January 20–26, 2015, an investigator, a general engineer, and a safety engineer from the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to New York to investigate this incident. The NIOSH investigators met with members of the volunteer fire department involved in this incident; members of the four volunteer fire departments that responded to the 1st Alarm assignment, working fire dispatch, and 2nd Alarm assignment; the county fire investigator; and the director of the county’s Fire Communications Bureau. The NIOSH investigators visited the site and took photographs. The NIOSH investigators interviewed officers, fire fighters, and emergency medical services personnel who were on-scene at the time of the incident. The investigators reviewed fire department standard operating procedures, training records, dispatch records, witness statements, and the medical examiner’s report. Also, the NIOSH investigators inspected the Truck 313 Irons fire fighter’s turnout gear and self-contained breathing apparatus.

Fire Department

This volunteer fire department has one station, which serves a population of approximately 6,000 within an area of about 1 square mile. The fire department is a private corporation. The town served by the fire department is primarily residential with some light industry that supports the operations of an international airport located in an adjoining city. The town is surrounded on two sides by water. The fire department employs one full-time emergency medical technician, who is also a certified fire fighter. The fire department employs a part-time business manager to oversee the daily administrative functions. Also, the fire department employs two part-time clerical staff. There are 50 active uniform members in the fire department of which 43 are Class A fire fighters trained and certified for interior structural fire-fighting operations.

To become a member of the fire department, the following must occur:

- Complete a fire department application.
- Pass a background check conducted by the county’s fire marshal’s office and sheriff’s office.
- Pass a medical examination that follows NPFA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments [NFPA 2013c].
- Be voted in by the membership of the department.

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Training and Experience

The state of New York recognizes the attainment of prescribed levels of training in specific disciplines, as established by the Minimum Standards for Firefighting Personnel in the State of New York, through the completion of New York State (NYS) Fire or Code Enforcement training [New York State 2008].

The requirements are:

- Minimum basic fire training for probationary and nonpermanent fire fighters shall consist of a minimum of 229 hours in approved courses.
- Satisfactory completion of basic training shall include a candidate physical ability test.

The courses shall be as set forth herein, with content at least equivalent to that found in appropriate sections of the NYS fire training courses and shall be conducted for the minimum times specified herein, section, or until the indicated performance objective has been accomplished and measured by the chief of the fire department or his/her designee.

The topics for the minimum basic training include:

- Local fire department rules, regulations, standard operating policies or procedures, communications systems, policies for receiving both personal and official phone calls, procedures to initiate an emergency response, and general duties other than those covered in training for emergency operations and response. There are no hours established for this training though compliance is required.
- Fire Fighter Skills—75 hours
- Fire Prevention—24 hours
- Ladder Operations—18 hours
- Pump Operations—18 hours
- Basic Wildland Fire Suppression—9 hours
- Rescue Operations—21 hours
- Hazardous Materials First Responder Awareness and Operations—16 hours
- Auto Accident Victim Extrication—16 hours
- First Aid and Cardiovascular Pulmonary Resuscitation—17 hours
- Incident Command System—12 hours
- Candidate Physical Ability Test. There are no hours established for this element though compliance is required.
- Health and Wellness—1 hour

Note: Where completion of the Fire Fighter I course is required for a NYS certification, completion of all of the following courses will be accepted as equivalent for certification purposes:

- Firefighting Essentials or Basic Fire fighter
- Initial Fire Attack or Intermediate Fire fighter
- Hazardous Materials First Responder Operations

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Fire service training is conducted at the county's fire service academy, which is located on 7 acres and instructs 10,000 fire fighters annually. The fire service academy trains approximately 450–500 fire fighter recruits annually and is under the direction of a chief instructor, assistant chief instructor, and 81 part-time instructors. All instructors are certified to NFPA 1041, *Standard for Fire Service Instructor Professional Qualifications*, Instructor III, through the NYS Fire Academy. The fire service academy offers fire service training; special operations training provides pump service testing, ground ladder testing, and aerial testing for all county fire departments. The budget for the fire service academy for 2015 was \$1,400,000.

The fire department requires all fire fighters to complete NFPA 1001 *Standard on Fire Fighter Professional Qualifications*, Fire Fighter I [NFPA 2013a]. This is a 23-week certification program that is taught at the county's fire academy. The course consists of 13 classroom sessions on fire-fighting essentials and 13 classes on primary (practical) fire-fighting training. Upon completion of the training, the fire fighter will be certified as a Fire Fighter I, Hazardous Materials Awareness level, and Hazardous Materials Operations level. The candidate will also complete emergency medical services (e.g., Certified First Responder) training through the county's emergency medical services (EMS) training academy.

For the position of fire fighter, the department also requires the completion of the Essentials of Fire Fighting, NIMS 100—Introduction to the Incident Command System (ICS), NIMS 200—Basic ICS, NIMS 300—Intermediate ICS, NIMS 800.B—National Response Framework, and the county's fire academy's Introduction to Department Operations.

The department requires participation in annual live fire training at the county's fire academy. The scenarios include residential, multifamily, garden apartments, and taxpayer (business on the first floor and residents on the upper floors) fires. The state of New York, Department of Labor Public Employee Safety and Health (PESH) Division requires annual training on the following:

- Bloodborne pathogens
- Fire station safety
- Respiratory protection
- Workplace violence

The training for the Truck 313 Irons fire fighter included:

Course Description	Date of Completion
Mask Confidence Course	November 1996
Essential of Fire Fighting	February 1997
Department Operations	Annually
Flammable Liquids	June 1999
Rope I	September 1999
Rope II	October 1999
Officer Training	February 2000

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Water Rescue—Awareness Level	May 2010
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The training for the incident commander included:

Course Description	Date of Completion
Incident Response to Terrorist Bombings	April 2003
Basic Fire Fighter Training	June 2003
Primary Training	July 2003
Hazardous Materials First Responder Operations	October 2003
Essentials of Fire Fighting	October 2003
NYS Hazardous Materials Operations	October 2003
Officer Training	January 2004
Strategy and Tactics	January 2004
Carbon Monoxide Response & Air Monitoring	February 2004
Ice Rescue	February 2004
WMD Incident Complexities (Responder-8)	August 2004
American Heart Association CPR/AED for BLS	September 2004
IS700.A—Introduction to NIMS	February 2005
Incident Command System	February 2005
ProBoard Certification: NFPA 1001, Fire Fighter 1	June 2005
Motor Pump Operator	December 2005
EVIP EVOC	May 2006
Liquid Propane Gas I	May 2006
Vehicle Extrication	August 2006
Fire Fighter Rescue & Survival While Searching Private Dwellings	October 2006
New York State Fire Incident Reporting	January 2007
Carbon Monoxide Response & Air Monitoring	January 2007
Fireground Communications	February 2007
American Heart Association CPR/AED for BLS	April 2007
Department Operations	Annually
CPR Certification	Annually
Rope I	August 2007
Rapid Intervention	June 2008
IS800.B—National Response Framework, An Introduction;	November 2008
ICS 100—Introduction to ICS	November 2008
ICS 200—Basic ICS	November 2008
Confined Space Awareness	November 2008
LI Railroad Safety and Awareness	March 2009
Building Construction	May 2009
ICS 300—Intermediate ICS	May 2009
ICS 400—Advanced ICS	May 2009
Liquid Propane Gas I	May 2010

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Liquid Propane Gas II	June 2010
Emergency Medical Technician Basic	August 2011
Incident Safety Officer	March 2012
Water Rescue—Awareness Level	March 2012
Principles of Instruction	March 2012
Rescue Technician—Basic	June 2012
Fire Dynamics in Modern Construction	June 2012
Basic Structural Collapse Operations	August 2012
Hazardous Materials Incident Command	September 2012
Calling the Mayday—Train-the-Trainer	April 2013
EMT/Basic Recertification	February 2014
Rope I	June 2014
Rope II	July 2014
Ladder Company Rope	July 2014

Equipment and Personnel

The county in which the fire occurred consists of 453 square miles—285 square miles of land, 169 square miles of water. There are 71 fire departments—3 being combination departments. The county is divided into 9 battalions with each battalion having 6–8 fire departments. This incident occurred in the 3rd Battalion. The battalions are for organizational purposes and not for response, which is determined by the fire chief of each fire department.

Forty-two of the 71 fire departments are dispatched by the county’s Fire Communications Bureau (FIRECOM). The remaining fire departments have their own dispatch center or are dispatched by another fire department. The county’s Second Battalion, Third Battalion, and Fourth Battalion use low band frequency 46.10 for dispatching and response. Low band frequency 46.20 is used as the tactical channel and is designated as the “all county-wide” channel. Each fire department’s portable radios have low band frequency 46.20. Not every fire fighter is issued a portable radio. Most departments supply a portable radio by riding position on each apparatus. Also, the mobile radios in the apparatus are not equipped with the low band frequency 46.20. Several of the 29 fire departments that operate from their own or joint dispatch centers operate on ultra-high frequencies (UHF). Each fire department has their own standard operating procedures/guidelines for fireground communications.

The Truck 313 Irons fire fighter’s fire department operates the following apparatus:

- 3 engines
- 1 tower ladder (75-foot Aerialscope)
- 2 ambulances
- 3 support vehicles (1 van and 2 pick-up trucks)
- 3 chief vehicles (SUVs)
- 3 boats

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- 1 6x6 vehicle

The maintenance on the apparatus and vehicles is performed by a third-party fire department vehicle maintenance company at the fire station.

Building Construction

The structure involved was a 2½-story colonial wood frame, center hallway home, with a brick exterior, a full basement, and a balloon frame construction. *Note: Balloon frame construction is defined as a wooden structure in which all vertical studs in the exterior bearing walls extend the full height from the bottom frame (sill), which is bolted to the foundation and to the roof. There are no firestops within the walls [Brannigan and Corbett 2007].*

The house was a single-family residence located on the southeast side of the street facing northwest. The structure was built in 1927. There was a total living space of 3,360 square feet. The first floor consisted of a dining room, kitchen, family room, living room, and half bath (**See Diagram 1**). The second floor consisted of five bedrooms with 2½ baths. There was an unfinished attic and a full basement. The basement consisted of storage racks, electrical panels, a natural gas furnace, and a hot water heater.

At the time of the fire, the home was under renovation and was not occupied. There was a large hole in the floor of the first-floor hallway, which was caused by the fire. The hole in the front hallway was approximately 9 feet 5 inches from the front door (Side Alpha) and approximately 12 feet 1 inch from the back of the hole to the entrance of the basement stairs. The hole was mostly on the north side of the hallway. There was approximately 18 inches to 24 inches that separated the hole and the south hallway wall and approximately 24 inches to 36 inches from the east side of the hole and the stairs to the second floor. The hole was approximately 6 feet (east to west) and 4 feet (north to south). On the east side of the hole there was a portion of material consistent with a painter's drop cloth, which hung partially down in the hole. Next to the hole on the south side was a cover to a quart-size can consistent with that of a paint can. The hallway sustained severe fire and heat damage toward the west end of the hallway near the hole. There was moderate to severe heat damage towards the east end of the hallway where the basement steps were located.

The origin and cause of the fire was spontaneous combustion of used rags containing staining materials left in a plastic bag on the floor of the first-floor hallway (**See Photo 1**).

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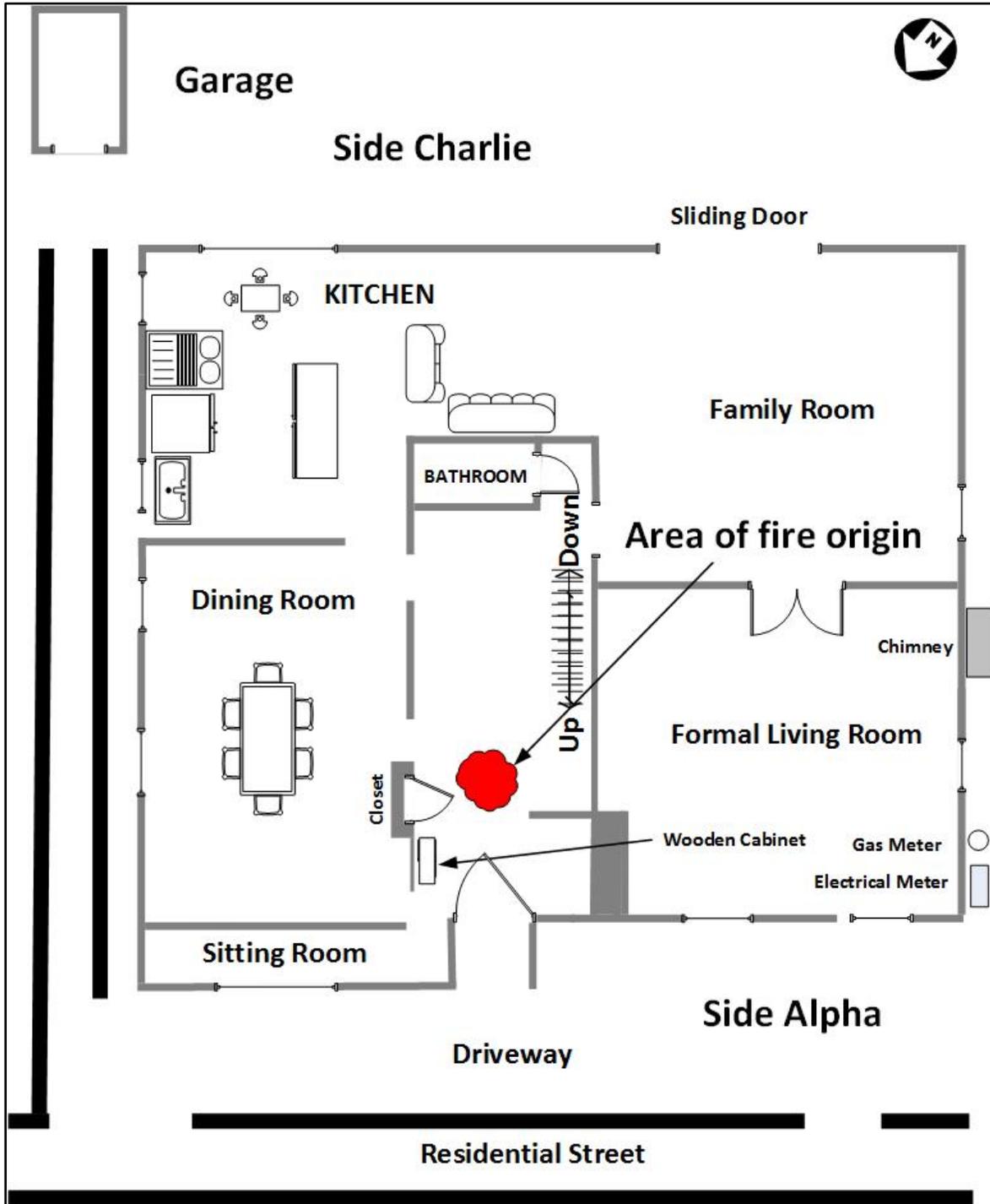


Diagram 1. The floor plan of the first floor. The fire originated in the front foyer near the front door.

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Photo 1. The hole in the foyer on the first floor covered by the ladder. This picture was taken from the front door after the fire was extinguished.

(Photo courtesy of the county fire marshal's office.)

Timeline

This timeline is provided to set out, to the extent possible, the sequence of events according to recorded radio transmissions. *Note: The fireground channel for this incident was on a non-repeater channel and was not recorded.* Times are approximate and were obtained from review of the dispatch records, witness interviews, and other available information. Times have been rounded to the nearest minute. NIOSH investigators have attempted to include all relevant radio transmissions. This timeline is not intended, nor should it be used, as a formal record of events.

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Incident and Fireground Conditions	Time	Response & Fireground Operations
The county’s Fire Communications Bureau (FIRECOM) received a 9-1-1 call that reported a residential structure fire.	0355 Hours	
FIRECOM dispatched Engine 354, Engine 355, Ladder 352, and Chief 3500 to a residential structure fire.	0356 Hours	
Chief 3500 responded and requested a full response from Fire Department 350. FIRECOM advised Chief 3500 this will be a working fire.	0401 Hours	
FIRECOM alerted Fire Department 350 for a general alarm—structure fire.	0402 Hours	
Chief 3500 arrived on-scene; Chief 3500 assumed Command.	0403 Hours	
Engine 355 arrived on-scene.	0405 Hours	Command advised, “This is a 48-foot by 40-foot, 2-story, wood-frame construction, single-family dwelling with smoke showing at this time. Transmit the 10.” <i>Note: Signal 10 is a working structure fire.</i>
Ladder 352 on-scene. Engine 304 (Fire Department 300) was alerted to backfill/relocate to Fire Department 350. Ladder 325 dispatched as FAST Truck.	0406 Hours	
Command requested a 2nd Alarm for this incident.	0407 Hours	Engine 355 requested the 2-inch hoseline stretched to the front door be charged.

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Incident and Fireground Conditions	Time	Response & Fireground Operations
Ladder 325 on-scene as FAST Truck. FIRECOM dispatched Truck 313 and Ambulance 319 to respond to the scene. Note: <i>Command had requested that Fire Department 310 respond as a RIC/FAST company.</i>	0408 Hours	
FIRECOM requested mutual aid to assist Fire Department 350 for a residential structure fire. Engine 343 dispatched to scene. Requested one ladder (Ladder 427) and one ambulance (Ambulance 429).	0409 Hours	
Engine 354 responded.	0410 Hours	
Engine 354 on-scene.	0411 Hours	
Engine 343 on-scene.	0412 Hours	
Fire Department 340 was alerted to backfill/relocate to Fire Department 350.	0414 Hours	
Command requested a Signal 27E. Note: <i>A Signal 27E is a request for the electric/power company to respond.</i>	0414 Hours	
Truck 313 responded.	0414 Hours	
Command requested that a standby ladder company and ambulance respond to the scene. Ladder 427 and Ambulance 425 are dispatched to the scene.	0415 Hours	
Engine 304 and Ambulance 309 responded to the scene.	0416 Hours	

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Incident and Fireground Conditions	Time	Response & Fireground Operations
	0417 Hours	An “urgent” was transmitted by a Fire Station 340 assistant chief (Chief 3401) (first-floor sector (division)) regarding the hole in the floor in the foyer. <i>Note: Due to the multiple radio systems being used at this incident and lack of radio transcripts, there was no record indicating this “urgent” was heard or acknowledged.</i>
<p>Engine 304 on-scene. Chief 3200 on-scene.</p> <p>Command requested that the Command Post transmit a 3rd Alarm for this incident. <i>Note: The 3rd Alarm would bring a heavy rescue from Fire Department 440.</i></p>	0418 Hours	Command advised the fire needed to be knocked down again from the exterior: “The first floor on Side 1 and Side 2 is gone.”
<p>Ambulance 408 dispatched and enroute to incident scene.</p>	0419 Hours	Engine 304 stretched a 2-inch to Side 3 (Side Charlie) of the structure. Engine 304 takes the hoseline into the living room of the structure.
<p>Engine 401 in quarters at Fire Department 350.</p> <p>Truck 313 on-scene.</p>	0420 Hours	
<p>Command requested a Signal 25. <i>Note: A Signal 25 is a request for a county fire investigator to respond to the scene.</i></p>	0423 Hours	
<p>Truck 313 reported to Command. Assistant Chief 3102 advised Command that Truck 313 was not equipped to function as a RIC/FAST company.</p>	0425 Hours	
	0428 Hours	Truck 313 entered the structure on Side Charlie through the sliding glass doors.

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Incident and Fireground Conditions	Time	Response & Fireground Operations
<p>Command requested another FAST Truck. Ladder 449 was dispatched. Command also requested a status of which EMS units were on-scene.</p> <p>FIRECOM advised Ambulance 3591 and Ambulance 408 were on-scene. An ambulance from Fire Department 310 was responding to the scene.</p>	0430 Hours	The approximate time that the Irons fire fighter from Ladder 313 became unaccounted for until he was located in the basement.
<p>Command requested an additional ambulance and requested the status of the fire investigator and power company.</p>	0436 Hours	The officer of Engine 304 transmitted a Mayday for a fire fighter down in the basement.
<p>Command requested “an additional FAST Truck to the scene ASAP.”</p>	0437 Hours	
<p>Dispatcher from Fire Department 300 advised Command, “We are receiving a Mayday signal on the portable radio frequency from a portable radio on-scene.”</p>	0438 Hours	
<p>Dispatcher from Fire Department 230 radioed Command, “We are receiving a Mayday signal on the portable radio frequency from the same portable radio that Dispatcher 300 contacted you about.”</p>	0438 Hours	
<p>Command requested a FAST company from Fire Department 700 (Truck 708) and Fire Department 430 (Truck 434) respond.</p>	0439 Hours	
<p>Command to FIRECOM, “We need 2 additional ambulances forthwith.” FIRECOM acknowledged.</p>	0451 Hours	Fire fighter from Truck 313 was removed from the structure.

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Incident and Fireground Conditions	Time	Response & Fireground Operations
Ambulance 3591 to FIRECOM, “Signal 21 to the hospital.” FIRECOM acknowledged. <i>Note: A Signal 21 is a unit responding to the hospital.</i>	0457 Hours	
	0500 Hours	Command conducted and completed a personnel accountability report (PAR) of all operating companies on-scene.
Ambulance 3591 arrived at the hospital (Signal 22) <i>Note: A Signal 22 is a unit arriving on-scene or at the hospital.</i>	0505 Hours	Utilities were secured to the structure.
Truck 313 is Signal 13. <i>Note: A Signal 13 is a unit returning to quarters.</i>	0545 Hours	
Command to FIRECOM, “Per the orders of Chief 3500, transmit a Signal 12.” <i>Note: A Signal 12 is a fire under control.</i>	0555 Hours	
Per the orders of Chief 3500: “Command is dissolved for the Signal 10. All companies are Signal 13.” <i>Note: A Signal 13 is all companies are returning to quarters.</i>	0741 Hours	

Personal Protective Equipment

At the time of the incident, the Truck 313 Irons fire fighter was wearing turnout pants, turnout coat, protective hood, helmet, boots, and gloves meeting current National Fire Protection Association (NFPA) requirements. The self-contained breathing apparatus (SCBA) and the personal alert safety system (PASS) that the victim was using were certified to the 2002 edition of NFPA 1981, *Standard on Open Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*. The county’s fire marshal’s office took possession of all personal protective equipment and clothing following the incident. The Truck 313 Irons fire fighter was on air while in the structure. He was found in the basement with his facepiece partially dislodged from his face.

The fire fighter was carrying a fire department-issued portable radio designated as the Truck 313 Irons. It is unknown if the portable radio was on at the time the fire fighter was found. The portable radio

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functioned properly when turned on and was on Channel 16 when evaluated by NIOSH investigators. Channel 16 was the assigned tactical channel for this incident.

The NIOSH investigators inspected the fire fighter's personal protective equipment at fire department headquarters. The personal protective equipment suffered no damage other than the turnout pants and boots were cut off in the hospital. The personal protective equipment (helmet, protective hood, turnout coat, turnout pants, gloves, and boots) was not considered to be a contributing factor in this incident. There was no further inspection or testing of the personal protective equipment by NIOSH investigators.

The SCBA with integrated personal alert safety system (PASS) meeting current NFPA requirements was also inspected at fire department headquarters by NIOSH investigators. The fire department requested that NIOSH conduct testing on this SCBA unit. The SCBA unit was hand-delivered by NIOSH investigators to the NIOSH facility in Morgantown, West Virginia, on January 26, 2015. As delivered, the SCBA unit was contained within a black plastic bag. The unit was placed in secured storage. The SCBA unit was then transported to the NIOSH National Personal Protective Technology Laboratory (NPPTL) in Bruceton, Pennsylvania, for inspection on February 19, 2015. The SCBA was secured in an evidence locker until the time of the testing on February 27, 2015.

On February 27, 2015, NPPTL personnel evaluated and tested the SCBA and the summary evaluation report is included as “**Appendix One: Summary of Personal Protective Equipment Evaluation—SCBA.**”

Weather Conditions

At 0351 hours on December 19, 2014, the following weather conditions were reported. The temperature was 38 degrees Fahrenheit (38° F), the dew point was 23 degrees Fahrenheit (23° F), the relative humidity was 55%, the winds were from the northwest at 17 miles per hour (mph) with gusts to 24 mph, the sky was overcast with 10 miles visibility, and there had been no precipitation in the past 24 hours [Weather Underground 2014].

Investigation

On December 19, 2014, at 0355 hours, the county's Fire Communications Bureau (FIRECOM) received a 9-1-1 call that reported a residential structure fire. The caller's address was from a house located around the corner from the structure with smoke showing. Prior to the 9-1-1 call, county police officers arrived on-scene at approximately 0350 hours and tried to locate the actual structure on fire. The police officers found the structure with smoke showing and walked around the house and found the sliding glass door on Side Charlie open. The police officers advised the county's police dispatcher of the correct address. Also, the officers advised that the rear door of the house was unlocked but not open. *Note: At this incident the request for additional resources during the early stages brought three different fire departments. Two of the fire departments were not dispatched by the county's FIRECOM but by either their own dispatcher or by another fire department and operated on different frequencies.*

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At 0356 hours, Fire Department 350 was dispatched for a residential structure fire with smoke showing. Engine 355, Engine 354, Ladder 352, and Chief 3500 responded. Chief 3500 arrived on-scene at 0403 hours and conducted a 360-degree size-up. At 0405 hours Chief 3500 advised FIRECOM, “This is a 48-foot by 40-foot, 2-story, wood frame construction, single-family dwelling with smoke showing at this time. Transmit the 10.” *Note: Signal 10 is a working structure fire. Chief 3500 will be Command.*

Engine 355 and second Assistant Chief 3502 arrived on-scene at approximately 0405 hours and pulled a 2-inch hoseline toward Side Bravo. *Note: The fire departments involved in this incident use numerical designations— Side 1, Side 2, Side 3, and Side 4—for the sides of a structure versus the phonetic designations—Side Alpha, Side Bravo, Side Charlie, and Side Delta. The phonetic designations are used to avoid confusion when operating at a multistory structure using Divisions to designate floors of the structure. Based upon the National Incident Management System (NIMS), the use of phonetic designation is the correct designation [DHS 2008]. For the purpose of this report, the sides of the structure will be designated as Side Alpha, Side Bravo, Side Charlie, and Side Delta.* Engine 355 initially stretched the attack line to the front door. An assistant chief from Fire Department 340 (Chief 3401) then ordered the hoseline moved to Side Bravo. The hoseline was moved to attack the fire that was showing from the basement windows. Water was flowed into the basement windows near the Side Alpha/Side Bravo corner. An assistant chief from Fire Department 350 ordered the window bars removed from all basement windows. Engine 354 arrived on-scene at approximately 0411 hours. Engine 304 and Engine 354 stretched a hoseline off of Engine 354 and down Side Delta to the rear (Side Charlie) of the structure.

Engine 343 crew stretched another 2-inch hoseline off Engine 354 to the front door. Several companies were operating at the front door. Crews realized there was a hole in the floor at the front foyer. The hole was approximately 6 feet by 4 feet in diameter (**See Diagram 2**). *Note: The distance from the front door to the hole was approximately 9 feet 5 inches, and the distance from the back of the hole to the entrance of the basement stairs was approximately 12 feet 1 inch.* A decorative wooden cabinet located in the foyer was moved by an interior safety officer (ex-chief from Fire Department 320) to protect someone from coming in the front door and falling into the hole. However, once the wooden cabinet was in place, the assistant chief later witnessed the wooden cabinet slide through the hole in the floor. This information was never communicated to Command or to all personnel on the fireground.

Ladder 352 was the first-due truck company. Ladder 352 arrived on-scene and the chauffer put the aerial ladder up to the roof so a crew could go to the roof and ventilate the roof. Ladder 325, the second truck company, which was assigned the FAST (Fire Fighter Assist and Search Team) Truck, was dispatched from Fire Department 320. Ladder 325 arrived on-scene and was assigned to fireground operations as the second-due truck instead of rapid intervention crew (RIC)/FAST. *Note: In some organizations, they can also be known as a rapid intervention team (RIT). The fire departments involved in this incident use the term FAST for fire fighters assigned a RIC function to be immediately available to assist a member who becomes trapped, distressed, or involved in other serious life-threatening situations.* The crew from Ladder 325 was assigned to the second floor to conduct search

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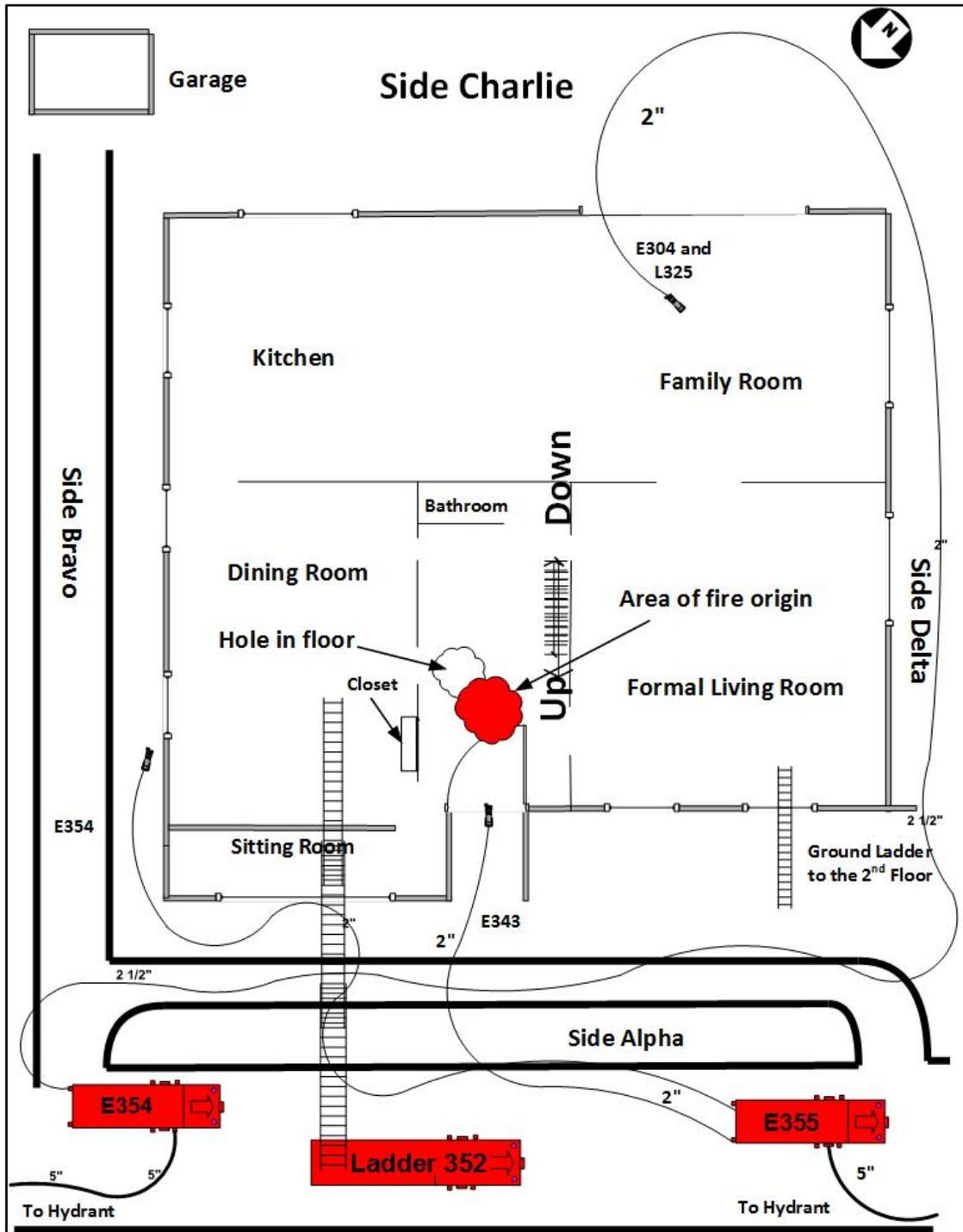


Diagram 2. Initial fire attack. The time is approximately 0414 hours.

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and rescue operations. Once the search of the second floor was completed, the Ladder 325 officer reported an ‘all clear.’ Also, part of the crew from Ladder 325 went to Side Charlie to operate with Engine 304. *Note: Based on interviews with the crew from Ladder 325, the crew split between searching the second floor and operating on Side Charlie.*

Truck 313 and Ambulance 319 were dispatched at 0408 hours. Command wanted Truck 313 to function as the RIC/FAST truck but this was not completely communicated or the information request was missed by FIRECOM. Truck 313 responded at 0414 hours and arrived on-scene at approximately 0420 hours. The staffing on Truck 313 was an acting officer (acting lieutenant), two fire fighters (outside vent man and irons), one probationary fire fighter, and the chauffeur.

Truck 313 parked approximately a block from the incident. The chauffeur stayed with the apparatus while the Truck 313 officer, the outside vent man (OVM) fire fighter, the Irons fire fighter, and a probationary fire fighter proceeded to meet Command at approximately 0425 hours. Command requested Truck 313 to function as the RIC/FAST. Assistant Chief 3102 advised Command that Truck 313 was not equipped for RIC/FAST. The heavy rescue from Fire Department 310 functioned as their RIC/FAST apparatus.

Command informed Truck 313 that there was RIC/FAST company equipment in the cabinet labeled ‘FAST’ on Ladder 352. Also, Command advised Truck 313 there was a Scott Pak Tracker located in the officer’s seat of Ladder 352.

The Truck 313 officer, OVM fire fighter, and Irons fire fighter proceeded to Side Charlie. They did not leave their accountability tags with Command. At approximately 0428 hours, they proceeded to Side Charlie due to the report of possible victims trapped. The Truck 313 OVM fire fighter had trouble with his SCBA before entering the house. The OVM fire fighter advised the Truck 313 officer and then went back to Truck 313 for another SCBA. The Truck 313 officer entered the house and conducted a right-hand search and crawled to the kitchen and saw fire in the dining room. The Truck 313 officer thought that the Truck 313 Irons fire fighter was behind him. The Truck 313 officer got to the entrance of the dining room and met a chief from a mutual aid department. The chief advised the Truck 313 officer that the dining room floor on Side Alpha/ Bravo had collapsed and verbally advised them not to enter the room. Crews in the dining room moved back to the family room to continue looking for the basement steps. The Truck 313 OVM fire fighter re-entered the house and met the Truck 313 officer. At this time, the Truck 313 officer and the OVM fire fighter went into the foyer and saw the hole in the floor. They moved by the hole and went to search the second floor. Truck 313 completed the search and reported an all-clear in terms of victims. Truck 313 did report that there was active fire on the second floor. After searching the second floor, they moved back to the first floor and heard the Mayday.

Engine 304 was directed to the scene by Command and arrived on-scene at 0418 hours. Command ordered Engine 304 to stretch a 2-inch hoseline to the basement. Engine 304 stretched the 2-inch from Engine 354 down Side Delta to Side Charlie (**See Diagram 2**). The smoke was banked down to the floor when Engine 304 got to the rear sliding glass doors (Side Charlie). The Engine 304 officer had

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the nozzle and entered the structure and went to the right, toward the kitchen. The Engine 304 officer got to the kitchen and was advised by another fire fighter that the floor in the dining room had collapsed near the front of the house (**See Photo 2**). The Engine 304 officer and two fire fighters continued to move the hoseline toward the basement with two fire fighters from Ladder 325. Engine 304 moved to the basement stairs and went down to the basement. Approximately 8–12 inches of water had accumulated in the basement from handlines flowing water on the fire from the exterior on the Side Alpha/Side Bravo corner. The Engine 304 officer contacted Command to have the exterior handlines shut down.

At 0418 hours, Command requested a third alarm be transmitted by the Command Post for this incident. At the time, Command had the following sectors (division/groups) in place:

- Operations Section Chief—Second Assistant Chief 3502
- First floor, Side Alpha—Assistant Chief 3401
- First floor, Side Charlie—Chief 3010
- Second floor, Side Alpha—First Assistant Chief 3201
- FAST Team (RIC Group)—Second Assistant Chief 3102
- Safety Officer (Interior)—Ex-Chief Fire Department 320
- Safety Officer (Exterior on Side Alpha/Side Charlie)—Ex-Chief 3200



Photo 2. The floor on the Side Alpha/Bravo corner in the dining room, which is partially collapsed into the basement.
(Photo courtesy of the county's fire marshal's office.)

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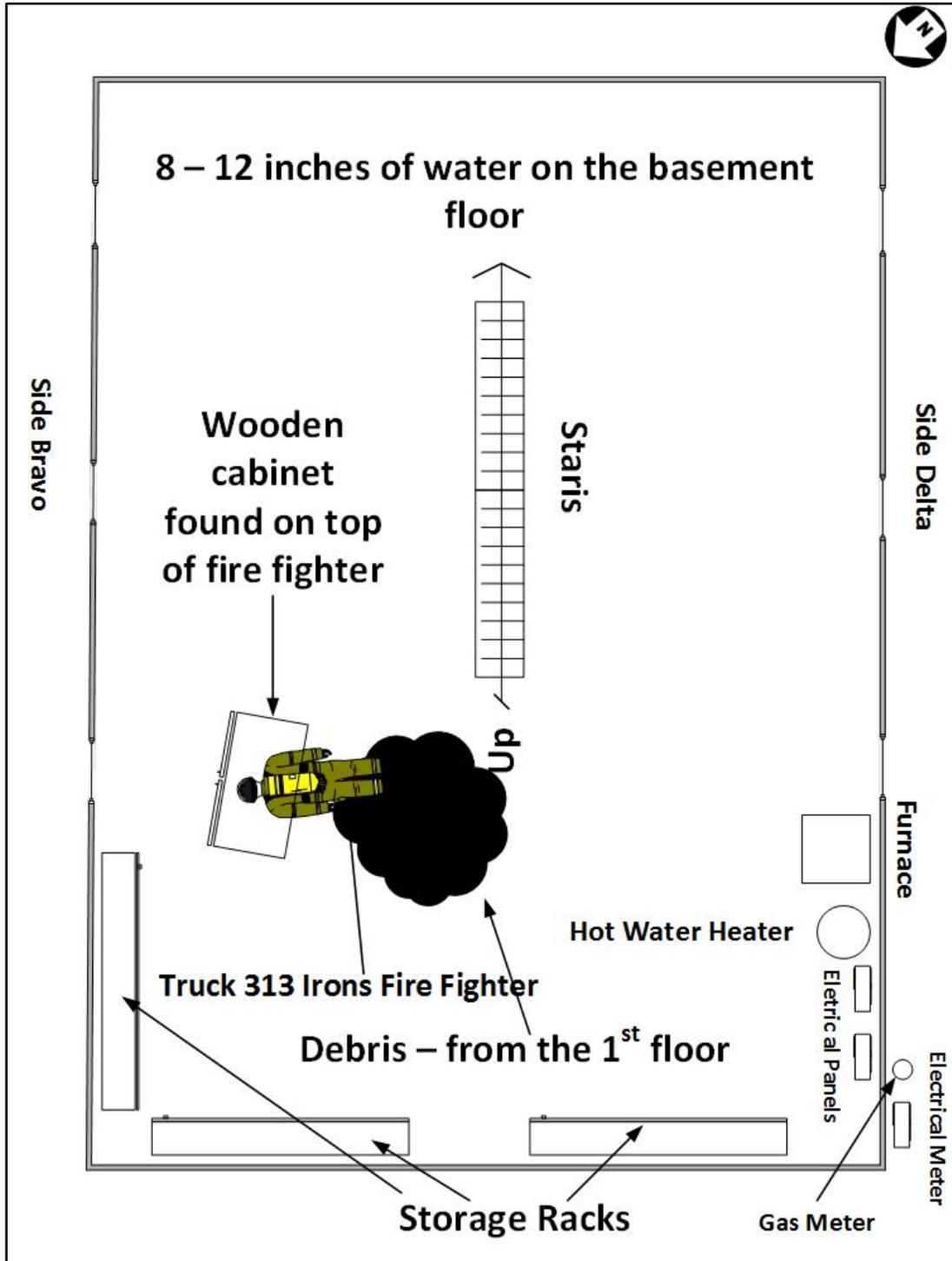


Diagram 3. The location of the Irons fire fighter from Truck 313 in the basement.

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The Engine 304 officer moved to the right at the bottom of the stairs and saw what looked like reflective trim from turnout gear on the floor. The crews from Engine 304 and Ladder 325 found a fire fighter with a wooden cabinet on top of his upper body under the hole in the first floor (**See Diagram 3**). The fire fighters removed the wooden cabinet from the downed fire fighter who was later determined to be the Truck 313 Irons fire fighter. Initially, no one knew who the fire fighter was as there was no report of a missing fire fighter. *Note: It is not clear how the Truck 313 Irons fire fighter got in the basement other than falling through the hole in the foyer or walking down the basement steps. None of the members interviewed during this investigation saw the Truck 313 Irons fire fighter after he was seen in the dining room.* The fire fighter's PASS device was under water, but they heard the SCBA's end-of-service-time indicator (EOSTI). The Engine 304 officer radioed a Mayday, but Command did not initially acknowledge the transmission. The dispatcher from Fire Department 300 acknowledged the Mayday and at 0438 hours advised Command, "We are receiving a Mayday signal on the portable radio frequency from a portable radio on-scene." The dispatcher from Fire Department 320 also contacted Command regarding the Mayday. They moved the downed fire fighter to the bottom of the stairs. The fire fighter was found face down, with his facepiece partially dislodged and his helmet missing. The SCBA PASS device was sounding after the fire fighter was moved out of the water. Command also initiated Ladder 427 and Ladder 449 as the RIC/FAST companies and ordered them to assist with the Mayday.

Two mutual aid assistant chiefs entered the basement. Two fire fighters started cardiopulmonary resuscitation (CPR) on the downed fire fighter. A stokes basket was sent down to the basement and the fire fighter was placed in the stokes basket. The stokes basket had a backboard, which created problems keeping the fire fighter in the stokes basket. Webbing was used to secure the fire fighter in the stokes basket in order to get the stokes basket up the steps. A 2-to-1 rope haul system was established to help pull the stokes basket up the steps (**See Photo 3**). While the removal of the fire fighter was occurring, a fire fighter was knocking down the fire in the Side Alpha/Side Bravo corner. He was using a hoseline that was brought through one of the basement windows.

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Photo 3. The stairs that fire fighters used to bring the Truck 313 Irons fire fighter out of the basement. The fire fighter was initially found about 3–4 feet to the right of the stairs.

(Photo courtesy of the county's fire marshal's office.)

Once the Truck 313 Irons fire fighter was removed from the basement at 0451 hours, fire fighters moved the stokes basket to Side Charlie. The crew from Ambulance 359 was waiting in the driveway with a stretcher. The fire fighter was transferred to the stretcher and CPR was still being performed. Ambulance 3591 responded to the hospital at 0457 hours and arrived at the hospital at 0505 hours. After extensive resuscitation efforts, the medic crew of Ambulance 3591 was able to restore a heartbeat at the hospital. The medic crew assisted with respirations.

While the Truck 313 Irons fire fighter was being removed from the structure, a second Mayday was transmitted. A fire fighter collapsed in front of the structure from exhaustion. Ambulance 408 treated the fire fighter, who refused transport. The fire fighter left the scene with his assigned company.

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Fire Origin and Cause

The fire was classified as accidental by the county's fire marshal's office. The area of origin of the fire was on the first floor in the hallway toward the west end of the hallway/foyer. The cause of the fire was spontaneous combustion of staining materials left in a plastic bag on the floor of the hallway.

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 fatality:

- Combustible materials left in hallway of home under renovation
- Lack of crew integrity
- Ineffective span of control
- Ineffective personnel accountability system
- Lack of assigned rapid intervention crew (RIC) or fire fighter assist and search team (FAST)
- Lack of training between automatic aid fire departments
- Hole in the first-floor foyer from the fire

Injuries

According to the death certificate, the medical examiner listed the fire fighter's cause of death as complications of asphyxiation (near drowning). One fire fighter collapsed from exhaustion after the Mayday. The fire fighter was treated by EMS but refused transport. Two fire fighters were treated for smoke inhalation at a local hospital. Both fire fighters were treated and released.

Recommendations

Recommendation #1: Fire departments should ensure that crew integrity is maintained when operating in an immediately dangerous to life and health (IDLH) atmosphere.

Discussion: Crew integrity during fire-fighting operations in an immediately dangerous to life and health (IDLH) atmosphere is essential for the safety and survival of all members. Based upon their assigned task, the company officer and crew must enter a structure together and remain together at all times while in the interior, and all members come out together [IAFC 2011; NFPA 2013b]. No fire fighter(s) should be allowed to be by themselves at any time while operating in an IDLH atmosphere. It is the individual responsibility of every fire fighter to stay connected with crew members at all times [IAFC 2011].

NFPA 1500 *Standard on Fire Department Occupational Safety and Health Program* states in Paragraph 8.5.5, "Crew members operating in hazardous areas shall be in communication with each other through visual, audible, or physical means or safety guide rope in order to coordinate their activities" [NFPA 2013b]. All fire fighters should be operating under the direction of an incident commander, division/group supervisor, or company officer during fireground operations. The

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accountability officer or resource status officer is responsible for maintaining the status of each company that is on-scene. The ultimate responsibility for crew integrity and ensuring no member gets separated or lost rests with the company officer. The company officer must ensure their members stay together. If any of these elements aren't adhered to, crew integrity is lost and fire fighters are at risk for becoming lost or missing.

Crew integrity is also essential to fireground accountability. All fire-fighting operations should be conducted under the department's accountability system. A key component of a recognized personnel accountability system includes tags or passports with crew names that are given to an accountability officer or resource status officer at the point of entry. The system must also be able to identify the location of assigned crews within a small geographic area of an incident scene. A personnel accountability system must have the capability of always identifying who is operating on the fireground, their assignment, and their location. Also, the personnel accountability system must be able to identify when a fire fighter is lost or missing. All accountability must be managed at the point of entry to maintain continual awareness of which fire fighters are in the hazard zone. Tags or passports collected only at the command post can't maintain awareness of fire fighters in or out of a building [IAFC 2011].

Companies working on the task level have the greatest stake in crew integrity and the personnel accountability system due to operating inside the hazard zone or IDLH. Task-level responsibilities include:

- Being properly assigned into the hazard zone.
- Properly using the personnel accountability system.
- Staying together as a company.
- All engine company members attached to a hoseline.
- Always maintaining an adequate air supply (proper air management) to safely exit the hazard zone or IDLH before the end-of-service-time indicator (EOSTI) activates.
- Maximum depth into a structure—175 feet—based on air supply.
- No freelancing [Fire and Rescue Departments of Northern Virginia 2013a; MABAS 2015].

The following rules should be adhered to at all times on the task level:

- The minimum number of personnel assigned to a crew or a team operating in a hazard zone shall be two fire fighters with a least one portable radio that is compatible and on the same frequency with all other radios and systems used at the incident.
- Crews or teams always go in and come out together.

However, despite being organized into companies and so establishing both a latent and an active philosophy that fire-fighting is a group activity, crew integrity can break down. In instances where the cohesion of the crew breaks down, the likelihood or occurrence of mishap escalates. Why is crew integrity so important? It's more than just company pride and the appearance of organization. The conclusive answer is that maintaining crew integrity saves fire fighters' lives [IAFC 2012].

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At this incident, Truck 313 arrived on-scene with an acting officer and four fire fighters. The Truck 313 officer and three fire fighters reported to Command in front of the structure. Command assigned Truck 313 as FAST. Assistant Chief 3102 advised Command that Truck 313 was not equipped for RIC/FAST. **Note:** *Fire Department 310 utilized their heavy rescue as their RIC/FAST apparatus.* Truck 313 then proceeded to Side Charlie. The Truck 313 outside vent man (OVM) returned to Truck 313 with a SCBA issue. The Truck 313 officer and the Truck 313 Irons fire fighter entered the structure at approximately 0428 hours due to a report of persons trapped. The Truck 313 probationary fire fighter stayed on the rear deck. Truck 313 OVM returned and met the Truck 313 officer at the basement steps in the foyer. The Truck 313 officer and the Truck 313 OVM fire fighter proceeded to the second floor. It is unclear where the Truck 313 Irons fire fighter was from this point until Engine 304 and Ladder 325 found the fire fighter in the basement and transmitted a Mayday. After searching the second floor, Truck 313 heard the Mayday and returned to the first floor. Truck 313 proceeded to the basement to assist removing Truck 313 Irons fire fighter from the structure.

Recommendation #2: Fire departments should review their personnel accountability system standard operating procedure/guideline to ensure that the system is staffed, functions properly, and all resources are accounted for at an incident.

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

An integral part of the accountability system is to make sure that the fire fighters who are assigned and operating in the hazard zone are accounted for, starting with the initial operations through the entire incident. Also, a process should be in place to periodically check to make sure that all members operating in the hazard zone are accounted for by this system.

One of the most important functions of command safety is for the incident commander to initiate a personnel accountability system that includes the functional and geographical assignments at the beginning of operations until the termination of the incident. NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* states in Paragraph 8.12.4, “The incident commander and members who are assigned a supervisory responsibility that involves three or more companies or crews under their command shall have an additional member(s) (e.g., staff aide) assigned to facilitate the tracking and accountability of the assigned companies or crews” [NFPA 2014].

A functional personnel accountability system requires the following:

- Development and implementation of a departmental SOP
- Necessary components and hardware, such as an accountability board, individual name tags, and company name tags
- Training for all members on the operation of the system
- Strict enforcement during emergency incidents

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There are many different methods and tools for resource accountability. Some examples are:

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

Resource accountability should be assigned to personnel who are responsible for maintaining the location and status of all assigned resources at an incident. As the incident escalates, resource status would be placed under the Planning Section. This function is separate from the role of the incident commander. The incident commander is responsible for the overall command and control of the incident. Due to the importance of responder safety, resource status should be assigned to a dedicated member as the size and complexity of the incident dictates. A number of positions could function in this role including an incident command technician, staff assistant, chief officer, or other designated member. As the incident escalates and tactical-level management components (e.g., divisions or groups) are assigned, the resource status officer (accountability officer) works with the division or group supervisors to maintain an on-going tracking and accountability of members [FIREScope 2012]. A properly initiated and enforced personnel accountability system enhances fire fighter safety and survival. It is vital that resources can be identified and located in a timely manner.

An important aspect of a personnel accountability system is the personnel accountability report (PAR). A PAR is an organized on-scene roll call in which each supervisor reports the status of their crew when requested by the incident commander [NFPA 2014]. **The PAR should be conducted every 15–20 minutes or when benchmarks are met.**

In order for the personnel accountability system to properly function, the process should include a standard operating procedure that defines each function's responsibility and the necessary hardware required to ensure this process is successful on the fireground. Also a training component—both classroom and practical—should be conducted to ensure this process functions properly during emergency incidents.

At this incident, the departments involved use a personnel accountability system that consists of individual accountability tags. Each fire fighter places his/her accountability tag on the assigned apparatus. The accountability tags are given to the incident commander by the company officer upon assignment on the fireground. The resource status officer or accountability officer is responsible for ensuring the system shows the location and function of each company. Each fire department has a standard operating procedure/guideline which defines the responsibilities and operation of the personnel accountability system to ensure this process is successful on the fireground. Truck 313 arrived on-scene, reported to Command, and was given an assignment as a RIC/FAST company. Truck 313 did not give their accountability tags to Command. When the Mayday was transmitted, no one knew a fire fighter was missing because there was no account of Truck 313 operating on the fireground. According to the incident commander, of the 13 fire departments assigned to this incident,

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approximately 2/3 of the fire departments provided Command with personnel accountability tags. At this incident the first personnel accountability report was done at 0500 hours after the Mayday occurred.

For incidents where a mutual aid response is common or even possible, fire departments should have one standardized personnel accountability system. When multiple fire departments respond together but each uses a different personnel accountability system, there is potential for confusion.

Recommendation #3: Fire departments should ensure that the incident commander establishes a rapid intervention crew (RIC) and that the RIC is available throughout the incident.

Discussion: In order to ensure compliance with 29 CFR 1910.134 Respiratory Protection [OSHA 1998], fire departments must maintain a rapid intervention crew or company when members are operating in an immediately dangerous to life and health (IDLH) or potentially IDLH atmosphere [NFPA 2013b]. In some organizations, they can also be known as a rapid intervention team (RIT) or **Fire fighter Assist and Search Team (FAST)**. *Note: The fire departments involved in this incident use the term FAST for fire fighters assigned as a rapid intervention company function to be immediately available to assist a member who becomes trapped, distressed, or involved in other serious life-threatening situations.*

The RIC/FAST function should be incorporated into the department's incident management system and the personnel accountability system [NFPA 2014]. Critical fireground operations and staffing needs should be continuously evaluated in regards to fire fighter safety. Resource assignments should be made with the goal of having the RIC/FAST function in place at all times. When the incident commander needs additional resources, the consideration of deploying the rapid intervention team for an operational assignment without additional resources on-scene to function as RIC/FAST should be carefully assessed [NFPA 2014].

The following restrictions regarding the use of RIC/FAST should be considered by the incident commander during fireground operations:

- The RIC/FAST should not be used for fire-fighting operations.
- The RIC/FAST is dedicated to assist, and if necessary, rescue members who become trapped, distressed, or involved in other serious life-threatening situations.
- The RIC/FAST should not be used to provide relief for operating companies until the fire/incident has been declared "under control" by Command.
- If assigned by a superior officer to other than RIC duties, the RIC/FAST unit officer should remind such officer of RIC designation [Toledo Fire & Rescue Department 2012; TSFRS 2014].
- When the incident commander orders the RIC/FAST to work, the incident commander should immediately assign another on-scene company to stand by as the RIC/FAST. **At a minimum, the incident commander should request an additional alarm and designate a company or companies to function as RIC.** The remainder of the companies should report to staging. If no units are available, the incident commander should assign at least two members to act as a rapid

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intervention team while awaiting a special-called RIC/FAST to arrive. An engine company may be designated as the RIC/FAST pending arrival of an additional ladder company or rescue company. This ensures compliance with OSHA's "Two In/Two Out" rule under 29 CFR 1910.134, Respiratory Protection [OSHA 1998].

Many fire departments have a defined response plan for the dispatch of an additional company (engine, truck, squad, or rescue) to respond to an incident and stand by as the rapid intervention team. Based upon the complexity, magnitude, configuration of the structure, or geographical layout of the incident, the incident commander may deploy additional RIC/FAST by location or function [NFPA 2014]. Upon arrival or upon appointment, the RIC/FAST officer should confer with the incident commander. The RIC/FAST officer should establish an area to stage the rapid intervention team and the necessary RIC/FAST equipment. The RIC/FAST equipment should include:

- Tool staging tarp
- Rescue SCBA (RIC/FAST Pack)
- Forcible entry tools such as a Halligan bar or other pry tool
- Stokes basket
- 150-foot rope for search and rescue
- Wire cutters
- Rebar cutter
- Saws
- Thermal imager
- Emergency strobe lights
- Life-saving rope/life belt
- Elevator keys for buildings with elevators [FDNY 2011; LAFD 2001; TSFRS 2014].

It is important to stage all necessary RIC/FAST equipment in an expedient manner. The RIC/FAST officer, accompanied by one member of the RIC/FAST, should perform an incident scene survey while the remaining RIC/FAST members assemble the RIC/FAST equipment. If the size of the structure negates a 360-degree survey of the building, this fact should be relayed to the incident commander as soon as possible. This should be a benchmark for Command to designate another RIC/FAST in order to effectively cover all sides of the building.

During this survey, the RIC/FAST officer and members should look for ways in and out of the structure, including window configuration, fire escapes, and construction features. The RIC/FAST officer should note the feasibility for placement of ground ladders for rescue or escape purposes. The RIC/FAST officer should be responsible for setting up and securing a suitable secondary egress for interior crews. This may include laddering multiple sides of the structure. Once the RIC/FAST has determined the need for an egress ladder, the window glass should be removed. This should only be done after conferring with Command that the removal of the window will not affect fire-fighting operations. Once approved by Command, the egress ladder should be placed at the window. The location of the egress ladder(s) shall be announced over the radio by the RIC/FAST officer [Toledo Fire & Rescue Department 2012].

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After the above tasks are completed, the RIC/FAST officer should inform Command that a 360-degree survey is complete and the RIC/FAST is ready to intervene, if necessary. Once the incident scene survey has been completed and the RIC/FAST equipment is in place, the entire RIC/FAST should be located in an area immediately accessible to the building in order for rapid deployment plus maintaining radio contact with Command. The RIC/FAST officer should brief all members of the RIC/FAST as to the results of his/her incident scene survey. The RIC/FAST should operate as one unit. Additional crews may be added to or in support of the team as necessary. When more than one company is added as part of the rapid intervention team, a rescue group should be formed with a rescue group supervisor [Toledo Fire & Rescue Department 2012]. Another consideration for Command is to request the response of an advanced life support (ALS) engine company or truck company as a component of the RIC/FAST Group. The members of the ALS company are trained to operate in an IDLH atmosphere and can function as part of the RIC, plus they can provide advanced life support to affected fire fighters [FDNY 2011].

The RIC/FAST officer and RIC/FAST members will coordinate with Command to formulate rescue plan contingencies and continue to monitor the radio and fireground conditions. RIC/FAST protection is not a passive assignment. This is a process of ongoing information gathering and diligent scene monitoring until the unit is released by the incident commander. The RIC/FAST function is a critical component for fire fighter safety.

To ensure that fire fighters and fire officers are properly trained to conduct RIC/FAST operations, they should meet the requirements of NFPA 1407 *Standard for Training Fire Service Rapid Intervention Crews* [NFPA 2015].

At this incident, Ladder 325 arrived on-scene as the RIC/FAST truck at 0408 hours. Once Ladder 325 arrived on-scene, Command changed their assignment to fireground operations. Command then requested another RIC/FAST company and Truck 313 was dispatched at 0409 hours. Truck 313 arrived on-scene at 0420 hours. Truck 313 was assigned RIC/FAST by Command, but this function was not filled by Truck 313 due Fire Department 310 utilizes their heavy rescue for the RIC/FAST assignment. Command advised Truck 313 that Ladder 352 had the necessary RIC/FAST equipment. Truck 313 then walked to Side Charlie, entered the rear door to conduct a primary search. At 0415 hours, Command requested Ladder 427 and Ambulance 425 report to staging. At 0430 hours, Command requested another RIC/FAST company to respond. Ladder 449 was dispatched. At 0437 hours, Command requested another RIC/FAST company after the Mayday was transmitted, which was Truck 708. Ladder 427 and Ladder 449 assisted with the removal of the fire fighter from the basement. **Note:** *Based upon interviews with county fire investigators, there was a lack of an assigned RIC/FAST company from 0408 hours until 0430 hours.*

Recommendation #4: Fire departments should ensure fireground operations are based upon scene size-up, risk assessment, and the incident commander's defined strategy and incident action plan.

Discussion: Fireground operations are very dynamic and fast paced. The incident commander must develop a strategy and then develops the incident action plan to ensure that the correct actions take

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control of the incident. The incident commander must incorporate the situational evaluation (size-up), the standard risk management plan, and forecasting as the decision-making process to define the incident strategy. This will lead to the development of the incident action plan which are the tactical priorities. The incident action plan (IAP) defines where and when resources will be assigned to the incident to control the situation [NFPA 2014].

NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* [NFPA 2014] requires the following regarding the incident action plan:

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

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

It is absolutely critical for the incident commander to develop an IAP during the initial stages of the incident and before committing fire fighters into an immediately dangerous to life and health (IDLH) atmosphere. Once developed, the IAP is communicated to all companies and all responders on-scene. Developing, using, and updating the IAP during simple or “day-to-day” incidents prepares for the use of an IAP during large or complex incidents. Problems develop based on habits that fire fighters are allowed to operate without an IAP. When fireground operations are allowed to start in piecemeal fashion, the entire operation becomes a freelancing and unproductive situation.

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

- Identify the incident’s critical factors before taking any action.
- Initial and ongoing size-up of the incident’s critical factors must produce the information that becomes the basis for the current incident strategy and IAP.
- Current, accurate, and relevant information provides the foundation for effective initial and ongoing action.

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- The goal of this systematic evaluation process continually produces standard, safe, well-managed incident outcomes [MABAS 2015] (See **Diagram 4**).

DEVELOPING an INCIDENT ACTION PLAN

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

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

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

INCIDENT ACTION PLAN COMPONENTS

- Scene Size-up
- Scene Size-up communicated to all responding companies
- 8 Critical Fireground Factors
- Incident Priorities
- SLICE-RS
- Staffing
- Risk Management Plan
- Fire Fighter Safety
- Utilize *ICS Form 202 – Incident Objectives* as a guide.

Tactical Worksheet

TACTICAL WORKSHEET COMPONENTS

- Strategy
- Tactical Objectives and Benchmarks Met
- Time Benchmarks
- Committed Resources
- Available Resources - Staging
- Personnel Accountability System
- Scene Diagram
- Tactical Level Management
- Safety Considerations
- *Continuous review of the Tactical Worksheet*

**LIFE SAFETY
PRIORITY ONE**

**INCIDENT STABILIZATION
PRIORITY TWO**

**PROPERTY CONSERVATION
PRIORITY THREE**

Diagram 4. This sheet is a guide for developing an incident action plan at Type V and Type IV incidents. For these types of incidents, the incident action plan is communicated verbally. Note: A larger diagram is found in Appendix Three (Courtesy of FireFighterCloseCalls.com)

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

- Size up all scenes.
- Locate the fire.

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- Identify and control the flow path.
- Cool the heated space from a safe location.
- Extinguish the fire.
- **Rescue and Salvage** (are actions of opportunity that must be considered not only at the initiation of operations, but throughout the incident) [Modern Fire Behavior 2014].

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

- **Rescue**
- **Exposures**
- **Confinement**
- **Extinguishment**
- **Overhaul**
- **Ventilation**
- **Salvage**

The following are guidelines for developing an incident action plan for offensive and defensive operations.

Offensive Incident Action Planning

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

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

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

Defensive Incident Action Planning

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

Fire fighter safety is the No. 1 defensive priority.

Defensive strategy tactical priorities and their corresponding completion benchmarks:

- **Define the Hazard Zone**

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- Establish Cut-offs—Forward progress stopped
- Search exposures—Primary and Secondary “All Clear”
- Protect exposures—“Fire Control”—Loss Stopped

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

A basic defensive IAP includes the following tasks:

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

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

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

In order to ensure the standard outcome and to effectively command and control each incident, the incident commander defines the strategic goals and the tactical priorities based on the department’s incident management system. This enhances safe and efficient fireground operations.

At this incident, the incident commander arrived on-scene and provided a scene size-up of the incident. He declared an offensive strategy and made his initial tactical assignments. Once additional companies

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and chief officers from the mutual aid request arrived on-scene, tactical objectives were made by chief officers. When division or group supervisors initiate tactical objectives, this should be communicated to Command as these changes can affect the IAP. There was no accountability of companies operating on the incident scene until the Mayday was transmitted. A personnel accountability report (PAR) was conducted at 0459 hours. Then the fireground operations were reorganized.

Recommendation #5: Fire departments should ensure that once Command is established at an incident, the incident commander maintains control of situation status, resource status, and fireground communications and ensures the completion of the tactical objectives.

Discussion: Fireground standard operating procedures (SOPs) define the strategic goals and tactical objectives for the coordinated deployment of departmental resources for specific incidents and occupancies. SOPs are based on factors not limited to but including department staffing; deployment capabilities; knowledge and skill levels; apparatus, tools, and equipment; community risk assessment and building information, including height, area, construction class, and type of occupancy; and potential life hazard.

The first arriving resource will establish command and control of an incident. This ensures the initial scene size-up is communicated to the initial responding units with or without a chief officer on the scene. The intent is to maximize efficiencies while minimizing confusion and duplication of effort.

The strategy and tactics for an incident are dictated by the size-up, initial risk assessment, and situational report by the first arriving officer. If physical barriers make the 360-degree size-up impractical for the first arriving officer, the size-up of Side Bravo, Side Charlie, and Side Delta may be delegated to another fire department unit. The priority is to get a fire department unit to the rear of the structure (Side Charlie). However, unless an obvious life-safety issue exists (e.g., visible victims requiring immediate assistance), interior fire-fighting operations should not commence until a report from Side Charlie is received. A radio report of conditions, including those on Side Charlie, should be transmitted over the assigned tactical channel to the incident commander and the dispatch center. The transmission should include the following information:

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

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The incident commander develops and communicates a strategy and tactical objectives based upon scene size-up and the risk assessment. This is a process that must be made in a short period of time involving a dynamic and fluid situation. Most importantly the strategy and tactics should include an observation and/or report from all sides of the structure, especially Side Charlie. The goal of effective fireground procedures is to increase the safety of the fire fighters, eliminate confusion, and prevent the loss of life [Fire and Rescue Departments of Northern Virginia 2013b; NIOSH 2015]. This will ensure a strong command structure is developed and essential strategic-, tactical-, and task-level functions are performed by the incident commander, division/group supervisors, company officers, and fire fighters.

Strategic Level. This organizational level is designed around the IC and incident advisory team operating in the command mode. The strategic level involves the activities necessary for overall operational control, considering critical fireground factors and the risk management plan in establishing objectives, determining the strategy and developing an (IAP), continuous review of the strategy, setting priorities, and allocating resources.

Strategic-level responsibilities include the following:

- Determining the appropriate strategy: offensive or defensive
- Establishing a strategic plan for the incident
- Setting priorities
- Obtaining and allocating resources
- Predicting outcomes and planning
- Assigning specific objectives to tactical-level units

Tactical Level. The first management “subdivision” of incident scene organization is accomplished by assigning division/group responsibilities. Officers at this level are responsible for the tactical deployment of assigned resources, evaluation, and communication with the incident commander. They are assigned by the incident commander and are supervised directly at the site of the assigned activity in order to meet the operational objectives given to them by the incident commander.

When Command appoints division supervisors, one of the most critical functions is to ensure the division supervisor is accountable for all resources assigned under their span of control and for coordination and with Command, the operations section chief, or other supervisory personnel at the same level. The division supervisor has the following responsibilities:

- Implement and manage the division IAP, which matches incident commander’s IAP.
- Implement a risk management plan in the division.
- Complete tactical priorities in the division.
- Ensure positions always match conditions in the division.
- Coordinate with other division supervisors as needed.
- Manage the passport accountability system within the division.
- Assist with division air management.
- Manage work-rest cycles within the division.
- Manage recycle & rehab within the division [MABAS 2015].

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Task Level. The level of the organization where the work is performed by assigned companies and other resources. The strategic and tactical levels are in place to support the task level. Task-level activities are routinely supervised by company officers [NFPA 2014].

Additionally, this process compliments the defined knowledge, skills, abilities, competencies, and fireground experience to assist:

- The incident commander in how to plan and implement an effective strategy and IAP.
- Division/group supervisors to formulate and follow tactics and maintain accountability of assigned resources.
- Company officers successfully carry out assigned tasks.
- Individual members effectively perform their duties [FDNY 2011; FIRESCOPE 2015].

There are necessary tasks that need to occur at any fire regardless of the occupancy, such as the initial on-scene report upon arrival, initial risk assessment, situational report, water supply, deployment of hoselines and back-up hoselines, search and rescue, ventilation, initial rapid intervention crews, ground and aerial ladder placement, fire attack and extinguishment, and salvage and overhaul. Any change to operational priorities or responsibilities based on the above size-up should be clearly communicated to Command, all responding units, and the dispatch center via the assigned tactical radio channel [FDNY 2011; TSFRS 2014]. Command is then obligated to re-broadcast and receive acknowledgement from all operating companies.

The procedures developed for fireground operations should be flexible enough to allow for change if any of the following issues occur or are present:

- Life hazard (must be given first priority).
- Problems with water supply and water application.
- Volume and extent of fire, requiring large caliber streams.
- Location of the fire, if inaccessible for hand-line operations.
- Materials involved in the fire and explosion potential compounding the problem.
- Exposure problems where further fire spread would be a major concern.
- Stability of the structure, which would be dependent on the condition of the structural components of the building, the intensity, and the duration of the fire [ISFSI 2013].

At this incident, the incident commander arrived on-scene and established command. The incident commander operated from the front yard of the structure. Once the incident commander appoints an operations section chief, the operations section chief becomes responsible for managing all fireground operations. The operations section chief is responsible for the management of all operations directly applicable to the primary mission, ensuring the overall safety and welfare of all members assigned to the operations section. The operations section chief activates and supervises organization elements in accordance with the IAP and directs its execution. The operations section chief also requests or releases resources and makes expedient changes to the IAP as necessary and reports such changes to the incident commander. Command or the operations section chief needs to ensure that the division supervisors assigned during an incident are trained and understand their designed responsibilities as listed in the tactical level section above.

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When appointing more than one safety officer at an incident, additional safety officers become assistant safety officers. A safety group can be formed and the safety officer becomes the supervisor who reports to Command or the operations section chief

Recommendation #6: Fire departments should ensure that the radio communication system is capable of providing adequate coverage based upon the demands of an incident and complies with NFPA 1561 Standard on Emergency Services Incident Management System and Command Safety.

Discussion: Effective fireground radio communication is an important tool to ensure proper command and control of an incident plus fire fighter safety and health. The radio system must be dependable, consistent, and functional to ensure that effective communications are maintained, especially during emergency incidents. Fire departments should have a “communications” standard operating procedure (SOP) that outlines the communication procedures for fireground operations. Fire departments should ensure that the department’s communications division and communication center and/dispatch center are part of this process. Another important aspect of this process is an effective education and training program for all members of the department.

Radio frequency usually refers to the radio frequency of the assigned channel. A radio channel is defined as the width of the channel depending on the type of transmissions and the tolerance for the frequency of emission. A radio channel is normally allocated for radio transmission in a specified type of service or by a specified transmitter. Fire departments should ensure that an adequate number of radio channels are available. Multiple radio channels are necessary at large-scale or complex incidents, such as a commercial structure fire, mass-casualty incident, hazardous materials incident, or special operations incident [FIRESCOPE 2015; NFPA 2014].

NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety*, Paragraph 6.1.2, requires, “The communications system shall have the capacity to provide one dispatch radio channel and a separate tactical radio channel for initial use at the incident.” Paragraph 6.1.3 states, “When a division or group has been implemented, the communications system shall have the capacity to provide a dispatch radio channel, a command radio channel, and a tactical radio channel.” Fire departments should preplan for not only large-scale or complex incidents, but also for the ability to handle daily operations. Standard operating procedures, radio equipment (e.g., mobile radios, portable radios), other hardware (e.g., mobile data terminals, laptop computers, CAD system), and dispatch and communications protocols should be in place to ensure that these additional channels are available when needed [NFPA 2014].

Every fire fighter and company officer should take responsibility to ensure radios are properly used. Ensuring appropriate radio use involves taking personal responsibility (e.g., to have your portable radio, to have the portable radio turned on and on the correct channel). A company officer’s responsibility is to ensure that all members of the crew comply with these requirements. Portable radios should be designed and positioned to allow a fire fighter to monitor and transmit a clear message [IAFF 2010; Varone 2003].

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A fire department should provide the necessary number of radio channels relating to complex or large-scale incidents needing multiple tactical channels. NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* states in Paragraph 6.1.4, “The communications system shall provide reserve capacity for complex or multiple incidents.” This would require fire departments to preplan radio channel usage for all incident levels based upon the needs of an emergency incident including large-scale or complex incidents [NFPA 2014].

When a fire department responds to an incident, the incident commander should forecast for the incident to determine if there is potential for being a complex or long-term operations that may require additional resources, including demands on the communications system. As incidents increase in size, the communication system has to keep up with the demands of the incident. The incident commander must be able to communicate with company officers and division/group supervisors [FIREScope 2012]. Before communications become an issue, the incident commander must consider options for alleviating excessive radio traffic. Several options are:

- Assign non-fireground resources (e.g., Staging, Rehab) to a separate tactical channel or talk-group channel.
- Designate a Command Channel, which is a radio channel designated by the fire department to provide for communications between the incident commander and the division/group supervisors or branch directors during an emergency incident.
- For incidents involving large geographical areas, designate a tactical channel or talk-group for each division [NFPA 2014].

NFPA 1561, Paragraph 6.2.2 states, “Clear text/plain language shall be used for radio communications.” The intent of the use of clear text/plain language for radio communications is to reduce confusion at incidents, particularly where different agencies work together [NFPA 2014].

At this incident, Command encountered communications issues such as sector officers (division/group supervisors) verbally communicating to company officers regarding tactical operations. Some of these tactical operations were not communicated to Command, which creates issues with the incident action plan. Also benchmarks, safety issues, and other fireground communications were not communicated to Command. With only one tactical channel available, the channel can be quickly overwhelmed due to excessive usage.

Another consideration is for fire departments with their own dispatch to consolidate and utilize the county’s Fire Communications Bureau (FIRECOM). This would allow the use of multiple tactical channels at an incident plus the benefit of having recorded tactical channels.

Fire departments need to have a common fireground communications procedure to ensure that adequate tactical channels are available. Training is an essential element of this process.

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Recommendation #7: Fire departments should ensure critical benchmarks are communicated to the incident commander.

Discussion: The size-up of interior conditions is just as important as exterior size-up. The incident commander monitors exterior conditions while the company officers monitor interior conditions and communicate these conditions to the incident commander as soon as possible. Knowing the location and the size of the fire inside the building lays the foundation for all subsequent operations. Interior conditions could change the incident commander's initial strategy [Klaene and Sanders 2000].

Also, when operating inside the structure, company officers should communicate to the incident commander when making initial entry, while searching and clearing areas, during fire attack, while progressing between floors, and when exiting the structure.

Proper size-up and risk-versus-gain analysis require that the incident commander gather a number of key pieces of information and be kept informed of the constantly changing conditions on the fireground. The incident commander must develop and utilize a system that captures pertinent incident information to allow continuous situational evaluation, effective decision making, and development of an incident management structure. Decisions can be no better than the information on which they are based. The incident commander must use an evaluation system that considers and accounts for changing fireground conditions in order to stay ahead of the fire. If this is not done, the incident action plan will be out of sequence with the phase of the fire and the incident commander will be constantly surprised by changing conditions [Brunacini 2002; NIOSH 2010; Smith 2002].

Interior size-up is just as important as exterior size-up. Since the incident commander is located at the command post (outside), the interior conditions should be communicated by interior crews as soon as possible to the incident commander. Interior conditions could change the incident commander's strategy. Interior crews can aid the incident commander in this process by providing reports of the interior conditions as soon as they enter the fire building and by providing regular updates, especially when benchmarks are met (e.g., "primary search complete is all clear" and "the fire has been knocked down").

Retired Fire Chief Alan Brunacini states that critical fireground factors, including interior and exterior conditions, are among the many items that the incident commander must consider when evaluating tactical situations. These items provide a checklist of the major issues involved in size-up, decision making, initiating operations, and review and revision. The incident commander deals with these critical factors through a systematic management process that creates a rapid, overall evaluation; sorts out the critical factors in priority order; and then seeks out more information about each factor [Brunacini 2002].

The incident commander should train and prepare through practice to engage in conscious information management. Incident factors and their possible consequences offer the basis for a standard incident management approach. A standard information approach is the launching pad for effective incident decision making and successful operational performance. The incident commander should develop the

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habit of using the critical factors in their order of importance as the basis for assigning the specific assignments that make up the incident action plan. The incident commander should create a standard information system and use effective techniques to keep informed at the incident. The incident commander can never assume the action-oriented responder engaged in operational activities will stop what they are doing so they can feed the incident commander with a continuous supply of top-grade objective information. It is the incident commander's responsibility to do whatever is required to stay effectively informed [NIOSH 2010].

For all members operating at an incident scene, in addition to general discipline on the fireground, radio discipline is essential. Fire fighters and fire officers should follow a standard operating procedure/guideline used by all responding departments. All members on the fireground should use the thought process of (and be trained on) "is my transmission necessary" as a part of fireground behavior. All radio transmissions should be reserved for relevant messages such as benchmarks, personnel accountability reports, safety issues or concerns, needed resources, changing conditions, and emergency traffic and Mayday, as opposed to transmissions that add little to the incident action plan.

At this incident, fireground operations became very confusing due to multiple chief officers giving orders to companies operating on the exterior plus interior on the first and second floors. This information was not communicated to Command due to the amount of radio traffic. The initial Mayday was missed by Command. Two fire department dispatch centers contacted Command regarding the transmission of the Mayday. Also several fire fighters were interviewed who stated they never turned on their portable radios.

Benchmarks are a critical part of the incident commander's incident action plan. If benchmarks are being met, this information must be communicated to Command, as this ensures that Command knows that tactical objectives are being met. This information then allows Command to update the incident action plan. Also, if benchmarks are not being met and not communicated to Command, this creates issues with tactical objectives being met. This may have Command duplicating assignments.

Moreover, the first due chief, engine company, and truck company should proceed to the scene with other arriving companies staging in the direction of travel. This allows the incident commander to maintain strict command, control, and accountability while systematically assigning companies based upon needs. This not only assures a more coordinated operation, but improves the ability to perform and complete tactical objectives.

Recommendation #8: Fire departments should ensure that all unassigned resources are dispatched to a designated staging area or base.

Discussion: During fireground operations, the incident commander may need a resource(s) beyond those resources that are already operating on the fireground. When Command identifies a task that needs to be done, Command chooses the proper resource, confirms their availability, and then orders them into action. Managing incident operations in this fashion is how the incident management system

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coordinates and incorporates all of the efforts of multiple units into a single, cohesive operation [MABAS 2015].

Staging is the function/location designated at the incident that is used to position uncommitted resources that are immediately available for assignment (within 3 minutes). The incident scene can quickly become congested with personnel and equipment if not managed effectively. During incidents when companies are involved in investigative operations or when companies have not yet been assigned, additional responding equipment will normally stage one block from the incident in the direction of travel. This will provide more flexibility in the use/clearing of resources at an incident. When additional resources or alarms are requested, the incident commander should establish a staging area and designate a location as soon as possible. A separate tactical channel should also be requested for staging so that the tactical channel utilized by on-scene resources does not become overrun with radio traffic. The first uncommitted company arriving at the staging area will be responsible for staging (staging area manager). Staging reports to the incident commander until such time as Operations is established. In the expanded organizational structure, all resources within Staging will be under the direct control of the operations section chief [VBFD 2011].

The following major responsibilities of the staging area manager should apply to any incident:

- Establish layout of staging area.
- Post areas for identification and traffic control.
- Provide check-in for incoming resources.
- Determine required resource reserve levels from the incident commander or the operations section chief.
- Contact the operations section chief or incident commander when reserve levels reach minimums.
- Maintain and provide status to resource unit of all resources in staging area.
- Respond to the incident commander or operations section chief requests for resources.
- Request logistical support for personnel and/or equipment as needed.
- Maintain staging area in an orderly condition.
- Demobilize or move staging area as required.
- Maintain unit log [NFPA 2014].

NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* Paragraph 5.10.1.8.1 states, “The incident management system shall provide a standard system to manage reserves of responders and other resources at or near the scene of the incident.” Additionally, NFPA 1561 Paragraph 5.10.1.8.2 states, “When emergency activities are being conducted in a location where there would be a delay in activating staged resources, the incident commander shall establish staging areas close to the area where the need for those resources is anticipated” [NFPA 2014].

Staging provides a standard method to keep reserves of responders, apparatus, and other resources ready for action close to the scene of an incident. Staging also provides a standard method to control, record, and account for the arrival of such resources and their assignment to specific activities. When resources are dispatched to assist at working incidents, they should be dispatched to a designated

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staging or base area where they can be ready for assignment when required by the incident commander. This process helps the incident commander to keep track of the resources that are on the scene and to know which are available for assignment, where they are located, and where specific units have been assigned (**See Photo 4**).

The incident commander should attempt to keep reserves of responders, equipment, and supplies available to rotate assignments with fatigued crews. Equipment failures should be anticipated, and supplies should be ordered to the scene in time and in sufficient quantities to provide a safe margin over anticipated needs. The ability to provide these reserves is dependent on the amount of resources that are available. Every fire department should have plans to utilize its available resources to maximum advantage and have contingency plans to obtain resources from other departments that might be available [NFPA 2014].

It generally is desirable to keep staged resources in locations where they can be ready for action within 3 minutes. In some cases, particularly where imminent hazards exist, it is advisable to keep an immediate response capability in a state of readiness in a safe location that provides immediate access to the area.

The term **Base** is often used to refer to a more remote location where standby resources are gathered but are not available for immediate action. As needed, resources can be moved up to a staging location where they are ready for immediate action. An example is a high-rise building where apparatus are parked at a safe distance from the building and responders and equipment are moved in to stand by in Staging on a safe floor below the fire level. Base is the location at which primary support activities are performed, including all equipment and personnel support operations. It is also designated as the initial gathering point for resources not immediately available for assignment. Base will most commonly be used during incidents involving high-rise structures, hazardous materials, and wildland incidents. The fire officer or fire fighter managing Base, reports to Command unless the Logistics Section has been established. The term “Base” is used for its radio designation [VBFD 2011].

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Photo 4. This photo is an example of companies that have been assigned to Staging at a structure fire. The staging area manager can utilize the resources in Staging as needed. These resources are no more than 2–3 minutes from the incident scene.
(World Wide Web.)

It generally is desirable to keep staged resources in locations where they can be ready for action within 3 minutes. In some cases, particularly where imminent hazards exist, it is advisable to keep an immediate response capability in a state of readiness in a safe location that provides immediate access to the area.

At this incident, companies that were requested on additional alarms or special-called to this incident were never assigned to Staging. Companies went directly to the scene and reported to Command.

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Recommendation #9: Fire departments should ensure that the incident commander properly utilizes a tactical worksheet during initial fireground operations and throughout the incident.

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

The use of a tactical worksheet can assist the incident commander with tracking various task assignments on the fireground. The tactical worksheet identifies critical incident information in a fill-in format and allows for the tracking of initial alarm assignment plus additional alarms, division/group assignments, and tactical/ functional considerations. It is intended that this form would be used by the incident commander as early in the incident as possible [NFPA 2014]. It can be used along with preplan information and other relevant data to integrate information management, fire evaluation, and decision making. The tactical worksheet should record unit status and benchmark times and include a diagram of the fireground, occupancy information, activities checklist(s), and other relevant information. The tactical worksheet can also help the incident commander in continually conducting a situation evaluation and maintaining personnel accountability [NFPA 2014].

The advantages of using a tactical worksheet are that the tactical worksheet:

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

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

The tactical worksheet is a vital resource because it helps the incident commander organize fireground operations. Also the tactical worksheet provides reminders, prompts, and a convenient workspace for tracking companies and apparatus. It allows the incident commander to slow down during an incident and record vital information that may help make future operational decisions. By documenting the assignments of division/group officers and division/group resources, the incident commander creates a visual reference of the overall fireground organization and deployment [NFPA 2014]. The tactical worksheet provides the necessary documentation when command of an incident is transferred.

At this incident, the incident commander arrived on-scene, provided a thorough scene size-up, and established Command. The incident commander operated in the front of the structure without the benefit of a tactical worksheet. A tactical worksheet was provided during the investigation but did not detail alarm assignments, benchmarks met, personnel accountability, staging assignments, and incident action plan. The incident commander should document resources as they arrive and their assignments. As additional resources are requested, this allows Command to maintain their status and location (e.g., staging).

The tactical worksheet compliments the personnel accountability system to ensure the safety of fire fighters operating on the fireground. The use of a tactical worksheet allows for documentation versus relying on memory. An incident scene is a dynamic situation that is continually changing with various levels of risk. It is unreasonable for anyone to rely on memory. Add the event of a Mayday, the use and value of a tactical worksheet becomes very clear. A tactical worksheet also allows for those assisting at a command post to know the big picture by seeing what is occurring versus trying to understand what the incident commander is thinking.

Recommendation #10: Fire departments should ensure that the incident commander incorporates the principles of command safety into the incident management system.

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

The eight functions of command are:

- Assumption/confirmation/positioning
- Situation evaluation, which includes risk management
- Communications

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- Deployment
- Strategy/incident action planning
- Organization
- Review/revision
- Transfer/continuation/termination [Brunacini 2002; Brunacini and Brunacini 2004].

A major objective of the incident management system is to create, support, and integrate an incident commander into this process. The incident commander will direct the geographical and functional needs of the entire incident on the task, tactical, and strategic level. Issues develop for the incident commander when these three standard levels are not in place, operating, and effectively connected. One of the most important components is to ensure the incident commander operates on the strategic level from the very beginning of the incident and stays on the strategic level as long as fire fighters are operating in an immediately dangerous to life and health (IDLH) environment [Brunacini 2002; Brunacini and Brunacini 2004].

The incident commander uses the incident management system as the basic foundation for managing the strategic level safety function. Command Safety ensures the highest level of safety for fire department members operating at emergency incidents. The incident commander completes the operational and safety responsibility to the fire fighters by performing the eight command functions. These functions serve as a very practical performance foundation for how the incident commander completes the responsibility as the strategic-level incident manager and the overall incident safety manager [NFPA 2014].

Fire departments operating at this incident needed to address command safety issues as part of their recovery process. These issues include fireground communications, personnel accountability, use of a tactical worksheet (which compliments personnel accountability and crew integrity), and a continuous scene size-up and evaluation. Additional items for the recovery process include common standard operating procedures/guidelines among mutual aid fire departments, a standardized accountability system for all fire departments that respond in this county, a standardized tactical worksheet, and regular training on structural fireground operations with mutual aid fire departments.

Recommendation #11: Fire departments should ensure the incident commander utilizes a Mayday tactical checklist in the event of a Mayday.

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

Some departments have adopted the term LUNAR—location, unit assigned, name, assistance needed, and resources needed—to gain additional information in identifying a fire fighter who is in trouble and needs assistance. The incident commander, division/group supervisors, company officers, and fire

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fighters need to understand the seriousness of the situation. It is important to have the available resources on-scene and to have a plan established prior to the Mayday [NFPA 2013b, 2014].

A checklist is provided in ***Appendix Two, Incident Commander's Tactical Worksheet for Mayday***. This checklist can assist the incident commander in the necessary steps for clearing the Mayday as quickly and safely possible. This checklist serves as a guide and can be tailored to any fire department's Mayday procedures. The checklist format allows the incident commander to follow a structured worksheet. This process is too important to operate from memory and risk missing a vital step that could jeopardize the outcome of the rescue of a fire fighter who is missing, trapped, or injured.

At this incident, when the Mayday occurred, the incident commander quickly called for additional resources. Due to the influx of resources, the incident commander was quickly overwhelmed mostly due to the issues dealing with radio communications and personnel accountability. A critical component of this process is to locate the lost or missing fire fighter(s), maintain fire-fighting operations, and maintain fireground communications. The intent of this Mayday worksheet, like the tactical worksheet, is to assist the incident commander during a very difficult and stressful time on the fireground.

Recommendation 12: Fire departments that respond automatic aid or mutual aid with other fire departments, need to ensure that all components of fireground operations are based upon the same standard operating procedures, deployment of resources, staffing, training, and communications.

Discussion: In order for fire departments to be able to provide the necessary standards of coverage for their community, many fire departments depend upon automatic aid or mutual aid. This ensures that adequate resources respond to incidents based upon the deployment models used by the affected fire departments [NIOSH 2012].

In order for the process to be effective, several key components need to be addressed. These components include:

- Defined goals and objectives
- Fireground strategy and tactics for an occupancy that are based upon the departments' standard operating procedures
- Communication systems and equipment that are compatible
- Defined deployment of adequate resources and staffing
- Training on fireground evolutions that are based upon the defined fireground strategy and tactics
- Incident management system that effectively commands and controls *Type V* and *Type IV* incidents
- Standardized personnel accountability system

The administrative functions such as the defined goals and objectives and developing the necessary standard operating procedures are essential elements of this process. Planning meetings will allow the

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affected departments to develop of automatic aid or mutual aid response that will be agreeable to the departments.

The communication component is a key component that can include a lack of common dispatch facilities, differences in radio frequencies, different terminology, and apparatus numbering issues. Affected fire departments may require frequency simulcasting or patching of frequencies in order to ensure effective fireground radio communication. The radio system must be dependable, consistent, and functional to ensure that effective communications are maintained, especially during emergency incidents. The affected fire departments should have a “Communications” standard operating procedure (SOP) that outlines the communication procedures for fireground operations. Fire departments should ensure that the Communications Division and Communication Center is part of this process. Another important aspect of this process is an effective education and training program for all members of the department [NFPA 2014: FIRESCOPE 2012].

Many fire departments initiate automatic aid due to the fact that staffing is an issue and needs assistance to ensure that proper staffing levels are maintained based upon the risk the fire department is responding to. Other factors can include reducing response times based upon location of neighboring resources. As the mutual aid or automatic aid agreements are developed, the staffing and response factors need to be based on community risk. If the response is to a single-family structure (low risk), multifamily occupancy (moderate risk), or a commercial structure fire (high risk), the necessary resources and staffing are dispatched.

As for the fireground operations, the issues that need to be identified, developed, and implemented are the incident management system, use of a command post, defined strategy and tactics, use of a personnel accountability system, assignment of a rapid intervention crew(s), a Mayday protocol, use of a tactical worksheet, use of safety officer, and incident scene rehabilitation. NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* serves as an excellent resource to ensure that these identified issues are in place to ensure safe and effective fireground operations.

At this incident, issues that impacted fireground operations included fireground communications, personnel accountability, use of tactical worksheet, and use of rapid intervention crews. Fire departments that respond regularly on automatic aid or mutual aid should develop common standard operating procedures, conduct fireground training, and ensure the operability of communications.

Additionally,

Recommendation #13: Fire departments should consider upgrading their self-contained breathing apparatus (SCBAs) to comply with the most current edition of NFPA 1981 Standard on Open Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services.

Discussion: Significant improvements have been made to self-contained breathing apparatus (SCBA) in the 2002, 2007, and 2013 editions of NFPA 1981 *Standard on Open Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services* [NFPA 2013d]. Improvements include heads-up

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display (HUD), rapid intervention crew/universal air connection (RIC/UAC), testing for emergency breathing safety systems (EBSS) or buddy breather connections, increased heat and flame testing requirements for the SCBA facepiece and the SCBA, enhanced communication testing (electronic and mechanical), and additional testing for electronic accessories such as integrated PASS alarms and other electronic components. A significant change was in the end-of-service-time indicator (EOSTI) that increased the emergency reserve air from 25% +/- 2% to 33% to give fire fighters more emergency reserve air [NFPA 2013d].

One of the most important changes to SCBA was the inclusion of HUD. For years, fire fighters have relied on their low-air alarm to warn them of the need to exit the immediately dangerous to life and health (IDLH) atmosphere. In many cases, the over-the-shoulder analogue gauge could not be viewed inside a smoke-filled environment. If the fire fighter was too far into a structure, the fire fighter may not have enough air to exit the structure safely. With the addition of a HUD, the fire fighter can now have an indication of how much air is remaining in the cylinder. This ensures the fire fighter can operate within air management principles and exit the structure before the EOSTI sounds.

This change in equipment design requires a change in training to clearly understand the principles of air management. The EOSTI is no longer referred to as a low-air alarm. It is the EOSTI and signals that the user is now using emergency reserve air. Additionally, this emergency reserve air is not intended as air for fire-fighting, rather it is the fire fighter's emergency air. Fire fighters should practice air management so they exit from the IDLH environment with their reserve air intact. The addition of HUD also includes a flash of the 50% signal, which is designed to get the attention of the fire fighter. This ensures fire fighters can make adjustments to exit with their reserve air intact.

Fire fighters should be overly familiar with their SCBA so they can overcome any out-of-air emergency. This level of training is only achieved through repetitive skill/muscle memory training. A trained response to any SCBA condition can help the fire fighter overcome a panic response. It is critical that the response from a fire fighter to an out-of-air or SCBA mechanical emergency be a trained/learned response. Frequently, fire fighters find themselves inside a structure when such an event occurs, and these conditions can cause a fight or flight anxiety response. Whenever anxiety or panic occurs, there is a narrowing of cognitive thinking or problem solving ability. This has been long recognized in the SCUBA diving community, and the survival or ability to overcome the situation relies on a trained response.

Repetitive skills training with SCBA is vital for fire fighters working inside an IDLH atmosphere. SCBA skills training is an ongoing process that should be performed regularly to ensure that fire fighters know their SCBA. The benefits of repetitive skill training with SCBA are an increased comfort and competency level, decreased anxiety, lower air consumption, increased awareness of the air supply (HUD), and an automatic muscle memory response of the vital function controls, such as the don/doff buttons, main air valve, emergency bypass operating valve, and auxiliary air connections (i.e., rapid intervention crew/universal air connection (RIC/UAC) and the buddy breather connection). Repetitive skills training can also provide the user with an increased ability to operate these functions and controls

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in a high-anxiety moment or an emergency. Many times these skills will be necessary with gloved hands, limited vision, and reduced ability to hear commands from others.

Performed in conditions that are non-IDLH, repetitive skills training helps build the fire fighters muscle memory skills. This ensures the fire fighter will be able to activate the controls with gloves on and the operation will be a conditioned or second-nature response. Fire fighters have died in IDLH conditions because they did not react properly to an out-of-air emergency.

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

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

Contact the department's PASS device manufacturers. Ask them about any reported problems with the devices and what upgrades they may be offering, if any, that can be made to allow current devices to meet the most current edition of NFPA 1982.

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Investigator Information

This incident was investigated by Murrey E. Loflin, Investigator, Matt Bowyer, General Engineer, and Tim Merinar, Safety Engineer with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH, located in Morgantown, West Virginia. This report was authored by Murrey E. Loflin. Expert technical reviews were provided by Billy Goldfeder, Deputy Fire Chief of the Loveland-Symmes, Ohio, Fire Department and Kevin D. Quinn, Chairman of the National Volunteer Fire Council. A technical review was also provided by the NFPA Public Fire Protection Division.

Additional Information

Modern Fire Behavior

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

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

These two agencies provide information including training videos showing the findings from NIST and UL research conducted in cooperation with the Fire Department of New York on Governor's Island in 2012. <http://www.firecompanies.com/modernfirebehavior/governorsislandonlinecourse/story.html>

Flashover TV sponsored by FireRescue.com includes a series of training presentations by NIST researcher Dan Madrzykowski. <http://flashovertv.firerescue1.com/videos/1875870-nist-and-ul-research-on-fire-dynamic-case-studies-part-4/>

Information on completed fire-fighting research studies is available at the NIST website at http://www.nist.gov/el/fire_research/firetech/index.cfm.

The information on completed fire-fighting research studies is available at the UL Firefighter Safety Research Institute website at www.ULfirefightersafety.com.

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International Association of Fire Chiefs (IAFC) Rules of Engagement for Firefighter Survival

The IAFC is committed to reducing fire fighter fatalities and injuries. As part of that effort, the nearly 1,000-member Safety, Health and Survival Section of the IAFC has developed DRAFT *Rules of Engagement for Structural Firefighting* to provide guidance to individual fire fighters and incident commanders regarding risk and safety issues when operating on the fireground. The intent is to provide a set of “model procedures” for structural fire-fighting to be made available by the IAFC to fire departments as a guide for development of their own standard operating procedures.

http://www.iafcsafety.org/downloads/Rules_of_Engagement.

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

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

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

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

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

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

FIRESCOPE

Incident Command System Publication, *Structure Fire Operations, ICS 500* (October 14, 2015) <http://www.firescope.org/ics-op-guides-job-aids/ics%20500.pdf>. FIRESCOPE last revised this

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document more than 20 years ago. While much of the strategy and tactics of combating structure fires has remained unchanged over the last 20 years, there have been some recent changes that will be recognized in this document. These changes address:

- Risk Assessment
- Improved Accountability
- Rapid Intervention
- Mayday
- Transitional Fire Attack

FIREScope recognizes that the vast majority of structure fires are short-term incidents (less than one operational period). Due to the compressed time frame, most structure fire incident management systems incorporate only the Command and Operations functions of an incident command system. For long-term incidents requiring the implementation of the Planning, Logistics, and/or Finance/Administration functions, the FIREScope Field Operations Guide ICS 420-1 (FOG) should be used as a reference.

Disclaimer

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

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**Appendix One
Summary of Personal Protective Equipment Evaluation
Status Investigation Report of one
Self-Contained Breathing Apparatus
Submitted By the
Fire Department
NIOSH Task Number TN-20065**

(Note: Full report is available upon request)

Background

As part of the *National Institute for Occupational Safety and Health (NIOSH) Fire Fighter Fatality Investigation and Prevention Program*, the National Personal Protective Technology Laboratory (NPPTL) agreed to examine and evaluate an SCBA unit identified as a Scott Health and Safety model AirPak 4.5, 4500 psi, 30-minute, self-contained breathing apparatus (SCBA). This SCBA status investigation was assigned NIOSH Task Number 20065. The NIOSH Division of Safety Research (NIOSH/DSR) and the fire department were advised that NIOSH NPPTL would provide a written report of the inspection and any applicable test results.

The SCBA unit was hand delivered in a black plastic bag to the NIOSH facility in Morgantown, WV on January 26, 2015 and taken to the lower floor of the testing lab (H-1513), for secured storage. The SCBA unit was then transported to Pittsburgh for inspection on February 19, 2015 and secured in the General Respirator Inspection Area (Building 20) until the time of the inspection on February 27, 2015.

SCBA Inspection

The unit was inspected in Building 20 on February 27, 2015 by Tom Pouchot, General Engineer, and Jay Tarley, Physical Scientist, NPPTL. The unit was identified as an SCBA from the fire department and was extensively examined, component by component, in the condition received to determine the conformance of the unit to the NIOSH-approved configuration. The unit was identified as a Scott Health and Safety Company model AirPak 4.5, 30-minute, 4500 psi units, NIOSH approval number TC-13F-0076. The visual inspection process was documented photographically with a digital camera and the condition of each major component of the SCBA noted.

The unit did not show any signs of heat damage but exhibited signs of wear and tear for the age of the unit. The cylinder valve, as received, was in the off position. The cylinder gauges showed a pressure reading of approximately 1000 psig. Once all the inspections were completed, the SCBA unit was repackaged and placed back in secured storage until it was removed for testing on February 27, 2015.

Personal Alert Safety System (PASS) Device

The PASS device did function. However, the unit was not tested against the specific performance requirements of NFPA1982, *Standard on Personal Alert Safety Systems, (PASS)*, 1998 Edition. Because NIOSH does not approve PASS devices, no further evaluation was performed.

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SCBA Compressed Air Cylinder Contents

The cylinder provided had approximately 1,000 psi. The air was tested by an outside lab and failed the requirements for carbon dioxide.

SCBA Testing

The purpose of the testing was to determine the SCBA's conformance to the approval performance requirements of Title 42, *Code of Federal Regulations*, Part 84 (42 CFR 84). Further testing was conducted to provide an indication of the SCBA's conformance to the National Fire Protection Association (NFPA) Air Flow Performance requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, 1997 Edition.

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

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

National Fire Protection Association (NFPA) Tests (in accordance with NFPA 1981, 1997 Edition):

7. Air Flow Performance Test [Chapter 5, 5-1.1]

All units were tested on February 27, 2015, and met all of the test requirements.

Appendix II of the Status Investigation Report contains complete NIOSH and NFPA test reports for the SCBA. Tables One and Two summarize the NIOSH and NFPA test results.

Summary and Conclusions

The unit did not show any signs of heat damage but exhibited signs of wear and tear for the age of the unit. The cylinder valve, as received, was in the off position. The cylinder gauges showed a pressure reading of approximately 1000 psig. The regulator and facepiece mating and sealing area on the unit were relatively clean. There were slight scratches on the lens of the unit but visibility through the facepiece lens was acceptable. The facepiece head harness webbing was in fair condition and was slightly dirty with some fraying at the connection points. The NFPA approval label was present and readable. The personal alert safety system (PASS) was functional.

The SCBA met the requirements of the NIOSH Positive Pressure Test, as the unit did maintain a positive pressure for the 30-minute minimum duration. The unit passed all of the other NIOSH tests. The air was tested by an outside lab and failed the requirements for carbon dioxide.

In light of the information obtained during this investigation, NIOSH has proposed no further action on its part at this time. The SCBA unit was returned to storage pending return to the fire department.

If this unit is to be placed back in service, the SCBA must be repaired, tested, cleaned and any damaged components replaced and inspected by a qualified service technician, including such testing

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and other maintenance activities as prescribed by the schedule from the SCBA manufacturer. Typically a flow test is required on at least an annual basis.

The investigation under task number TN-20065 will be considered closed.

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Appendix Two Incident Commander’s Tactical Worksheet for Mayday

INCIDENT COMMANDER’S TACTICAL WORKSHEET FOR “MAYDAY”

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

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

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

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Appendix Three Incident Action Plan

DEVELOPING an INCIDENT ACTION PLAN

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

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

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

INCIDENT ACTION PLAN COMPONENTS

- Scene Size-up
- Scene Size-up communicated to all responding companies
- 8 Critical Fireground Factors
- Incident Priorities
- SLICE-RS
- Staffing
- Risk Management Plan
- Fire Fighter Safety
- Utilize *ICS Form 202 – Incident Objectives* as a guide.

Tactical Worksheet

REMEMBER
✓ Air Status Every 10 Minutes
Maintain Team Integrity at All Times

Incident Name: _____
 State Location: _____
 Local Address: _____
 ZIP Location: _____
 ICS Location: _____
 Dispatch/Command Address: _____

Company	Engine	Truck	Rescue	Utility	Other
1					
2					
3					
4					

Incident Priorities/Maneuvers/Legitimate priorities to all companies:
 1. _____
 2. _____
 3. _____
 4. _____

RISK ASSESSMENT

Incident: _____
 Structural: _____
 Electrical: _____
 Gas: _____
 Other: _____

IC: _____
 Safety Officer: _____
 PIO: _____
 Liaison: _____

Benchmark	Time	Benchmark	Time	Benchmark	Time
AT Clear		Under Control		Lines Staged	
Hot Out		Structural Entry		Damage and Overhaul	
ITF		Attack Team		PIO or Investigator	
Primary Search		Exhaust		Public-Place Work	
Secondary Search		Water Supply		Overhaul/Exhaust	
Multiple Egress		Extractions		Person for IC	
Resources Requested					

TACTICAL WORKSHEET COMPONENTS

- Strategy
- Tactical Objectives and Benchmarks Met
- Time Benchmarks
- Committed Resources
- Available Resources - Staging
- Personnel Accountability System
- Scene Diagram
- Tactical Level Management
- Safety Considerations
- *Continuous review of the Tactical Worksheet*

**LIFE SAFETY
PRIORITY ONE**

**INCIDENT STABILIZATION
PRIORITY TWO**

**PROPERTY CONSERVATION
PRIORITY THREE**