1000 FREDERICK LANE, MORGANTOWN, WV 26508 · 304.285.5916

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire-Pennsylvania

Executive Summary

A firefighter from E336 was killed when the front porch roof collapsed on him while operating at this residential structure fire. Engine 336 is parked on Side Bravo and Command is located at the Side Bravo/Side Charlie corner in the red vehicle.
(Photo courtesy of the fire department.)

On March 9, 2020, a 36-year-old volunteer firefighter was killed when the front porch roof of a single-family residential structure collapsed while he was operating a 1¾-inch hoseline on the porch. Two other firefighters were injured while operating at Box 25-11. At 01:31:38 hours, the county communication center (Headquarters) dispatched Engine 125, Engine 225, Engine 336, Engine 129, Truck 36, Squad 33 (Rapid Intervention Crew (RIC), Squad 29, Tanker 33, Tanker 41, Air 45, and Chief 25 to Box 25-11 for a report of a residential structure fire. The crew of Engine 336 consisted of an officer, engineer, and a firefighter. Engine 336 arrived on scene at 01:37:32 hours, and Chief 25 arrived on scene at 01:38:06 hours. Chief 25 advised Headquarters that the structure was a 2½-story farmhouse, and the fire was well-involved. Chief 25 assumed Command. Fire was showing from every window and doorway of the structure. A male occupant of the house with several burns advised Command that there was an occupant trapped inside the house. Engine 336 pulled into a driveway of the residence and parked on Side Bravo, which was approximately 60 feet from the structure. When the officer opened the cab door of Engine 336, the chauffeur had to shield his face from the heat. The jumpseat firefighter (Firefighter 36-36) exited the apparatus and pulled a preconnected 200-foot 1¾-inch hoseline towards the Side Bravo/Side Alpha area of the structure. The jumpseat firefighter was wearing turnout gear, self-contained breathing apparatus (SBCA), and was “on air”. The captain of Engine 336 told the Firefighter 36-36, that Engine 336 was the only apparatus on scene, and this was a

defensive fire. Firefighter 36-36 acknowledged this order. The captain went to the rear of Engine 336 and pulled a 300-foot 1¾-inch hoseline and moved towards Side Charlie. Firefighter 36-36 operated the hoseline and eventually moved onto the porch. Chief 36 arrived on the scene at 0140 hours. After donning his turnout gear, Chief 36 began a walk around the structure to update Command. When Chief 36 approached Side Alpha, he noticed Firefighter 36-36 using an attack line in a defensive position flowing water into the 1st floor windows. Chief 36 then proceeded along Side Delta to Side Charlie. Chief 36 saw the captain of Engine 336 waiting for water. Chief 36 radioed Engine 336 and advised him to charge the hoseline. Truck 36 was responding and was given the assignment to setup for aerial operations upon arrival. Chief 36 heard a noise in the front yard and walked to Side Alpha. He noticed the porch roof had collapsed. Chief 36 saw a handline going under the burning, collapsed porch roof. Chief 36 immediately called a Mayday at 01:44:48 hours for a firefighter down on Side Alpha and requested a hoseline. The PASS alarm on Firefighter 36-36's SCBA had activated and was in full alarm. A 2nd Alarm was dispatched to Box 25-11 at 01:46:42 hours. The RIC (Squad 33) was not on the scene yet. Firefighters from Engine 225 and Truck 36 were trying to locate the trapped firefighter. The porch roof was made of heavy timber and could not be lifted by hand. The columns supporting the porch roof were made of powdered aluminum. The fire caused the columns to melt and split, which led to the columns failing. Firefighters immediately started removing debris and putting the fire out around the front porch to locate the trapped firefighter. Firefighters crawled under the roof and located the trapped firefighter's (Firefighter 36-36) hand. The down firefighter was laying on his back. Truck 36 firefighters went between the front of the house and the porch roof to start cutting the porch roof into sections so it could be lifted. Squad 33 arrived at 01:48:28 hours. Chief 36 requested a set of hydraulic spreaders to lift the porch roof for access. The spreaders could not lift the roof. Long 4 x 4's and a straight ladder provided leverage for lifting the porch roof, and crews pulled the firefighter out at 0156 hours. The firefighter was unresponsive and in cardiac arrest. The firefighter was moved to Ambulance 91 for patient care by emergency medical services (EMS) personnel. After approximately 20 minutes of advanced life support (ALS) care, medical control at a local trauma center advised EMS to stop resuscitation efforts. The firefighter was declared deceased at 0220 hours. Command marked the fire under control at 02:41:33 hours. The fire was declared out at approximately 0430 hours.

Contributing Factors

- *Lack of effective scene size-up and risk assessment*
- *Lack of crew integrity*
- *Lack of established collapse zones*
- *Lack of situational awareness*
- *Lack of personnel accountability*
- *Offensive operations at a defensive fire*
- *Lack of command safety*
- *Lack of Mayday management*
- *Lack of fireground training and proficiency.*

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Key Recommendations

- *Fire departments should ensure the strategy and incident action plan, based upon the scene size-up and risk assessment, are communicated to all responding resources by the first arriving fire department resource. This includes communicating any hazard zones and defined collapse zones or exclusion zones at defensive fires*
- *Fire departments should ensure that company officers and firefighters maintain crew integrity during fireground operations*
- *Fire departments should ensure that all members utilize the principles of operational risk management at all incidents*
- *Fire departments should ensure that firefighters are trained to understand building performance under fire conditions and the potential for structural collapse*
- *Fire departments should train fire officers and firefighters on the principles of situational awareness*
- *Fire departments should ensure that incident commanders incorporate command safety into the incident management system during fireground operations*
- *Fire departments should ensure that all companies are operating based upon the assignment given by the incident commander. The Task-Location-Objective assignments should be communicated over the radio*
- *Fire departments should review their personnel accountability system standard operating procedure (SOP)/standard operating guideline (SOG) to ensure that accountability is maintained at each operational level*
- *Fire departments should provide a Mayday tactical worksheet for incident commanders in the event of a Mayday*
- *Fire departments should require all members engaged in fireground operations participate in annual proficiency training and evaluation. This verifies essential qualifications and competencies of its members to operate on the fireground.*

For report slides that summarize this incident and recommendations: F2020-11RS

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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Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Introduction

On March 9, 2020, a 36-year-old volunteer firefighter from Company 36 was killed when the porch roof of a residential structure collapsed on him while he was operating a 1¾-inch hoseline. On March 9, 2020, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On October 2020, the deputy fire chief from Fire Company 36 contacted the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) project officer regarding investigation of this incident. On October 13, 2020, this incident was assigned to an investigator and occupational health and safety specialist with FFFIPP. A virtual investigation was initiated due to the COVID-19 pandemic and governmental travel restrictions. An opening meeting was held on December 3, 2020, with the fire chief from Company 25 (incident commander) and the fire chief from Company 36. After the pandemic travel restrictions were lifted, on June 16 -18, 2022, three FFFIPP investigators traveled to Pennsylvania to conduct interviews with members of Company 36 and Company 25.

Fire Chief 36 provided the NIOSH FFFIPP investigators with incident reports, dispatch tapes (audio and transcripts), training records for Firefighter 36-36, witness statements from members on Engine 336, helmet camera video of fireground operations, SCBA annual service test reports, incident scene diagrams, the county coroner's autopsy report, the run card assignment for Box 25-11, and the standard operating guidelines (SOGs) for Company 36. Fire Chief 25 provided the NIOSH investigator with incident scene diagrams, witness statements from members of Company 25 that responded to the incident, and the National Fire Incident Reporting System (NFIRS) incident report.

Fire Departments

Company 36 consists of two fire stations, 40 officers and firefighters, and has operated since 1895. Company 36 serves a population of approximately 22,500 and covers an area of approximately 100 square miles. The department provides a part-time, paid driver at each station during weekdays. The remainder of the staffing is provided by volunteers. The department provides structural firefighting, basic life support (BLS) non-transport, wilderness rescue, wildland urban interface (WUI) firefighting, and hazardous materials operations level response. The fire company operates three engine companies, one truck company, two brush trucks, two utility vehicles, one van, and one all-terrain vehicle. The fire department responded to 489 incidents in 2020.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Company 25 consists of one fire station, has 40 officers and firefighters, and has been operational since 1860. The fire company serves a population of approximately 7,000. Company 25 is a combination department with a paid driver during the weekdays from 0700 – 1700. The department provides fire protection to approximately 7,000 residents living in the township. Company 25 operates a fleet of apparatus and vehicles which includes 2 engines, a heavy rescue, a mini-pumper, and three chiefs' vehicles.

Company 25 responds to more than 350 incidents annually including non-emergency public assistance incidents, water rescues, vehicle crashes and entrapments, and structures fires. The fire company has a 26.5 square mile first-due area including rural farmland, residential developments, the Appalachian Trail, mountain trails, and a Class I railroad.

Both fire companies have written policies and SOPs/SOGs, which are available to all department members. These policies and guidelines have been implemented and are enforced.

Training, Education, and Professional Development

The Commonwealth of Pennsylvania has no mandated training requirements for firefighters. Each fire department in the Commonwealth is responsible for establishing the training requirements for each position/rank in their fire department.

Company 36 has an SOG titled *Training* which provides a continuous and progressive training program for company members. The intent of this guideline is to provide the highest possible level of service to the community. It also provides continuous reinforcement and monitoring of the necessary skills and knowledge of fire department members.

The following identifies the minimum required training for active operational members who seek to respond to emergency calls:

- Pennsylvania State Fire Academy Entry Level Fire Training Curriculum:
  - Level 1: *Introduction to the Fire Service* (ELIS) (16 hours)
    - This entry level course is designed to introduce new firefighters to basic information including an overview of the fire service, fire service history, it's mission and organization, firefighter safety, personal protective equipment, tools, communications, work areas, and backing apparatus. This is the first of four levels (courses) in the curriculum.
  - Level 2: *Fire Ground Support* (EFG) (32 hours)
    - This entry level course is designed to introduce new firefighters to fire ground operation including fire hose, water supply, hose operations, ropes and knots, self-contained breathing apparatus (SCBA), building construction, and scene lighting. This is the second of four levels (courses) in the curriculum.
  - Level 3: *Exterior Firefighter* (ELEF) (40 hours)
    - This entry level course is designed to introduce new firefighters to fire ground operation including self-contained breathing apparatus (SCBA), fire dynamics, fire extinguishers,

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

forcible entry, ladders, and fire streams/hose line advancement. This is the third of four levels (courses) in the curriculum

- Level 4: *Interior Firefighter* (ELIF*)* (48 hours)
  - This entry level course is designed to introduce new firefighters to interior fire ground operations including air monitoring, search and rescue, firefighter survival, tactical ventilation, interior hose streams, fire suppression, and overhaul, salvage & property conservation. This is the fourth of four levels (courses) in the curriculum.

Upon successful completion of these four levels of training, a firefighter meets the requirements for NFPA 1001, *Standard on Fire Fighter Professional Qualifications*, Fire Fighter I (**See Diagram 1**). This certification allows a firefighter to conduct interior firefighting operations.

The next step in the process is for a firefighter to complete Fire Fighter II certification, which complies with NFPA 1001, *Standard on Fire Fighter Professional Qualifications*, Fire Fighter II (**See Diagram 2**).

All training must be achieved in accordance with state and federal regulations regarding junior members:

- Vehicle Rescue (Awareness at a minimum)
- Hazardous Materials Awareness (4 hours) and Hazardous Materials Operations (24 hours)
- Cardiopulmonary resuscitation (CPR)
- Basic First Aid
- 29 CFR 1910.1030, *Bloodborne Pathogens*.

Firefighter 36-36 had completed the following training: *Introduction to the Fire Service* – Level 1; Fire Ground Support – Level 2; *Exterior Firefighter* – Level 3; *Interior Firefighter* – Level 4; Fire Attack at Attic Fires; Fire Attack at Basement Fires; Flashover Survival; Life Lion Landing Zone Officer Course; Basic Vehicle Rescue Awareness; Vehicle Rescue Operations – NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents* (Pilot); Basic Rescue Vehicle Technician; Special Vehicle Rescue Technician; Pump Operations I; Rapid Intervention Teams – Concepts & Procedures; ICS 100 – *Introduction to ICS*; Traffic Incident Management (TIM); Emergency Vehicle Driver Training (EVOC); and Hazardous Materials Operations Refresher.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

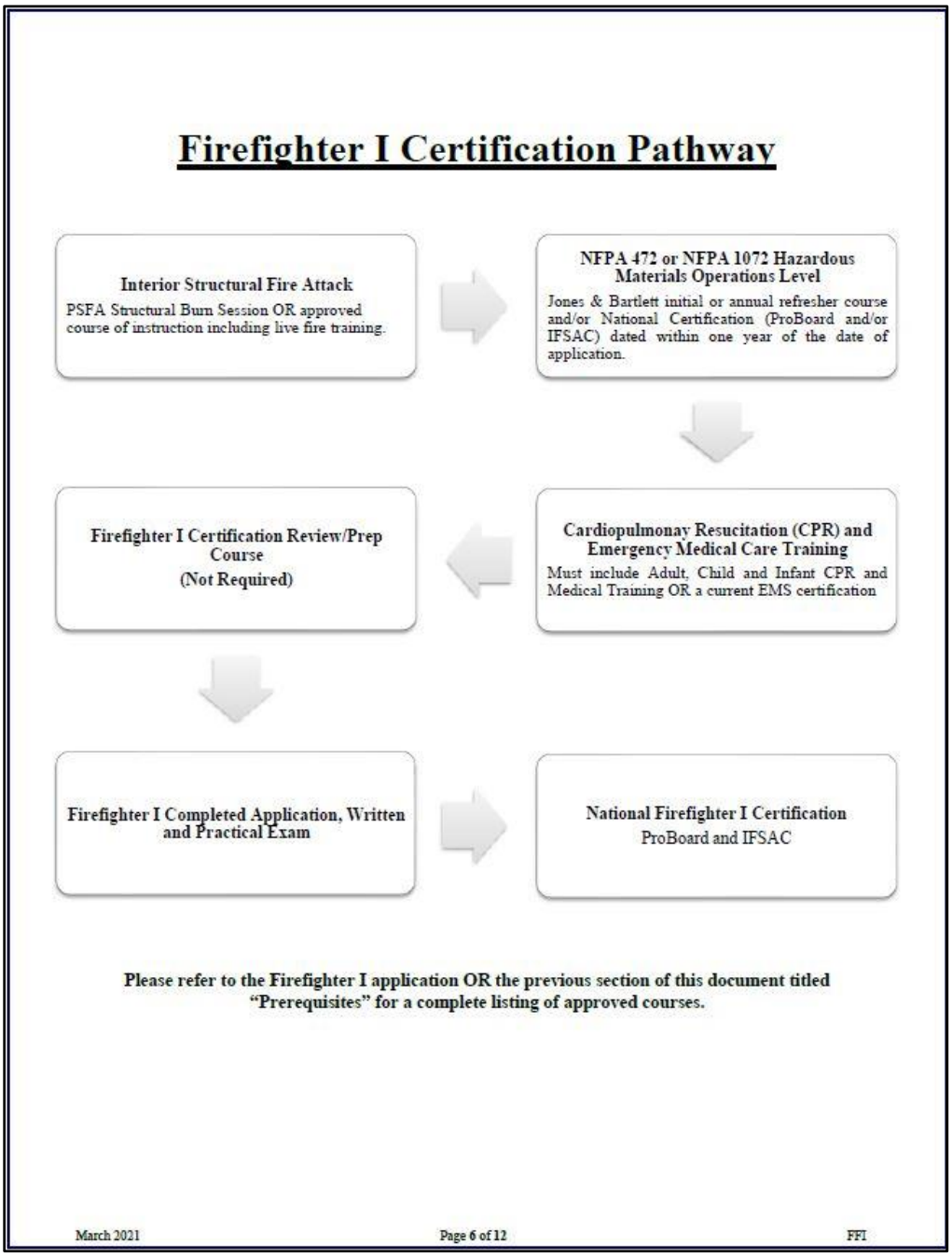

Diagram 1. The Commonwealth of Pennsylvania State Fire Academy's pathway for Fire Fighter I Certification.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

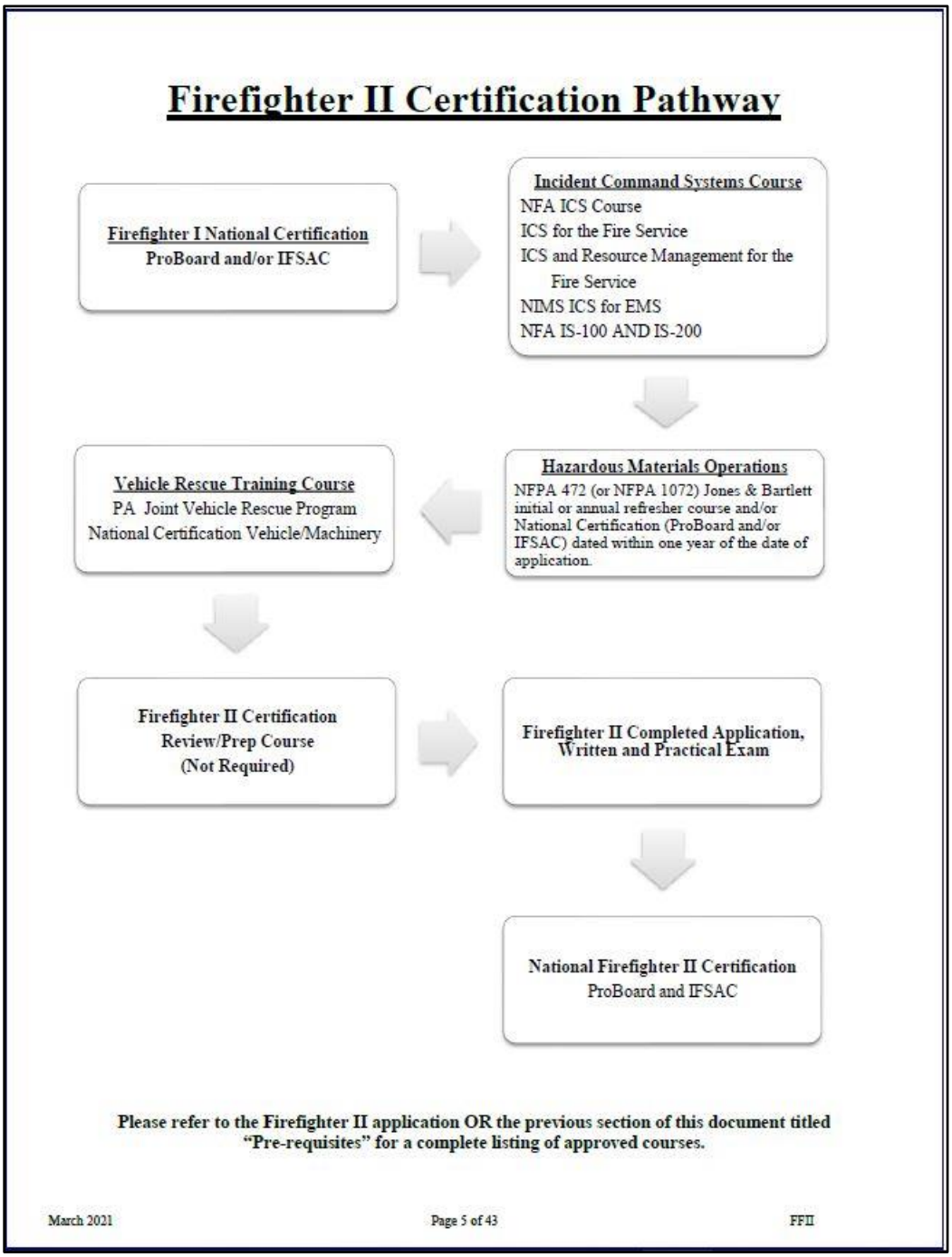

Diagram 2. The Commonwealth of Pennsylvania State Fire Academy's pathway for Fire Fighter II Certification.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Building Construction

The structure was a 2½-story wood frame residential farmhouse. The year the structure was built was not determined. The house was constructed of heavy timber and balloon-framed ordinary construction with brick-and-mortar exterior. The house was built on a concrete slab. The dimensions of the house were approximately 40 feet wide by 25 feet in length. There was an addition on Side Bravo. The structure was approximately 2000 – 2500 square feet (**See Photo 1 and Photo 2).** The columns or pillars supporting the front porch roof were powdered aluminum. There were entrances to the house on Side Alpha and Side Charlie.

Photo 1. Residential structure from Side Alpha. The house was balloon frame, built on a slab and termed a farmhouse.
(Photo from Google Maps)

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Photo 2. Sides Alpha and Side Bravo of the house. The service line on Side Bravo burned through during the fire.
(Photo from Google Maps)

Farmhouse Architecture

These structures were based on the classic colonial farmhouse's rectangular design and were often two-stories tall. Even better, they could easily be added on to with wings out the side or rear of the home to accommodate new family members or the next generation of families. Many older homes have a similar floor plan. The 1st floor features an ample cooking space in the back of the house, a formal living area in the front of the house, and bedrooms on the 2nd floor [The Spruce 2022].

The property consisted of the farmhouse, a garage, and a driveway on Side Bravo of the property. There was no access to the property on Side Delta due to a fence next to the private driveway on the adjacent property (**See Diagram 1**).

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

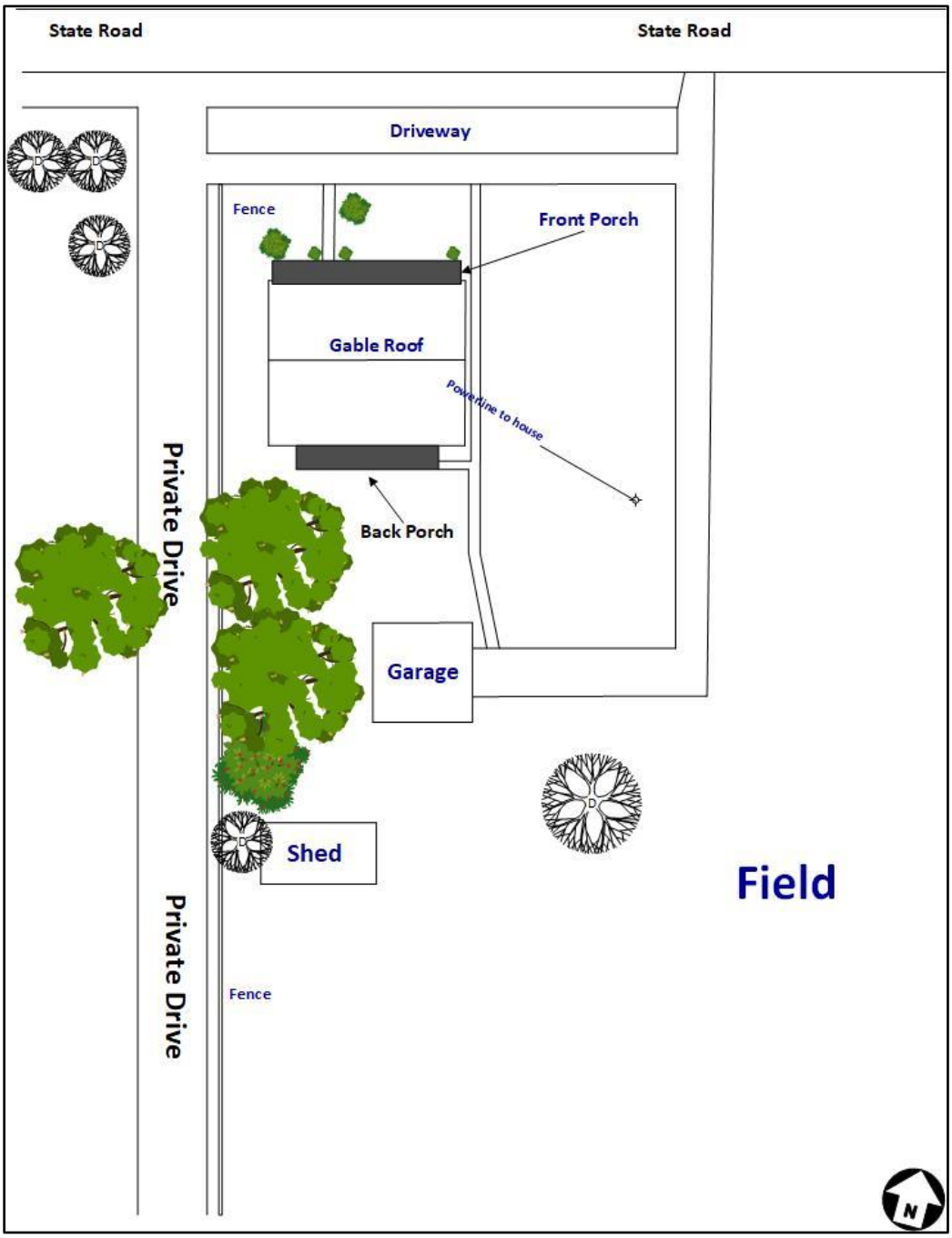

Diagram 1. An overview of the structure and associated properties.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Apparatus, Staffing, and Communications

The 1st Alarm for Box 25-11 was dispatched at 01:31:38 hours. The following companies and resources were dispatched.

1st Alarm	Company	Staffing	Notes
Engine 125	25	3	
Engine 129	25	3	Add-on response
Engine 225	25	3	
Engine 336	36	3	
Truck 36	36	6	
Squad 29	29	4	Arrived after Mayday cleared
Squad 33	33	7	
Tanker 41	41	2	Staging
Tanker 33	33	2	Staging
Air 45	45	2	
Chief 25	25	1	Incident Commander
Medic 40		2	
Chief 36	36	1	Added to Box 25-11
Ambulance 91		2	

County 9-1-1 and Communications Center
The county's 9-1-1 and communications center, identified as Headquarters is located within the Department of Public Safety in the county seat. Headquarters operates 24 hours a day, 7 days a week and can be accessed for public safety needs by dialing 9-1-1 for emergencies. Headquarters also handles non-emergency calls via three regional phone numbers. Headquarters dispatches calls for all law enforcement agencies and departments within the county, except the Pennsylvania State Police. Headquarters serves all the county fire companies, activates school district alert devices, and dispatches EMS incidents for all of the county. The county is licensed through medical priority to provide emergency medical dispatch (EMD).

Timeline

Not all incident events are included in this timeline. The times were determined by reviewing the dispatch records, audio recordings, witness statements, National Fire Incident Reporting System (NFIRS) incident reports, and other available information. This timeline also lists the dispatch communications and fire department response. Also, the timeline lists critical fireground communications and fireground operations.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Headquarters (the county's dispatch center) dispatched E125, E225, E336, Truck 36, Squad 33 (RIC), Squad 29, Tanker 33, Tanker 41, Air 45, Car 25, Medic 40, and Ambulance 91 on Box 25-11. The initial 9-1-1 call came from the registration desk of a resort which was on the same street where the fire building was located.	**01:31:38 Hours**	
Headquarters advised all responding companies the fire was at the "big white house that sits at the bottom of the road".	**01:32:05 Hours**	
Ambulance 91 and Medic 40 responded to Box 25-11.	**01:32:47 Hours**	
Tanker 41 (PAR 2) responded to Box 25-11.	**01:34:33 Hours**	
Chief 25 (PAR 1) responded to Box 25-11	**01:34:44 Hours**	
Engine 225 (PAR3) responded to Box 25-11.	**01:35:04 Hours**	
Truck 36 (PAR 6) responded to Box 25-11.	**01:36:06 Hours**	Headquarters advised a change in address for the structure fire.
Engine 336 (PAR3) responded to Box 25-11.	**01:36:13 Hours**	

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Chief 25 advised Headquarters this was going to be a working fire. Chief 25 was approximately 2 miles from the scene and could see smoke showing.	**01:36:35 Hours**	All responding companies to Box 25-11 were advised to switch to OPS2 (tactical channel).
Air 45 (PAR 2) responded to Box 25-11.	**01:36:56 Hours**	
Squad 33 (RIT 33) (PAR7) responded to Box 25-11.	**01:37:10 Hours**	
Engine 129 (PAR 3) was dispatched and responded to Box 25-11. *E129 responded in place of Engine 125.*	**01:37:22 Hours**	
Engine 336 arrived on-scene.	**01:37:32 Hours**	The officer and firefighter from E336 each pulled a 1¾-hoseline towards Side Charlie and Side Bravo.
Ambulance 91 (A91) arrived on-scene.	**01:38:01 Hours**	
Chief 25 arrived on-scene. Chief 25 advised Headquarters that the structure was a 2½-story farmhouse well-involved. Chief 25 assumed Command.	**01:38:06 Hours**	
Tanker 33 (PAR 1) responded to Box 25-11.	**01:38:27 Hours**	
Chief 36 arrived on-scene.	**0140 Hours**	Chief 36 was designated as Chief 36 by Command.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
	0141 Hours	Chief 36 saw Firefighter 36-36 operating a hoseline and flowing water through 1st floor windows of the house on Side Bravo.
Truck 36 arrived on-scene.	**01:42:52 Hours**	
Tanker 41 arrived on-scene.	**01:42:59 Hours**	
	0143 Hours	Approximate time the front porch roof collapsed.
Engine 225 arrived on-scene at the hydrant.	**0144 Hours**	
Medic 40 (M40) arrived on-scene.	**01:44:23 Hours**	
	01:44:44 Hours	Chief 36 called a "Mayday" on OPS2 (tactical channel).
Headquarters acknowledged the Mayday and sounded tones to restrict radio traffic on OPS2. Engine 129 arrived on-scene at the hydrant.	**0145 Hours**	E225 laid the 5-inch supply line to the driveway. The chauffeur of E225 connected the 5-inch supply line to the pump. The chauffeur then connected a 5-inch supply line to pump to E336. E129 connected to the hydrant and then pumped the 5-inch supply line to E225.
Command requested a 2nd Alarm for Box 25-11 plus an additional BLS unit and an additional advanced life support (ALS) unit.	**01:45:47 Hours**	

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Headquarters dispatched Engine 136, Engine 241, Truck 12, and Truck 15 for a 2nd Alarm on Box 25-11.	**01:46:42 Hours**	
M40 requested Headquarters to check on the availability of the helicopter (air ambulance).	**01:47:30 Hours**	
Squad 33 (RIC) arrived on-scene.	**01:48:28 Hours**	
Command requested Headquarters move fireground operations to OPS3. Mayday operations remained on OPS2.	**01:50:14 Hours**	
Air Ambulance enroute to incident scene.	**01:56:43 Hours**	Landing zone was designated as a field east of the incident scene.
	01:56:50 Hours	The Rapid Intervention Group Supervisor (Chief 36) advised Command that the firefighter had been removed from underneath the porch roof. Firefighter 36-36 was transferred to EMS.
	0158 Hours	Firefighter 36-36 was moved to Ambulance 91 for treatment.
Air Ambulance arrived on-scene.	**02:06:15 Hours**	
	0220 Hours	Medical Command at a local trauma center advised to stop resuscitation efforts. Firefighter 36-36 was declared deceased.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Dispatch Communications & Fire Department Response	Time	Fireground Communications & Fireground Operations
Command advised Headquarters the fire was under control.	**02:41:33 Hours**	
Approximate time that Command advised Headquarters that the fire was declared out at Box 25-11.	**0430 Hours**	
Chief 25 dissolved Command and advised that companies were clearing the scene. Fire investigators would be remaining on the scene.	**08:23:23 Hours**	

Personal Protective Equipment

At the time of the incident, Firefighter 36-36 was wearing full turnout gear plus SCBA. On June 16, 2022, NIOSH investigators evaluated the turnout gear and SCBA at Fire Station 2. The turnout coat had significant thermal damage to the left side both front and back. The turnout pants also sustained significant thermal damage to the left side/leg both front and back. The left boot also sustained thermal damage. The protective hood had thermal damage around the face opening. The helmet sustained thermal damage. The chin strap and protective head and ear cover were burned. The protective eye shields were melted. A helmet camera was mounted on the right side of the helmet.

The SCBA frame sustained significant heat damage. The shoulder strap on the left side was burned/melted and the waist strap was melted to the turnout coat. The air cylinder sustained significant heat damage. The SCBA facepiece also sustained significant heat damage and the mask mounted regulator (MMR) was melted to the facepiece. The most current annual certification test for the SCBA worn by the firefighter from E336 is listed in **Appendix One**.

The turnout gear and SCBA were not considered to be a contributing factor in this incident. No further evaluation or testing of the turnout gear and SCBA was conducted by NIOSH.

Weather Conditions

At 0156 hours on March 9, 2020, the following weather conditions were reported. The temperature was 43 degrees Fahrenheit (43°F), the dew point was 25 degrees Fahrenheit (25°F), the relative humidity was 49%, and the winds were out of the SE at 5 miles per hour. The conditions were mostly cloudy. There had been no precipitation in the past 24 hours [Weather Underground 2020].

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Investigation

On March 9, 2020, a 36-year-old volunteer firefighter was killed when the porch roof of a single-family residential structure collapsed while he was operating a 1¾-inch hoseline on the porch. At 01:31:38 hours, Headquarters dispatched Engine 125, Engine 225, Engine 336, Engine 129, Truck 36, Squad 33 (RIC), Squad 29, Tanker 33, Tanker 41, Air 45, Chief 25, Ambulance 91 and Medic 40 to Box 25-11 for a report of a residential structure fire. The initial 9-1-1 call came from the registration desk of a resort which was on the same street where the fire building was located. The fire was initially dispatched to the resort but was later corrected to the actual structure on fire which was on the corner of a state road and a local street. The crew of Engine 336 consisted of an officer (captain), chauffeur, and a Firefighter 36-36. Engine 336 responded from the department's Fire Station 2. At 01:36:35 hours, Chief 25 advised Headquarters this was going to be a working fire. Chief 25 was approximately 2 miles from the scene and could see smoke showing.

Engine 336 arrived on scene at 01:37:32 hours. Engine 336 pulled into a driveway of the residence and parked on the Bravo Side, which was approximately 60 feet from the structure (**See Diagram 2**). According to the officer, when he opened the cab door of Engine 336, the chauffeur had to shield his face from the heat. The jumpseat firefighter (Firefighter 36-36) exited the apparatus and pulled a preconnected 200-foot 1¾-inch hoseline towards the Side Bravo/Side Alpha area of the structure. The jumpseat firefighter was wearing turnout gear, SCBA, and was "on air." The captain of Engine 336 told Firefighter 36-36, that Engine 336 was the only apparatus on scene, and this was a defensive fire. Firefighter 36-36 acknowledged. The captain went to the rear of Engine 336 and pulled a 300-foot 1¾-inch hoseline and moved towards Side Charlie. Firefighter 36-36 moved his hoseline towards the Side Alpha/Side Bravo corner of the structure. The captain stated his decision was to pull the two 1¾-inch hoselines was at least to make a knockdown on the fire with staffing of 3 firefighters. The structure was fully involved.

Chief 25 arrived on scene at 01:38:06 hours. Chief 25 advised Headquarters that the structure was a 2½ story farmhouse with fire showing from Sides Alpha, Bravo, and Charlie. Chief 25 assumed Command. Chief 25 parked in the driveway on the Side Bravo/Side Charlie corner of the house, about 75 feet from the structure. As Chief 25 was giving his size-up to Headquarters and responding companies, a male occupant from the house approached him and said there was a female occupant and dog still in the structure. The male occupant had burns on his right arm. Command radioed Headquarters and requested an EMS response for a burn patient. The patient was transported to a trauma center later in the incident. Before Command could communicate his incident action plan, E336 had pulled the two 1¾" hoselines to Side Alpha and Side Charlie. Command's IAP was to stretch a 2 ½-inch hoseline with a blitz fire type monitor to Side Charlie.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

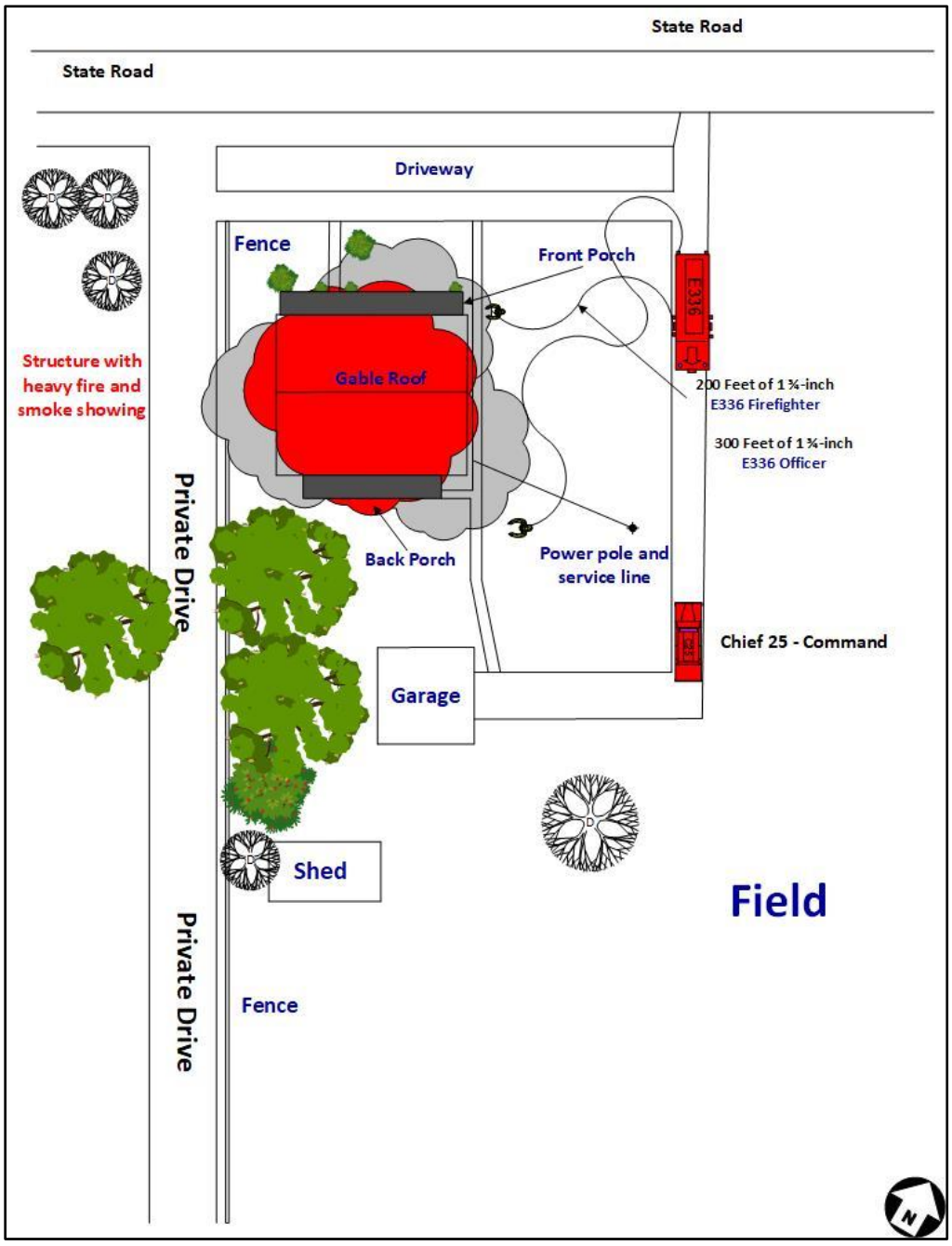

Diagram 2. The initial location of Chief 25 and E336, including the deployment of hoselines to Side Alpha/Bravo and Side Charlie. The time is approximately 0141 hours.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Chief 36 arrived on the scene at 0140 hours. After donning gear, Chief 36 began a walk around of the structure to update Command. When Chief 36 approached Side Alpha, he noticed Firefighter 36-36 using an attack line in a defensive position flowing water into the 1st floor windows. Chief 36 then proceeded along Side Delta to Side Charlie. There was heavy fire showing on Side Charlie. Chief 36 saw the captain of Engine 336 waiting for water. Chief 36 radioed Engine 336 and advised Engine 336 to charge the hoseline going to Side Charlie. Truck 36 arrived at 01:42:52 hours and was assigned by Command to set up to flow the ladder pipe. Truck 36 (PAR 6) split into two teams. One team went to Side Charlie and the other team operated on Side Alpha preparing to operate the ladder pipe.

Engine 225 arrived at approximately 0144 hours. Command ordered E225 to stop at the hydrant approximately 800 feet east of the incident on the state road. E225 dropped a 5-inch supply line at the hydrant and laid it to the driveway. E225 connected the 5-inch supply line from E336 and prepared to pump to E336. Engine 129 arrived at approximately 0145 hours, connected to the hydrant, and pumped to E225.

Chief 36 was at the Side Charlie/Side Delta corner of the structure when he heard a loud noise coming from Side Alpha. He walked to Side Alpha and saw Truck 36 parked on the state road in front of the structure. While Chief 36 was in the front yard on Side Alpha, he noticed a handline going under burning rubble. He recognized that the burning rubble was the collapsed porch roof. At the same time, a firefighter from Truck 36 and Chief 36 noticed a helmet on the ground. Chief 36 immediately called a Mayday at 01:44:44 hours for a firefighter down on Side Alpha and stated that a hoseline was needed. At 0145 hours, Headquarters acknowledged the Mayday and restricted radio traffic (emergency traffic only) on tac channel OPS2 (**See Diagram 3**). The porch roof was made of heavy timber and could not be lifted by hand. The columns or pillars supporting the porch roof were powdered aluminum and hollow. These columns failed once they were exposed to the fire causing the porch roof to collapse. When the front porch roof fell, the roof pulled away from the house. This created an approximately one foot opening between the porch roof and the house.

Command requested a 2nd Alarm, including an additional BLS ambulance and ALS medic unit to Box 25-11 at 01:45:47 hours. At 01:46:42 hours, Headquarters dispatched Engine 136, Engine 241, Truck 12, and Truck 15 for a 2nd Alarm at Box 25-11. Squad 33 (the designated RIC) was not on the scene yet. Firefighters from Truck 36 and Engine 225 were assigned to locate the missing firefighter.

Firefighters immediately started removing debris and putting the fire out around the front porch roof. Firefighters from Truck 36 and Engine 225 were to locate the missing firefighter. A firefighter from E225 crawled under the roof and located the trapped firefighter's (Firefighter 36-36) hand. Firefighter 36-36 was laying on his back. The firefighter from E225 crawled under the roof from the front of the house. When the roof fell there was a gap between the house and the roof debris. A firefighter from T36 went in between the house and the porch roof. The firefighter entered the gap and was able to locate Firefighter 36-36. Audio from a helmet camera video was able to confirm the PASS Alarm on Firefighter 36-36 was activated. The time was approximately 0147 hours.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

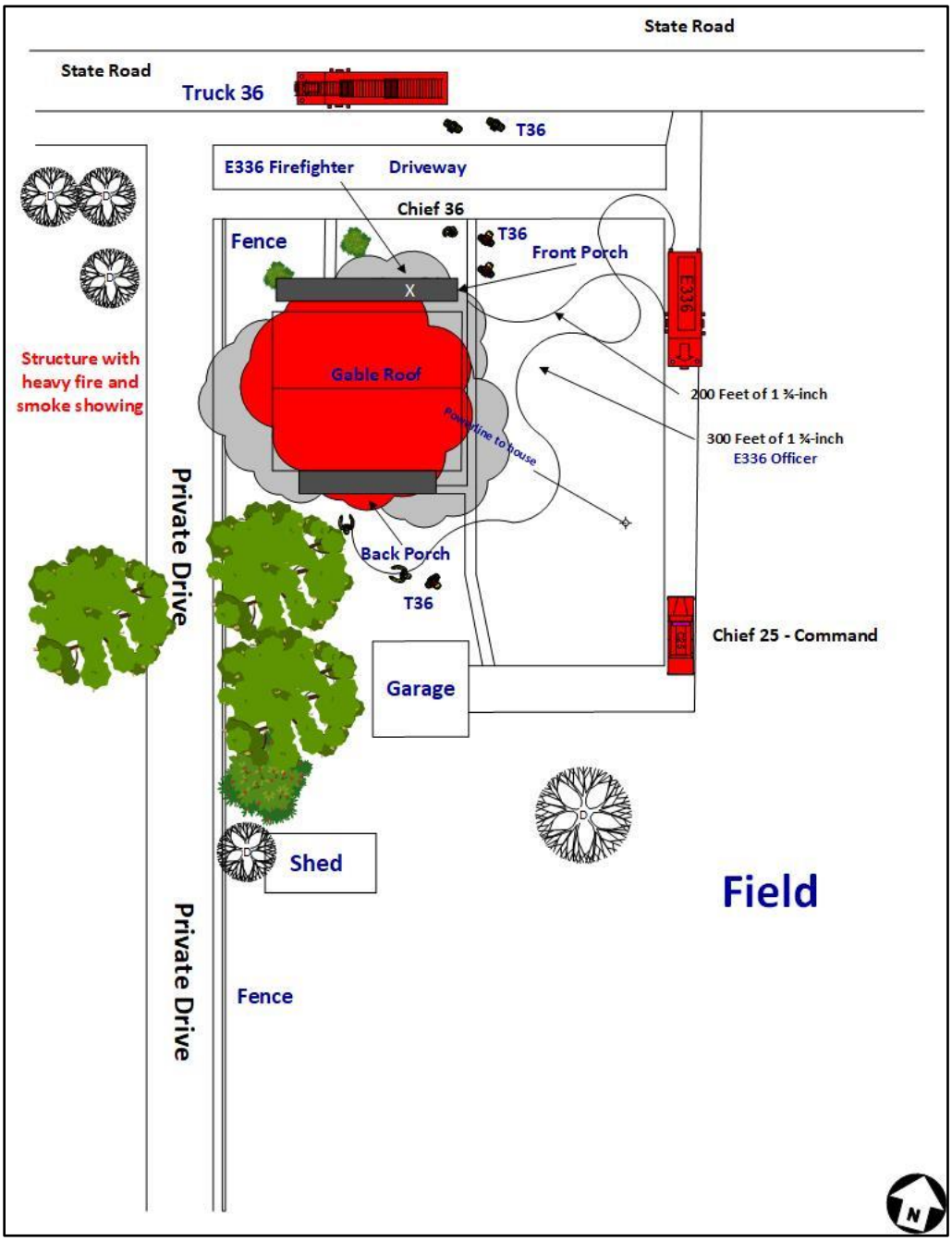

Diagram 3. The porch roof has collapsed. The firefighter from E336 is trapped under the porch roof. Chief 36 has called a Mayday. The time is approximately 0145 hours.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Squad 33 arrived on-scene at 01:48:28 hours. Chief 36 was assigned as the Rapid Intervention Group Supervisor by Command. Squad 33 started to move their rescue cache to the front yard on Side Alpha. Chief 36 ordered a set of spreaders to try and lift the porch roof off the trapped firefighter. Squad 33 tried to use the spreaders to lift the porch roof, but there was no leverage due to the soft, wet ground (**See Diagram 4**).

After the spreaders did not lift the porch roof, Chief 36 ordered the porch roof to be cut into sections. Chief 36 wanted to cut the porch roof in half so the roof could be lifted. The weight of the front porch roof prevented firefighters from lifting the entire roof, which was built with heavy beam construction. Firefighters and the officer from Truck 36 were cutting the porch roof into sections with chainsaws in order to be able to lift the porch roof off Firefighter 36-36. While this was being done, there were three firefighters under the porch roof trying to pull the Firefighter 36-36 free. At this time there was fire underneath the collapsed roof around Firefighter 36-36. A firefighter from Truck 36 operated the blitz hoseline to try and knock down the fire underneath the porch roof. Due to the electrical service line to the home being burned through and falling into the yard on Side Bravo, several firefighters received an electrical shock when they walked through a puddle of water. The area was cordoned off until the power was shut off by the utility company.

Once the porch roof was cut into smaller sections, long 4 x 4's, pike poles, and a straight ladder were used to provide leverage for lifting the porch roof. Crews gained enough lift of the porch roof to pull Firefighter 36-36 out from under the porch roof at 0156 hours. The firefighter was unresponsive and in cardiac arrest. The Rapid Intervention Group Supervisor advised Command at 01:56:50 hours that the Firefighter 36-36 was removed from under the porch roof and CPR was in progress in the front yard.

Firefighter 36-36 was moved to Ambulance 91 for patient care by emergency medical services (EMS) at approximately 0158 hours. Advanced life support (ALS) care was initiated by EMS. The air ambulance landed in the field east of the structure at 02:06:15 hours. ALS personnel on the air ambulance assisted ALS personnel on Medic 40 and Ambulance 91 with patient care and treatment. At 0220 hours, Medical Command at a local trauma center advised Medic 40 to stop resuscitation efforts. Firefighter 36-36 was declared deceased at 0220 hours.

Command marked the fire under control at 02:41:33 hours. The fire was marked out at approximately 0430 hours. At 08:23:23 hours, Chief 25 dissolved Command and advised Headquarters all firefighting resources were cleared. Investigators from the Pennsylvania State Police remained on scene.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

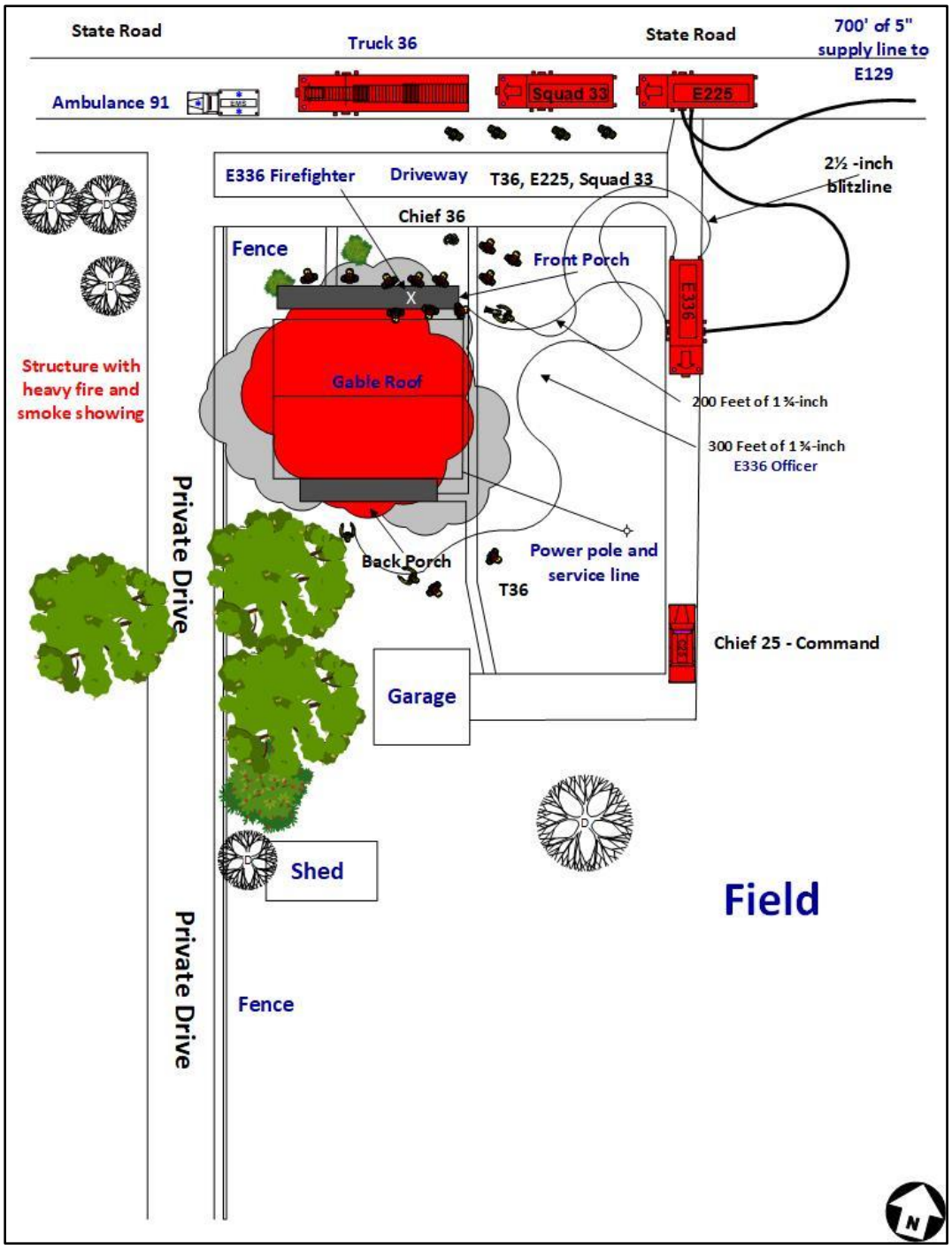

Diagram 4. The porch roof has collapsed. The rapid intervention group is trying to access the firefighter from E336. The time is approximately 0151 hours.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Fire Cause

The cause of the fire was listed as undetermined by the Pennsylvania State Police investigators.

Cause of Death

According to the death certificate, the medical examiner listed the victim's cause of death as asphyxia, smoke inhalation, and thermal burns. The manner of death was accidental.

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:

- Lack of effective scene size-up and risk assessment
- Lack of crew integrity
- Lack of established collapse zones
- Lack of situational awareness
- Lack of personnel accountability
- Offensive operations at a defensive fire
- Lack of command safety
- Lack of Mayday management
- Lack of fireground training and proficiency.

Recommendations

Recommendation #1: Fire department should ensure the strategy and incident action plan, based upon the scene size-up and risk assessment, are communicated to all responding resources by the first arriving fire department resource. This includes communicating any hazard zones and defined collapse zones or exclusion zones at defensive fires.

Discussion: At this incident, Engine 336 arrived on-scene at 0137 hours. The company officer and firefighter each stretched a 1¾-inch hoseline to different sides of the structure. The company officer told Firefighter 36-36 this was a defensive fire. Chief 25 arrived on-scene approximately 1 minute later at 0138 hours and assumed command. The strategy and incident action plan (IAP) developed by Command was to stretch a 2½-inch blitz hoseline to Side Bravo and sweep the structure. Before Command could communicate his IAP, the crew from Engine 336 had their hoselines in operation. Before the strategy and IAP was communicated, a male occupant from the house went to Command and advised him there was a female occupant and dog still in the house. Before any further orders were communicated the front porch roof collapsed on Firefighter 36-36.

All firefighters should maintain unity of command by always operating under the direction of the incident commander, division/group supervisor, or their company officer. The ultimate responsibility

for crew integrity and ensuring no members become separated or lost lies with the company officer. While operating in a hazard zone, the officer should maintain constant contact with their assigned members by visual observation, voice, or touch. If any of these elements are not adhered to, crew integrity is lost, and firefighters are placed at great risk.

Chief 25 arrived on-scene and drove around the house having the advantage to see all four sides of the house. Chief 25 then parked in the driveway on Side Bravo/Side Charlie of the structure and established Command. Based upon the scene size-up and risk assessment, Chief 25 determined this was a defensive fire and the IAP was defensive water application. Once a defensive strategy is announced, the tactical priorities should include:

- Define the hazard zone
- Establish collapse zone(s) and exclusion zone(s)
- Search exposures with primary and secondary "all clears"
- Protect exposures [SKCFTC 2023].

Defensive operations are the standard organizational response to situations that cannot be controlled utilizing offensive tactics. When conditions go beyond the safety systems required for interior operations, the IC must conduct defensive operations from outside of the hazard area. The IC must write off lost property and decide where the cut-off will take place (if there are exposures). In addition to cut-offs, the IC must define and establish collapse areas. Once in place, the IC must clearly communicate where the collapse area(s) is/are to all firefighters operating on the fireground. The IC, division/group supervisors, and company officers should ensure firefighters do not enter the areas.

If the fire is defensive from the beginning of the incident, command must notify the dispatch center/fire alarm office of the defensive conditions. Command also needs to further indicate that the structure will not be searched until post fire control.

A fire with defensive conditions from the beginning should contain the following IAP elements:

- Identify critical fireground factors
- Perform a rapid resource determination for additional resources
- Evaluate fire spread/write-off lost property
- Identify, and formally establish, the collapse zone
- Search exposures
- Protect exposures
- Prioritize fire streams, provide big, well-placed streams
- Surround and drown main fire area [SKCFTC].

Command's IAP was to have Engine 336 stretch a portable blitz monitor with a 2½-inch hose to Side Bravo and operate it from the yard on the structure. This was never communicated as a male occupant, who was suffering burns from the fire, went to Command to tell him that a female occupant and a dog were still in the house.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

With a defensive fire, the process is:

- Deploy master stream(s)
- Command must consider aerial master streams vs. ground level master stream devices. As part of the incident commander's IAP was to utilize the blitz monitor from Engine 336 and the ladder pipe from Truck 36
- A standard master stream flow of 750 GPM should be the minimum
- Small diameter hoselines not protecting exposures should be shut down. Hoselines at defensive fires almost always end up getting stretched to offensive positions
- After exposure protection is in place (as needed), attention should be directed to knocking down the main body of fire and thermal-column cooling [SKCFTC 2023].

Although structural collapse is a significant cause of injury and death to fire fighters, the potential for a structural collapse is one of the most difficult situations to predict. A collapse zone is defined as the area around the perimeter of a structure that could contain debris if the building collapsed. This area is often defined by establishing a perimeter at a distance from the building that is equal to 1½ times the height of the structure. In most fireground situations involving a structure fire, the probability of and anticipation for structural collapse or compromise are minimized, overlooked, or at times disregarded until the catastrophic conditions present themselves with little to no time to react accordingly. The loss of situational awareness, coupled with distracted attention to subtle or obvious pre-collapse building indicators and knowledge gaps in building and construction systems combine to elevate operational risks to firefighters on the fireground. [Naum 2012].

Understanding the influence that building design, construction, and conditions have on structural collapse potential has a direct correlation to safe fireground operations and firefighter survivability. A collapse zone should be established whenever the risk of structural collapse is identified as a potential occurrence [NIOSH 2014].

When established, a collapse zone should be identified by a fireground transmission, colored tape, signage cones, flashing beacons, fences, or other appropriate means. A "No Entry" policy should be enforced by the incident commander, safety officer, division/group supervisors, and company officers. When it is not possible or practical to visually mark a collapse zone, the incident commander should verbally identify the collapse zone area to all fireground personnel via radio or other communication methods. During structure fires, the incident commander should initially evaluate and continually reevaluate risk factors, including the potential for structural collapse based on direct observations, reports, and pre-incident plan information.

An exclusion zone is defined as a zone established by the IC that prohibits specific activities in a specific geographic area. If the fire is not contained and an exterior (defensive) attack becomes necessary, the exclusion zone is moved far enough away from the structure to place the firefighters outside of the collapse zone. In large or extended firefighting operations, these zones must be continually adjusted as necessary, and all personnel at the scene must be made aware of the exclusion zone or collapse zone locations [NIOSH 2014].

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

The collapse precursors or indicators must be identified, monitored, and managed on the strategic-, tactical-, and task levels [Naum 2013]. A collapse zone is defined as the area around the perimeter of a structure that could contain debris if the building collapsed.

Command needs to designate exclusion zones or no-entry zones when conditions warrant, and a collapse zone is not sufficient. The IC and the safety officer have a responsibility to establish and enforce the collapse zones plus the exclusion or no-entry zones. If a division supervisor is assigned to a side (division) of a structure, they have the responsibility to determine the conditions as they relate to the safety of firefighters. Everyone has a responsibility to abide by the decisions made for the established collapse zones and exclusion/no- entry zones. If an exterior (defensive) attack is necessary, the collapse zone is moved far enough away from the structure to place the firefighters outside the collapse zone. The collapse zone then becomes an exclusion/no-entry zone [NFPA 1500 2021].

The incident commander has the responsibility to enforce collapse zones including exclusion zone(s) or no-entry zones once established. The safety officer is an important component of the command team for helping define, implement, and enforce these zones throughout the incident. No member shall enter the hazard zone of a defensive fire area. Any structure that has defensive fire conditions shall not be entered by any personnel to perform any overhaul or loss control of any kind.

Recommendation #2: Fire departments need to ensure that company officers and firefighters maintain crew integrity during fireground operations

Discussion: At this incident, the company officer and firefighter each stretched a 1¾-inch hoseline to different sides of the structure. The initial incident action plan (IAP) developed by Command was to stretch a 2½-inch blitz hoseline to Side Bravo and sweep the structure. Before Command could communicate his IAP, the crew from E336 had their hoselines in operation. The appropriate strategy was a defensive strategy with an exterior fire attack.

A critical element for firefighter survival is crew integrity. Crew integrity means firefighters stay together as teams of two or more. No firefighters shall be allowed to be by themselves at any time while in a burning structure.

All firefighters should maintain unity of command by always operating under the direction of the incident commander, division/group supervisor, or their company officer. The ultimate responsibility for crew integrity and ensuring no members become separated or lost lies with the company officer. While operating in a hazard zone, the company officer should maintain constant contact with their assigned members by visual observation, voice, or touch. The company officer should ensure members stay together as a company. If any of these elements are not adhered to, crew integrity is lost, and firefighters are placed at great risk. If firefighters becomes separated and can’t get reconnected with their company immediately, they must get on the radio and attempt to communicate with their company officer.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

NFPA 1500, *Standard on Fire Department Occupational Safety, Health, and Wellness Program*, provides the following information regarding firefighters operating on the fireground:

- Paragraph 8.6.4: Members operating in hazardous areas at emergency incidents shall operate in crews of two or more.
- Paragraph 8.6.5: Crew members operating in hazardous areas shall be in communications with each other through visual, audible, or physical means or safety guide rope, in order to coordinate their activities.
- Paragraph 8.6.6: Crew members shall be in proximity to each other to provide assistance in case of emergency. [NFPA 1500 2021]

Crew integrity starts with the company officer ensuring that all members of the company understand their riding assignment, have the proper personal protective equipment, and have the proper tools to perform their job. Crew integrity continues upon arrival at the incident, where the company officer assigns tasks based upon the IAP. The company officer communicates to the members of the company what their assignment is and how they will accomplish the assignment. Members of a company operate in the hazard zone together and should leave together to ensure that crew integrity is maintained. If one member must leave, the whole company leaves together [IAFC 2012]. The company officer of Engine 336 and Firefighter 36-36 eventually were not in sight of each other when the firefighter moved to Side Alpha and then went onto the front porch. Also, there was no radio communications between the officer and firefighter of Engine 336 at this point.

Every fire fighter is responsible for always staying in communication with other crew members. All firefighters must maintain the unity of command by operating under the direction of the incident commander, division/group supervisor, or their company officer at all times. The ultimate responsibility for crew integrity (functioning as a team, ensuring no members get separated or lost) at the company level rests with the company officer. They must maintain constant contact with their assigned members by visual observation, voice, or touch while operating in a hazard zone. They must ensure they stay together as a company or crew. If any of these elements are not adhered to, crew integrity is lost, and fire fighters are placed at great risk. If a firefighter becomes separated and cannot re-connect with his/her crew immediately, the fire fighter must attempt to communicate via portable radio with the company officer. If reconnection is not accomplished after three radio attempts or reconnection does not take place within 1 minute, a Mayday should be declared. If conditions are rapidly deteriorating, Mayday must be declared immediately.

Recommendation #3: Fire departments should ensure that all members utilize the principles of operational risk management at all incidents.

Discussion: In this incident, Firefighter 36-36 was operating a hoseline on Side Bravo and then moved towards the Side Bravo/Side Alpha corner of the house. The house was fully involved. Eventually, the firefighter moved onto the front porch. Due to the amount of fire, the pillars holding the front porch failed and collapsed on the firefighter.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Firefighters are routinely exposed to certain known and predictable risks while conducting operations that are directed toward saving property. The incident commander (IC) is responsible for recognizing and evaluating those risks and determining whether the level of risk is acceptable or unacceptable. Risks taken to save property should always be less than those to save lives. Risks to firefighters versus gains in saving lives and property must always be considered when deciding whether to use an offensive or defensive attack. The IC should routinely evaluate and re-evaluate conditions and radio progress reports in reaching objectives to dispatch and on scene firefighters.

The following risk management plan should be used at all times when a hazard zone exists:

- Activities that present a significant risk to the safety of members shall be limited to situations where there is a potential to save endangered lives
- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of members, and actions shall be taken to reduce or avoid these risks
- No risk to the safety of members shall be acceptable when there is no possibility to save lives or property
- In situations where the risk to fire department members is excessive, activities shall be limited to defensive operations [NFPA 1561 2020].

The IC develops their strategy and the IAP based on the initial size-up of the incident's critical factors. These critical factors are very dynamic; they are either getting better, or they are getting worse, but they never stay the same. The current and forecasted incident conditions must drive the strategy, the IAP and the risk management plan.

Levels of risk can only be assumed in a highly calculated and controlled manner. Highly calculated and controlled refers to effective application of department SOPs/SOGs, training, and the safety systems (PPE, radios, apparatus, supervision/organization, water, etc.) that should be used/followed at all times.

The offensive/defensive strategy should be re-evaluated and re-declared after the fire has been knocked down and primary is complete – all clear. Both are critical decision points for the IC. The IC is responsible for evaluating conditions at a structure fire and determining safe tactics for fighting the fire. To accomplish this, the IC should use a standardized strategic decision-making model. First, the IC should size up the critical fireground factors.

The risk to firefighters is the most important factor considered by the IC in determining the strategy that will be employed in each situation. The management of risk levels involves all of the following factors:

- Routine evaluation of risk in all situations
- Well-defined strategic options
- Standard operating procedures (SOPs)
- Effective training
- Full protective clothing and equipment
- Effective incident management and communications

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

- Safety procedures and safety officer
- Backup crews for rapid intervention
- Adequate resources
- Rest and rehabilitation
- Regular re-evaluation of conditions
- Pessimistic evaluation of changing conditions
- Experience based on previous incidents and critiques [NFPA 1561 2020].

Additionally, a full range of factors must be considered in making the risk evaluation, including (but not limited to):

- Presence of occupants in the building
- A realistic evaluation of occupant survivability and rescue potential
- Size, construction, and use of the building
- Age and condition of the building
- Nature and value of building contents
- Location and extent of the fire within the building
- Adjacent exposures (structures)
- Fire involvement or compromise of the building's structural components
- A realistic evaluation of the ability to execute a successful offensive fire attack with the resources that are available [NIOSH 2010].

These fireground factors must be weighed against the risk management plan. This process allows the IC to determine whether to continue or revise the strategy and attack plans. Incident demands on the modern fireground, require firefighters to have increased technical knowledge of building construction with a heightened sensitivity to fire behavior, a focus on operational structural stability, and considerations related to occupancy risk versus the occupancy type. The IAP should be based on occupancy risk, not occupancy type, and must orchestrate sufficient staffing, fire flow, and tactical patience. This is done in a manner that identifies with the fire profiling, the predictability of the occupancy profile, and accounts for presumptive fire behavior. The first arriving resource, as well as the IC, must make an informed judgment upon arrival and continuously throughout the incident as to what is at risk, people or property. This judgment will determine the risk profile for the incident.

The risk management process is based on always conducting operations within standard operational and safety SOPs. The hazard zone is the only place where, based on the possibility of saving threatened lives. The risk management plan allows firefighters to take a significantly higher level of risk when there is the potential to save endangered lives. Operating in the rescue mode is based on situation evaluation, a conscious decision by the company officer, and the continual application of the safety SOPs.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Recommendation #4: Fire departments should ensure that firefighters are trained to understand building performance under fire conditions and the potential for structural collapse.

Discussion: At this incident, firefighters encountered a fully involved structure upon arrival. Based upon these conditions, the strategy was defensive, which the officer of Engine 336 stated to the jumpseat firefighter on E336. The fire was not threatening any exposures.

Understanding the influence that building design, construction, and conditions have on structural collapse potential has a direct correlation to safe fireground operations and firefighter survivability. A collapse zone should be established whenever the risk of structural collapse is identified as a potential occurrence.

Although structural collapse is a significant cause of injury and death to firefighters, the potential for a structural collapse is one of the most difficult situations to predict. The potential for structural collapse in a building on fire can be predicted by a building's susceptibility to a variety of factors, including fire dynamics and behavior, fire exposure and extension, environmental impact, fire suppression activities, building age, and deterioration. A building's performance and risk for structural collapse, compromise or failure must be foremost in the minds of ICs, division/group supervisors and operating companies working to execute the incident action plan. Recognizing and defining collapse precursors and risk through exclusion and control zones is fundamental to collapse zone management principles [NIOSH 2014].

Fire departments should not rely solely on the amount of time a fire has been burning as a collapse predictor. External loads, such as a parapet wall, steeple, overhanging porch roof, awning, sign, or large electrical service connections may also cause structural collapse. Other factors to consider include:

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

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Inherent characteristics prevalent in buildings of Type III ordinary construction or Type IV heavy timber construction present risks for masonry perimeter wall collapse, as well as internal floor collapses. Whereas buildings of Type V wood frame may be affected by compromised wall-floor or wall-roof interconnections or from the collapse of architectural features and components such as a chimney, porch or attached canopy. Type I fire resistive and Type II non-combustible construction may have parapets, suspended signage, or large span lintel or beam openings that affect the integrity of the building envelope [Naum 2015].

Community risk assessments when coupled with pre-fire planning programs can provide pre-incident insights to the organization, incident managers and officers for occupancy risk, inherent collapse probability and projected operational demands associated with fire-based incident conditions. Determining when to establish a collapse zone starts with a community risk assessment program [Naum 2015].

Community risk assessments satisfy many fire department objectives, but one of the most important aspects is to evaluate the fire risk associated with occupancy and construction classifications. A community risk assessment program, coupled with a pre-incident planning initiative that evaluates building construction, structural integrity, fire load, and fire protection systems is a vital tool for safely fighting fires. Fire departments should ensure all members are trained in the organization's rules of engagement, risk assessment, and situational awareness procedures [NIOSH 2014].

Recommendation #5: Fire departments should train fire officers and firefighters on the principles of situational awareness.

Discussion: At this incident, the officer of Engine 336 told Firefighter 36-36 that this was a defensive fire, which Firefighter 36-36 acknowledged. Firefighter 36-36 stretched his hoseline towards Side Bravo initially and then to Side Alpha. Eventually Firefighter 36-36 moved the hoseline to the front porch, was operating on the front porch when the porch roof collapsed.

Situational awareness is an important component in an effective operational risk management plan. It is one of the most critical aspects of fireground survival. Maintaining situational awareness involves not only perceiving and understanding the current situation but also being able to accurately predict outcomes in time to react to changing conditions in time to prevent harmful outcomes from occurring. [Gasaway 2019].

Situational awareness can be described as a heightened vigilance of what is currently happening and what is developing. One of the most critical aspects of coordination between fireground crews is maintaining shared situational awareness, sometimes referred to as crews having a common operating picture. A danger for firefighters in the initial stages of the event is task fixation. The firefighter can become so focused on operational assignments that they fail to sense and/or comprehend changes in their environment [Gasaway 2017].

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Situational awareness, as it applies to risk management, consists of three levels:

- Perception: Capturing information (clues and cues) in your environment
- Comprehension: Making sense of the clues and cues you have captured and piecing them together in a way that ensures you understand what is happening
- Projection: Being able to take your understanding of what is happening and make predictions about future events, including predicting outcomes based on your decision options [Gasaway 2021].

Every firefighter operating at a scene, not just the IC, is responsible for developing and maintaining situational awareness. As such, all responders must be familiar with the concept of situational awareness and understand how to develop and maintain this vital component of personal and fireground safety. All fire officers and firefighters operating at an incident should possess the skills to develop and maintain situational awareness and conduct a continuous risk assessment throughout the incident, reporting unsafe or changing conditions to the incident commander. It is important to train firefighters and fire officers on skills to maintain their situational awareness, especially regarding expected building performance under the stress of fire conditions. The training should focus on helping responders understand what situational awareness is, beyond the superficial meaning of the term (e.g., "pay attention"). Firefighters should be taught how to capture and understand critical clues and cues that indicates the dangers inherent to a building's performance under fire conditions [Gasaway 2013b; Chadwick 2014].

One of the most critical aspects of coordination between members when looking for a specific hazard is maintaining situational awareness and avoiding task fixation [Gasaway, 2017]. Task fixation occurs when an individual becomes focused on a specific task or other operational assignments and fails to sense and/or comprehend changes in their environment. Members can maintain better situational awareness by routinely looking up, down, and around themselves for other potential hazards as well as listening for new, unusual, or unexpected sounds or movement. When changes are observed or heard on the incident scene which raise red flags of concern about safety to members, these concerns should be immediately communicated to other members as well as to the incident commander.

Fireground dangers and hazards can and do change as an incident evolves and the event duration increases. Every firefighter needs to be responsible and accountable for their own safety, as well as team members and others working in the immediate area. This applies not only to the conditions found within a burning structure, but to the exterior fireground conditions as well.

Firefighters operating on the outside of a burning building who see changes in their environment such as electrical service drops exposed to fire, changes in smoke color/pressure, fire venting below firefighter positions or exposure buildings becoming threatened by intensifying fire conditions should report these conditions to their officer to be relayed to the incident commander. Firefighters operating on the fireground may be the first to notice subtle changes in their environment. These changes can be subtle signals for events yet to come. Situational awareness is essentially being a "heads up" firefighter [IFSTA 2018].

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

A company officer's responsibility is to direct and supervise the operations of their company. Company officers should always be scanning the environment in which their firefighters are operating. Fire officers should measure their company's success by accomplishing their assigned task while limiting risk. To achieve operational success at the company level, a fire officer must maintain a keen sense of situational awareness for both the safety of their company and the success of its mission. They should look for any conditions that may impact the company's safety like fire spread, heat conditions, building integrity, or smoke conditions. Fire officers should listen to all fireground communications for announcement of worsening conditions. However, it is vital that the company officer's analysis of their environment is accurately interpreted and reported to the IC [Warren 2017].

The situational awareness of the IC operating at the scene of a structure fire is based on what the IC directly observes, augmented by transmitted radio reports, which is the repository of all the information observed and transmitted. The IC depends on the skillset of company officers to develop and maintain strong situational awareness and their ability to accurately and timely update command about current and changing conditions [Gasaway 2013a]. The IC's situational awareness is larger in scope. From the command post, the IC will observe the fireground environment, looking for dangers like smoke color and pressure, visible fire, obstacles to line advancement, possible victims, age, and condition and deterioration of the building, and, when possible, observation of company operations. The IC's situational awareness should allow them to adjust the IAP accordingly. This includes each company's ability to accurately and timely update Command regarding current and changing conditions [Warren 2017].

Establishing and maintaining this fireground awareness can be challenging, because effective fireground operations involve teams of firefighters performing a full range of assigned tasks, all at once in a lot of different places. This involves multiple sequential tasks occurring simultaneously in a decentralized work environment. They must occur very fast and must be effectively coordinated, because operational action in one place must hook up to (e.g., integrate) and support what is going on in other locations on the fireground [Warren 2017].

Recommendation #6: Fire departments should ensure that incident commanders incorporate command safety into the incident management system during fireground operations.

Discussion: At this incident, the officer and fire fighter each stretched a 1¾-inch hoseline to different sides of the structure. The initial incident action plan (IAP) developed by Command was to stretch a 2½-inch blitz hoseline to Side Bravo and sweep the structure. Before Command could communicate his IAP, the crew from E336 had their hoselines in operation. From an operational risk management standpoint based on the fire conditions, there were no savable lives.

The purpose of command safety is to provide the IC with the necessary resources on how to use, follow, and incorporate safety into the incident management system at all incidents. Command safety is used as part of the eight functions of command developed by Fire Chief Alan V. Brunacini. Command safety is designed to describe how the IC 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 incident safety and incident management.

The functions of command in the "Command Safety" book differ than the eight functions of command [Brunacini and Brunacini 2004]. The functions of command safety are:

- Assumption, confirmation, and positioning of command
- Situation Evaluation
- Communications
- Deployment
- Strategy and Incident Action Planning
- Organization
- Review, Evaluate, and Revise
- Continue, Transfer, and Terminate Command.

The incident commander must follow each of these functions in order without skipping or missing any function. Automatically connecting and integrating safety with command becomes a simple and essential way that the incident management system protects assigned resources at an incident. These functions serve as a practical performance foundation for how the incident commander completes their responsibility as the strategic-level incident manager and the overall incident safety manager [Brunacini and Brunacini 2004].

Command safety focuses on the balance between the level of the hazards that are present in relation to the size of the standard safety system. The book refers to this term as "safety math" and becomes a simple way to make operational position/action decisions about the survivability of where firefighters can go, and what firefighters can do. This becomes a survivability index the IC can use to make offensive/defensive strategy decision for the incident [Brunacini and Brunacini 2004].

The IC cannot assign firefighters to positions where the safety system will not offer effective protection. If the safety system is bigger than the hazard, the incident commander defines the strategy as an offensive strategy. If the hazard is bigger than the safety system, the incident commander defines the strategy to be operated in a defensive strategy.

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

Generally, the incident commander tries to achieve the same basic objectives from one incident to the next. Tactical priorities offer a regular set of tools that the incident commander can utilize for tactical

activities in order to develop a standard approach to solving incident problems. With this standard approach, the incident commander can manage the basic work sequence at every incident, in the same manner.

During most incident situations, the IC must develop an IAP based only on the critical factors they can see at the beginning of operations. Most of the time, the initial information is very incomplete. The ability to identify the "known" and the "unknown" emerges when the IC uses the standard inventory of the critical factors. The IC must:

- Quickly size up what they know and what they do not know
- Identify and address critical "unknowns" during incident operations
- Some unknowns must be addressed immediately, especially in situations that involve firefighter safety and survival before the problem can even be engaged (such as basement fires)
- Some forecasted critical unknowns are so critical that they may drive the initial or current strategy choice.

The two separate strategies create a simple, *understandable* plan that describes how close the emergency responders will get to the incident's hazards. The incident's overall strategic decision is based on the incident's critical factors weighed against the risk management plan (**See Diagram 5**). Declaring the incident strategy up front, as part of the initial radio report will:

- Announce the overall incident strategy to everybody
- Eliminate any question on where firefighters will be operating on the incident scene inside the structure
- Offensive and defensive strategies should not be combined [SKCFTC 2023].

Basic, structural firefighting incident hazards that often injure or kill firefighters includes:

- Structural collapse
- Toxic insult from the products of combustion
- Thermal threat posed by the fire
- Becoming trapped or lost.

The safety system components used to protect firefighters includes:

- Adequate number of fit and trained firefighters (adequate staffing)
- Proper turnout gear and SCBA being worn
- Functional and operational equipment and apparatus
- Water
- Safety SOPs
- Incident Management System [Brunacini and Brunacini 2004].

The beginning of the safety system starts with the firefighters. Every firefighter that operates with a company must take responsibility for their own compliance with the department's safety plan. This requires every member to behave in the following manner:

- Understand the details, dynamics, and effects of basic firefighting hazards

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

- Understand the department's safety plan and its limitations
- Be physically, mentally, emotionally, and organizationally capable of doing their job
- Monitor their own safety and wellbeing
- Continually evaluate and self-adjust their own safety procedures in relation to the incident
- Directly stop any unsafe acts they can impact
- Always assist those nearby
- Actively report safety conditions throughout the incident organization
- Comply with safety orders and instructions [Brunacini and Brunacini 2004].

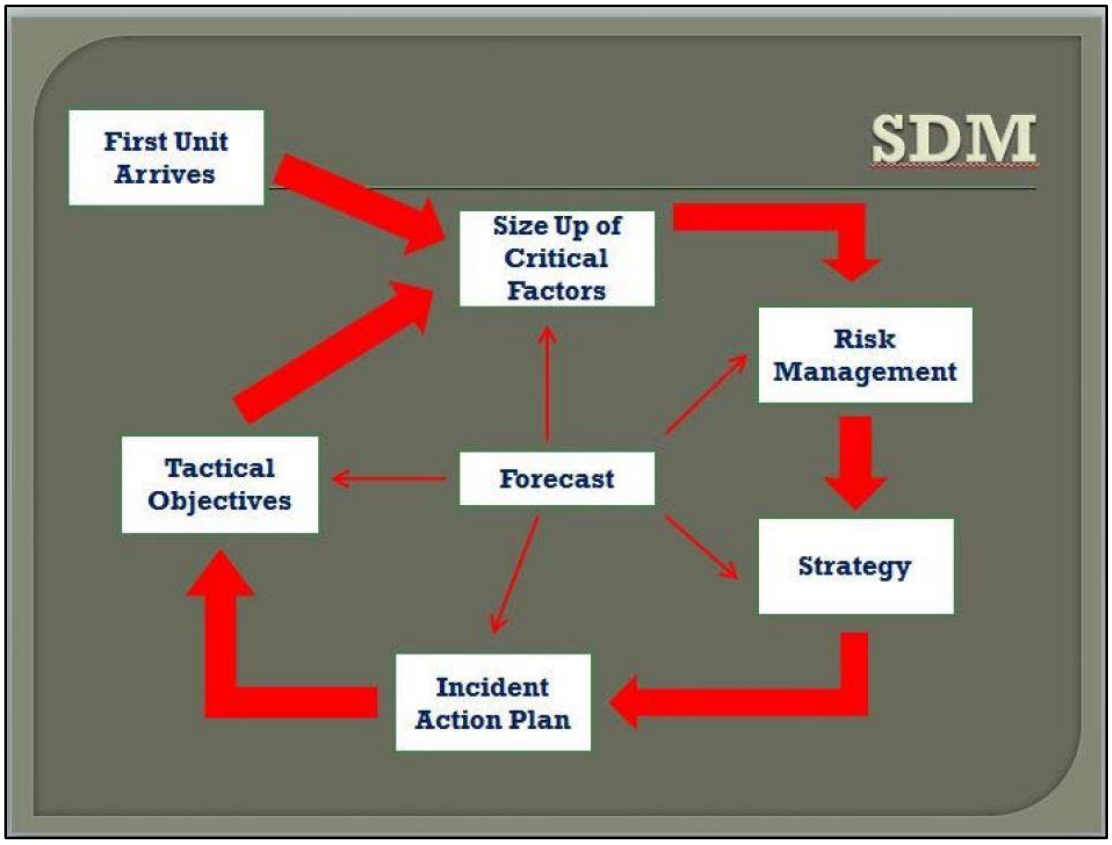

Diagram 5. This model displays the decision-making process into a standard sequence. (Diagram courtesy of Phoenix Fire Department)

The reason for including this information is to emphasize the important roll a firefighter has regarding their own personal safety. Everyone in the organization has a role and responsibility. No operational level of the organization (task, tactical, or strategic) can perform the duties or responsibilities of another level. Firefighters are not absolved from their own personal responsibility to the safety system because the IC is in place. Firefighters play an integral role in the safety system and if they aren't following the recommendations above, injuries or losses can occur [Brunacini and Brunacini 2004].

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

The incident commander must use the incident management system as the basic foundation for doing the strategic level safety function. Command safety is an important factor in achieving the highest level of safety for fire department members operating at emergency incidents. The incident commander completes their operational and safety responsibility to the firefighters by performing the eight command functions. These functions serve as a very practical performance foundation for serving as the strategic level incident manager and the overall incident safety manager [NFPA 1561 2020].

A major objective of the incident management system is to create, support, and integrate an incident commander who will direct the geographical and functional needs of the entire incident on the task, tactical, and strategic levels. Issues develop for the incident commander when these three standard levels are not in place, not operating, and/or are not effectively connected. The incident commander should develop the strategic level at the very beginning of the incident. They should then build an effective incident organization to stay on the strategic level while firefighters are operating in the hazard zone [SKCFTC 2023].

Recommendation #7: Fire departments should ensure that all companies are operating based upon the assignment given by the incident commander. The Task-Location-Objective assignments should be communicated over the radio.

Discussion: Chief 25 arrived on the scene approximately 40 seconds behind Engine 336. The officer and firefighter each stretched a 1¾" hoseline to different sides of the structure. The company officer told Firefighter 36-36 that this was a defensive fire. There was no other direction given to Firefighter 36-36 from the company officer or Command. The IAP developed by Command was to stretch a 2½-inch blitz hoseline to Side Bravo and sweep the structure. Before Command could communicate his IAP, the crew from Engine 336 had their hoselines in operation. The collapse occurred approximately 6½ minutes after the arrival of Engine 336. Even though the company officer told the crew of Engine 336 that this is a defensive fire, the strategy was not declared by Command.

The first order of business is to establish command and manage all 8 functions of command. Once in command, the strategic decision-making model becomes paramount to successful outcomes (**See Diagram #5**). The IC uses the strategic decision making model to evaluate the critical fireground factors, which ensures the following:

- should put them in the proper or correct risk management plan
- allowing them to get into the proper strategy
- incorporated into an incident action plan that includes the task-location-objectives for every company
- and trying to satisfy the tactical priorities of the incident [SKCFTC 2023].

What makes the strategic decision making model so effective is the arrow that returns the tactical priorities to the critical fireground factors. This takes the process from a static "photograph" or snapshot of the incident to a dynamic "movie" of sorts that evolves over time. New inputs create new outputs. The IAP describes the objectives reflecting the overall incident strategy, tactics, risk

management, and member safety that are developed by the IC. IAPs are updated throughout the incident. [NFPA 1561 2020]. The IAP should be communicated verbally over the tactical channel by the IC. This ensures that all resources receive the IAP.

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

Firefighter safety is the first defensive priority. No firefighter should be injured on a defensive fire. The IC can choose to implement the IAP by assigning tactics in order of accomplishment, which will aid in the coordination of the fireground activities [USFA 2009]. Assigning tactics also limits the amount of radio traffic needed to implement the IAP, allows companies to react immediately to unforeseen or changing conditions, and reduces the demands placed on the incident commander.

Progress on assigned tactics allow ICs to evaluate the IAP. If a company is unable to complete the assignment, the incident commander needs to know as soon as possible in order to adjust the IAP. The incident commander also must understand why the company is not capable of completing its assigned tactic, such as no water, unanticipated conditions, or conditions that have deteriorated since the original assignment [USFA 2009].

Even though the company officer told the crew of Engine 336 that this was a defensive fire, the strategy was not declared by Command. If we don't evaluate the critical fireground factors correctly, we can't conduct an adequate risk management plan. Without the risk management plan, it is difficult to operate in the right strategy. The chief knew what he wanted to do but got distracted by the occupant and didn't get the orders out. Within 6½ minutes of arriving on scene, the porch roof collapsed. No strategy was declared, and no orders were given by Command. The only orders given were to Firefighter 36-36 to pull the 1¾-inch hoseline for a defensive fire.

An evaluation of the critical fireground factors of this incident:

- Small, 2-story residential structure with no basement
- Defensive fire conditions showing through every door & window
- Determine the risk with a risk management plan
  - Risk nothing to save what is already lost (people or property)
- Determine and operate in the right strategy
  - Defensive strategy
  - Hoselines going to Side Alpha and Side Charlie
  - 2 ½ - inch hoseline to Side Charlie with a blitz nozzle (Chief 25's IAP)
- Create an IAP with a task-location-objective for every company
  - Pull a line for a defensive fire
    - From captain on 336
    - No location
    - No clear objective

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

- Satisfy the tactical priorities
  - Company officer flowing water on Side Charlie
  - Firefighter 36-36 was flowing water from Side Bravo and then Side Alpha.

One of the biggest pieces of the task-location-objective assignments applies to the accountability system. The personnel accountability system is paramount. It starts with the firefighter and their own "personal" responsibility to themselves and the rest of the safety system. Next, is task level accountability that is managed by the company officer through voice, vision and touch. After the command transfer, a strategic level of accountability is established with the IC being responsible for knowing the position and function of everyone on the fireground. This is managed with the use of a tactical worksheet. Command reinforces the strategic accountability position with the creation of division supervisors. When the incident becomes subdivided, the division supervisor(s) assume the "tactical" level accountability with the utilization of a passport system to track the movement of companies in and out of the hot zone. Without good task-location-objective, the tiered accountability system where all the moving pieces are being accounted for, the entire safety system can fall into disarray [SKCFTC 2023].

The initial IAP should include the following:
- The tasks of the initial arriving unit
- The location of the tasks
- The objectives of the tasks.

Tasks: Some of the standard tasks that should be communicated in the radio report:
- Investigating (nothing showing)
- Establish a water supply
- Stretching attack lines (for quick hit/fire attack)
- Operating a master stream
- Performing forcible entry (takes a while)
- Performing a physical rescue.

Location: Some of the standard locations of those tasks should include:
- What floor you will be operating on
  - Structures that have multiple units (apartments / strip malls) will need to have the specific unit identified, i.e., Main fire unit/Bravo1 Exposure along with floor number
- What occupancy/exposure will be operating in
- What side you will make entry on
- What side you will be operating on (defensive).

Objective: Some of the standard objectives should include:
- Fire attack/primary search
- Primary search/check for extension
- Overhaul

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

- Salvage
- Secondary search
- Defensive fire attack
- Exposure protection [SKCFTC 2023].

The first arriving resource should match the incident's problems with the resources required to solve them. The request for the appropriate number of resources should happen at the beginning of the event, when the window of opportunity for success is greatest.

Recommendation #8: Fire departments should review their personnel accountability system standard operating procedure (SOP)/standard operating guideline(SOG) to ensure that accountability is maintained at each operational level.

Discussion: At this incident, Command was responsible for the accountability of the members working on the fireground. Command assumed all firefighters understood they were operating in a defensive strategy.

Whether operating in an offensive strategy or defensive strategy, a personnel accountability system has to be utilized to readily identify both the location and function of all members operating at an incident scene. The philosophy of the personnel accountability system starts with the same principles of an incident management system—company unity and unity of command. It is possible to fulfill unity initially and maintain it throughout the incident by documenting the situation status and resource status on a tactical worksheet or a resource status/accountability board. A personnel accountability system should be adopted and routinely used to collect and document the status and location of the resources working in, or potentially working in, an immediately dangerous to life and health (IDLH) environment at an incident. All members operating at an incident are responsible for understanding and participating in this system. The incident commander should be responsible for the overall accountability for the incident. Incident commanders may delegate to other appropriate staff members the facilitation of the accountability for those resources to meet those goals, objectives, and tasks as needed. An integral part of the accountability system is to make sure that the firefighters who are assigned and operating in the hazard zone are accounted for, starting with the initial operations through the entire incident.

The function of 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, this function would be placed under the Planning Section [NFPA 1561 2020]. This function is separate from the role of the IC who is responsible for the overall command and control of the incident. Due to the importance of responder safety and resource accountability should be assigned to dedicated accountability personnel as the size and complexity of the incident dictates. A number of positions could function in this role including:

- a staff assistant/incident command technician
- another chief officer(s)

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

- or other qualified responder [NFPA 1561 2020].

One of the most important functions of command safety is for the IC 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 or incident command technician) assigned to facilitate the tracking and accountability of the assigned companies or crews" [NFPA 1561 2020].

An important aspect of a personnel accountability system is the Personnel Accountability Report (PAR). PAR is an on-scene roll call in which supervisors report the status of their crew when requested by the incident commander [NFPA 1561 2020]. It is necessary to conduct the PAR every 15–20 minutes or when benchmarks are met.

A functional personnel accountability system requires the following:

- Development and implementation of a departmental SOP/SOG
- 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.

A functional personnel accountability system should have the ability to identify:

- All members operating in the hazard zone (who)
- Where all members are in the hazard zone (where)
- The conditions in the hazard zone (conditions)
- What actions are in use in the hazard zone (actions)
- Paths of access and egress in and out of the hazard zone (exits)
- RICs and their assignments.

Many different methods and tools are available for resource accountability, including:

- Tactical worksheets
- Command boards
- Apparatus riding lists
- Company responding boards
- Electronic bar-coding systems
- Accountability tags or keys
- Electronic tablets [NFPA 1561 2020].

For the personnel accountability system to properly operate, the process should include an SOP/SOG that defines each position's responsibility and the necessary equipment required to ensure this process

is successful on the fireground. Another key to the success of the personnel accountability system is to include a training component (both classroom and practical) to ensure this process functions properly during emergency incidents.

Recommendation #9: Fire departments should provide a Mayday tactical worksheet for incident commanders in the event of a Mayday.

Discussion: At this incident, Firefighter 36-36 was operating by himself and was trapped when the porch roof collapsed. He was discovered by Chief 36 who called the Mayday. At 0149 hours, fireground operations were moved to radio channel OPS3. The companies involved with the Mayday remained on OPS2. There was no officer designated or assigned to OPS3 to conduct a roll call and manage these resources. Headquarters transmitted tones and a message restricting radio traffic on OPS2.

When a Mayday is transmitted, the IC has a very narrow window of opportunity to locate the lost, trapped, or injured member(s). The IC must restructure the strategy and IAP (tactics) to include a priority rescue [NFPA 1561 2020].

Some departments have adopted the term *LUNAR*—location, unit assigned, name, assistance needed, and resources needed—to gain additional information to identify a firefighter who is in trouble and in need of assistance. The IC, division/group supervisors, company officers, and firefighters need to understand the seriousness of the situation. It is important to have the available resources on scene and to have a plan established prior to the Mayday [Brunacini and Brunacini 2004; NFPA 1561 2020] **See *Appendix Two,*** *Incident Commander's Tactical Worksheet for Mayday.*

This checklist can assist the IC in ensuring the necessary steps are taken to clear the Mayday as quickly and safely as possible. The checklist also serves as a guide that can be tailored to any fire department's Mayday procedures/guidelines. 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 firefighter who is missing, trapped, or injured.

Recommendation #10: Fire departments should require all members engaged in fireground operations receive annual proficiency training and evaluation. This verifies essential qualifications and competencies of its members to operate on the fireground.

Discussion: Fire departments should ensure that all members assigned to operate in the hazard zone during a structure fire participate in annual proficiency training. The intent is to ensure that all members are competent to operate in the hazard zone while working with an incident management system and personnel accountability system.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

In order to ensure the proficiency and competency of fire department members, fire departments should conduct an annual skills evaluation to verify minimum professional qualifications. This annual evaluation should address the qualifications specific to the member's assignment and job description. An annual skills check should address the professional qualification specific to a member's assignment and duty expectation. As an example, a fire fighter is checked for skills required by NFPA 1001, *Standard on Fire Fighter Professional Qualifications* [NFPA 1001 2019]. The goal should be to prevent skills and abilities degradation and ensure the safety of members. Proficiency evaluation and training provides an opportunity to ensure that all fire officers and firefighters are competent in the knowledge, skills, and abilities in fireground operations [NIOSH 2016].

NFPA 1410, *Standard on Training for Initial Emergency Scene Operations*, defines basic evolutions that can be adapted to local conditions and serve as a method for the evaluation of minimum acceptable performance during initial fireground operations [NFPA 1410 2020]. Proficiency training for fireground operations and emergency incidents should be conducted annually. This training should include, but not be limited to, scene size-up, situational awareness, use of the incident management system, personnel accountability system, strategy and tactics, search and rescue, hoseline operations, ladder operations, coordinated fire attack and ventilation, thermal imaging cameras, fireground communications, use of rapid intervention teams, and Mayday operations.

The annual refresher training should include current content and be of sufficient duration so that each member can demonstrate proficient knowledge and abilities in their assigned duties. No specific time is allotted to the annual training or specific topics to provide you with the flexibility to adjust the length of time spent on specific topics that your department feels are more or less necessary [NIOSH 2016].

Suppression topics are intended to increase the knowledge, skills, and abilities of personnel through practical evolutions, lecture, and established learning objectives. Monthly fire suppression training and support activities should ensure that the department is utilizing the most current and nationally accepted skills related to fire suppression and safety. Monthly fire suppression training should range from two to eight hours. Adequate time allotted to each subject will be dependent on the topic, resources, and personnel required. The prescribed objectives may be altered depending upon members and resources required to ensure training evolutions are productive and safe. The number of companies that simultaneously attend training should maximize hands-on time and ensure skill development. Live fire scenarios at a live fire training structure is paramount.

NFPA 1500, *Standard for a Fire Department Occupational Safety, Health, and Welfare Program*, requires a fire department to establish and maintain a training, education, and professional development program with the goal of preventing occupational deaths, injuries, and illnesses. This ensures members are trained and competencies are maintained in order to effectively, efficiently, and safely execute all responsibilities [NFPA 1500 2021]. This process is consistent with the organizational statement that establishes the existence of the fire department, the services the fire department is

authorized and expected to perform, the organizational structure, and the job descriptions and functions of fire department members [NFPA 1500 2021]. As members progress through various job duties and responsibilities, the department should ensure the introduction of necessary knowledge, skills, and abilities to members who are new in their job titles as well as ongoing development of existing skills [NFPA 1500 2021].

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Investigator Information

This incident was investigated by Murrey Loflin, Safety and Occupational Health Specialist, Michael Richardson, Safety and Occupational Health Specialist, and Tammy Schaeffer, Safety and Occupational Health Specialist with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH, located in Morgantown, WV. Expert technical review was by Deputy Fire Chief Tony Carroll, Louisa County, VA Fire and EMS and Deputy Chief Jeff King of the Spring, TX Fire Department. Also, the NFPA Public Fire Protection Division provided a technical review of this investigation report.

Additional Information

National Institute of Standards and Technology (NIST) and Underwriters Laboratories (UL)
Over the past decade, NIST and UL's Firefighter Safety Research Institute has worked with fire departments and fire service organizations to conduct research on fire behavior, fire safety issues, and fireground operations. Since 2019, UL's website has made available 25 training videos on these, and other topics.

International Association of Firefighters (IAFF) Fire Ground Survival Program
The IAFF Fire Ground Survival Training addresses Mayday prevention and Mayday operations for firefighters, company officers, and chief officers. Firefighters must be trained to perform potentially life-saving actions if they become lost, disoriented, injured, low on air, or trapped. Funded by the IAFF and assisted by a grant from the U.S. Department of Homeland Security through the Assistance to Firefighters (FIRE Act) grant program, this comprehensive fireground survival training program applies the lessons learned from firefighter fatality investigations conducted by the National Institute for Occupational Safety and Health (NIOSH). It was developed by a committee of subject matter experts from the IAFF, the International Association of Fire Chiefs (IAFC), and NIOSH.

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety* (2020 edition)

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

The primary focus of the revision to NFPA 1561 in the 2020 edition was to develop requirements directly aimed at reducing and eliminating fireground injuries and fireground deaths of fire department members. The most apparent change to this edition is the inclusion of "Command Safety" in the document title and the creation of a new chapter, "Command Safety." This chapter provides a foundation for incorporating the incident management system at all emergency incidents, especially *Type V* and *Type IV* incidents.

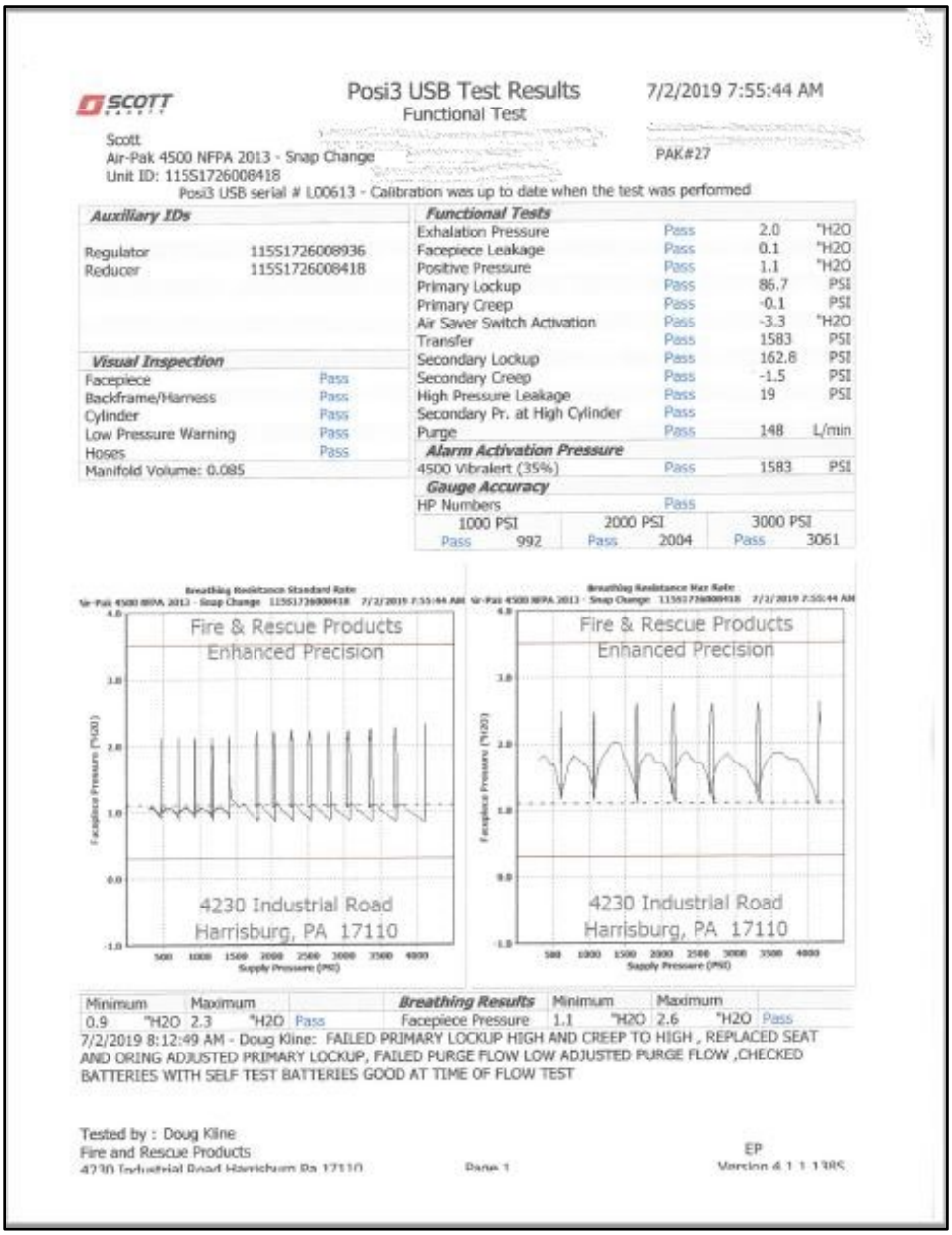
The chapter on Command Safety clearly defines the requirements for the IC, including establishing a fixed command post, personnel accountability, the use of staff aides and rapid intervention crews, and the appointment of a safety officer and assistant safety officer(s) (as needed). The standard addresses 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 V or Type IV Incidents,* and *Structural Fire-Fighting—Risk Assessment and Operational Expectation.*

Disclaimer

The information in this report is based upon dispatch records, audio recordings, witness statements, and other information that was made available to the National Institute for Occupational Safety and Health (NIOSH). Information gathered from witnesses may be affected by recall bias. The facts, contributing factors, and recommendations contained in this report are based on the totality of the information gathered during the investigation process. This report was prepared after the event occurred, includes information from appropriate subject matter experts, and is not intended to place blame on those involved in the incident. Mention of any company or product does not constitute endorsement by NIOSH, Centers for Disease Control and Prevention (CDC). In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Appendix One
SCBA Annual Certification Test



SCOTT

Posi3 USB Test Results
Functional Test

7/2/2019 7:55:44 AM

Scott
Air-Pak 4500 NFPA 2013 - Snap Change
Unit ID: 115S1726008418
PAK#27
Posi3 USB serial # L00613 - Calibration was up to date when the test was performed

Auxiliary IDs	
Regulator	11551726008936
Reducer	115S1726008418

Visual Inspection	
Facepiece	Pass
Backframe/Harness	Pass
Cylinder	Pass
Low Pressure Warning	Pass
Hoses	Pass
Manifold Volume: 0.085	

Functional Tests			
Exhalation Pressure	Pass	2.0	"H2O
Facepiece Leakage	Pass	0.1	"H2O
Positive Pressure	Pass	1.1	"H2O
Primary Lockup	Pass	86.7	PSI
Primary Creep	Pass	-0.1	PSI
Air Saver Switch Activation	Pass	-3.3	"H2O
Transfer	Pass	1583	PSI
Secondary Lockup	Pass	162.8	PSI
Secondary Creep	Pass	-1.5	PSI
High Pressure Leakage	Pass	19	PSI
Secondary Pr. at High Cylinder	Pass		
Purge	Pass	148	L/min
Alarm Activation Pressure			
4500 Vibralert (35%)	Pass	1583	PSI
Gauge Accuracy			
HP Numbers	Pass		

1000 PSI		2000 PSI		3000 PSI	
Pass	992	Pass	2004	Pass	3061

Minimum		Maximum		Breathing Results	Minimum		Maximum		
0.9	"H2O	2.3	"H2O Pass	Facepiece Pressure	1.1	"H2O	2.6	"H2O	Pass

7/2/2019 8:12:49 AM - Doug Kline: FAILED PRIMARY LOCKUP HIGH AND CREEP TO HIGH , REPLACED SEAT AND ORING ADJUSTED PRIMARY LOCKUP, FAILED PURGE FLOW LOW ADJUSTED PURGE FLOW ,CHECKED BATTERIES WITH SELF TEST BATTERIES GOOD AT TIME OF FLOW TEST

Tested by : Doug Kline
Fire and Rescue Products
4230 Industrial Road Harrisburg Pa 17110

Page 1

EP
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The annual flow test on the SCBA worn by Firefighter 36-36.

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Appendix Two
Mayday Tactical Worksheet

MAYDAY	Talk Group		Time MAYDAY CALLED		Time MAYDAY CLEARED	
WHO		WHAT		WHERE		

○	1	Confirm MAYDAY	"Command to all units on the scene, a MAYDAY has been declared. STOP all routine radio traffic & continue operations. The following units are assigned to the MAYDAY Branch (read units). Stand by for an accountability check."						
○	2	SCENE ANNOUNCEMENT							
○	3	LOCATION OF MAYDAY	Location	QUAD	UNIT	NAME	AIR SUPPLY	RESOURCES NOTES	CLEARED
○	4	Unit with mayday							
○	5	Name of member(s)							
○	6	Air status of member(s)							
○	7	Resources needed							
○	8	Deploy RIT - Action Plan	"Command to RIT, deploy to _____ for (units) _____"						
○	9	Notify Dispatch	"Command to dispatch, a MAYDAY has been declared at (address)." Give "LUNAR". "Send me (additional units) _____"						
○	10	Request resources							
○	11	Continue fire attack (action)	"Command to fire attack (or Division/Group), continue operations while RIT works."						
○	12	Conduct Accountability	"Command to Division 1, PAR", wait for response, "Command to Roof, PAR", etc. Division & Group supervisors report units/# of personnel operating, what action is being done, and announces "PAR", or announces missing assigned members						
○	13	Assign MAYDAY Branch Director							
○	14	Assign RIT Safety Officer							
○	15	Establish Point of Entry Accountability	MAYDAY Branch Director				RIT Supervisor		
○	16	ALS Resources	Units Assigned to MAYDAY & RIT	# Personnel Assigned			MAYDAY Group	Location	EMS Group Supervisor
○	17	Create defendable space		2	3	4	5	6	
○	18	Develop alternative strategies							UNITS / Hospital
○	19	Control unassigned resources							
○	20	Risk Assessment							
○	21	Control information release							
○	22	NOTIFY ALL when MAYDAY is CLEARED							

Firefighter Killed by the Collapse of the Porch Roof at a Residential Structure Fire – Pennsylvania

Appendix Two (Continued)
Mayday Tactical Worksheet

LOS ANGELES FIRE DEPARTMENT

MAYDAY
"IC PROCEDURES"

INITIATE EMERGENCY TRAFFIC TONES FOR 3 SECONDS
"ALL COMPANIES CLEAR THIS CHANNEL FOR A MAYDAY, MEMBER CALLING THE MAYDAY GO"
ACKNOWLEDGE AND DETERMINE (WHO WHAT WHERE)
"MEMBER CALLING MAYDAY INITIATE GRAB LIVES HELP IS ON THE WAY"
DEPLOY THE RIC/RIG
INITIATE EMERGENCY TRAFFIC TONES FOR 3 SECONDS **"ALL COMPANIES WE HAVE A MAYMAY (WHO WHAT WHERE) MAINTAIN CURRENT OPERATIONAL POSITION UNLESS REDIRECTED FOR RESCUE. CONDUCT A PAR"**
MAINTAIN COMMUNICATIONS WITH THE MEMBER DECLARING THE MAYDAY
"METRO WE HAVE A MAYDAY (WHO WHAT WHERE)"
COORDINATE THE RESCUE AND MAINTAIN SUPPRESSION EFFORTS
OBTAIN A PAR FROM EACH COMPANY ASSIGNED TO THE INCIDENT PRIOR TO RESUMING NORMAL RADIO COMMUNICATION

"MAYDAY" RESCUE WORK SHEET

"WHO" **"WHAT"**

COMPANY	CAPTAIN	ENGINEER	DOWN	MISSING	TIME MAYDAY	ASSIGN/TASK
	A/O	FF	TRAPPED	SCBA		

"WHERE"

"GRABLIVES"

RADIO CHANNEL____	SCBA GAUGE: E ¼ ½ ¾ FULL			
ACTIVATE PASS	YES		NO	
CONTROL BREATHING	YES		NO	
STAY LOW	YES		NO	
TURN ON LIGHT	YES		NO	
MAKE NOICE	YES		NO	
EXIT/SHIELD AIRWAY	YES		NO	

RAPID INTERVENTION GROUP

- ☐ MFC NOTIFIED
- ☐ ADDITIONAL RESOURCES

COMPANIES ASSIGNED	LF___	ENG___	USAR___	BC___	RA___
RESCUE CHANNELS	TAC___	TAC___			
DEPLOYMENT TIME	1ST TEAM @___		2ND TEAM @___		

- ☐ MEMBER/COMPANY FOUND AT = ____
- ☐ MEMBER/COMPANY OUT AT = ____
- ☐ COMPLETE PAR/CAR
  - ☐ ANNOUNCE "MAYDAY" CLEARED AT = ____