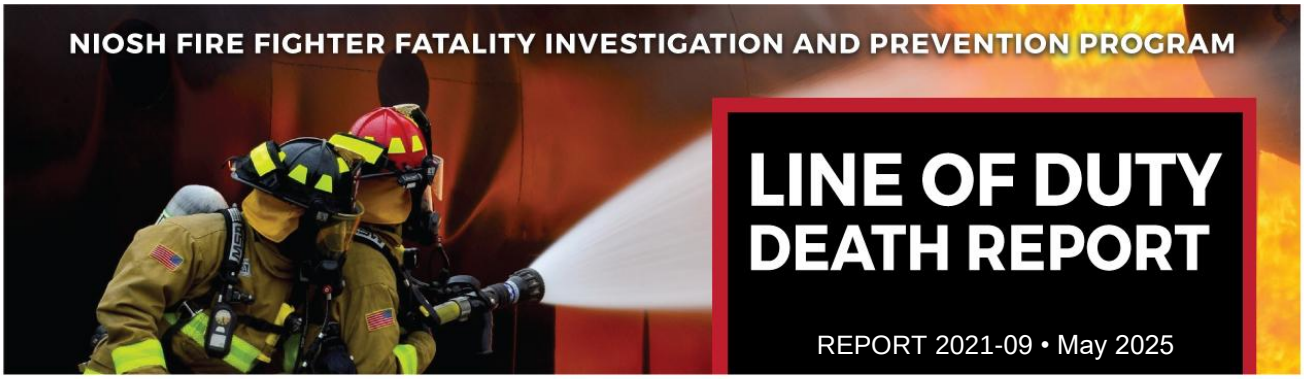


1000 FREDERICK LANE, MORGANTOWN, WV 26508 · 304.285.5916

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

Executive Summary

On December 27, 2020, a 30-year-old military firefighter was struck on the head and killed by a falling structural support beam while fighting a barn fire. The heavy timber beam fell on the firefighter during the collapse of the barn. At 01:59 hours, stations 60 and 80 along with county emergency medical services (EMS), were dispatched for a barn fire. Captain 60 and assistant chief 60 responded in their privately owned vehicles. While enroute, assistant chief 60 requested stations 1 and 16 be added to the barn fire call as stations 60 and 80 were already operating on-scene at a nearby residential structure fire.

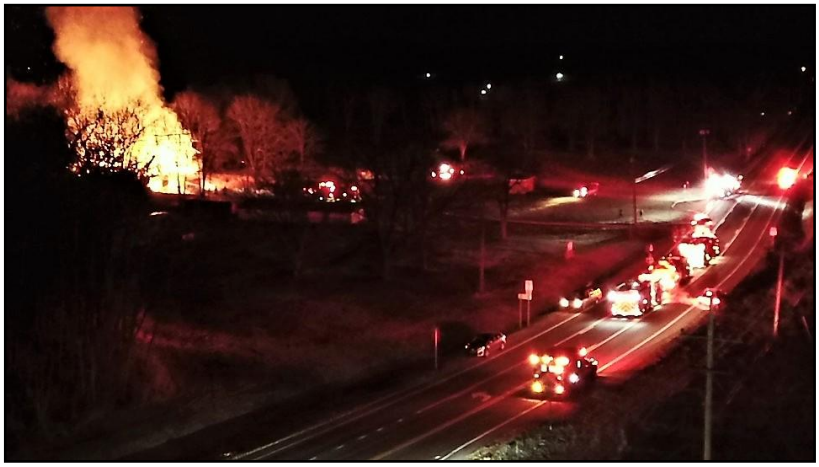


Photo 1: The barn fire that killed a military firefighter and injured two other firefighters.
(Courtesy of Statter911.com)

At 02:05 hours, station 16 was dispatched with Rescue Engine 16 (RE16) going enroute. At 02:13 hours, captain 60 arrived on-scene and reported a fully involved barn fire. Captain 60 established himself as the incident commander (IC) and reported to the emergency communications center (ECC) that a partial roof collapse occurred on Side Delta of the barn. He also reported a powerline down on the Side Alpha/Side Bravo corner and requested the local electric company respond. Engine 61 responded and laid a 5" supply line from the hydrant located on the road in front of the property to the end of the driveway near the entrance of the barn on the Side Alpha/Side Delta corner. Engine 3 arrived on-scene at approximately 02:15 hours. The driver/operator spotted the hydrant and the supply line laid by Engine 61. He connected to the hydrant through the front intake, connected the 5" to the discharge, and then sent water to Engine 61. Suppression efforts began with the use of the front bumper turret of Engine 61. The driver/operator of Tanker 61 deployed a 1¾" hoseline with a combination nozzle from the front bumper of Engine 61 while proceeding to Side Alpha. Engine 3's crew deployed a 1¾" hoseline to Side Delta. RE16 and Rescue Engine 31 (RE31) arrived on-scene at 02:18 hours. RE31's crew deployed 100ft of 2½" hoseline to Side Delta. RE16's crew were assigned to Side Alpha of the barn where they met the Engine 4 crew operating the 1¾" hoseline from Engine 61. The nozzle on this hoseline became clogged resulting in reduced flow, forcing the

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

hoseline crew to move closer to the barn for their stream to reach the fire. RE16's officer asked if RE16 firefighter 4 (deceased firefighter) could take over the hoseline to get some experience. RE16 firefighter 4 was backed up on the hoseline by another RE16 firefighter. Tanker 61's driver/operator then noticed the Side Alpha wall was now unsupported. He notified Engine 4's officer and requested that the firefighters on Side Alpha be told to back away from the barn. Engine 4's officer acknowledged but stated he would keep an eye on the barn and let the firefighters know when to back away. At 02:33 hours, the Side Alpha wall of the barn began to collapse. Multiple firefighters yelled that the wall was collapsing, and crews attempted to retreat while an EMS officer called a Mayday. The wall fell, striking three firefighters (RE16, Engine 4, and Engine 61) and knocking down seven others. One firefighter was struck in the shoulder, and another sustained a leg injury. RE16 firefighter 4 was trapped under a large timber frame. He was unconscious and not breathing with apparent blunt force trauma to his head sustained from a fallen beam. RE16 firefighter 4 was pulled towards the road. Firefighters performed a primary assessment and began CPR. Fire suppression efforts were halted. RE16 firefighter 4 was transported to a local medical center where he was pronounced deceased.

Contributing Factors

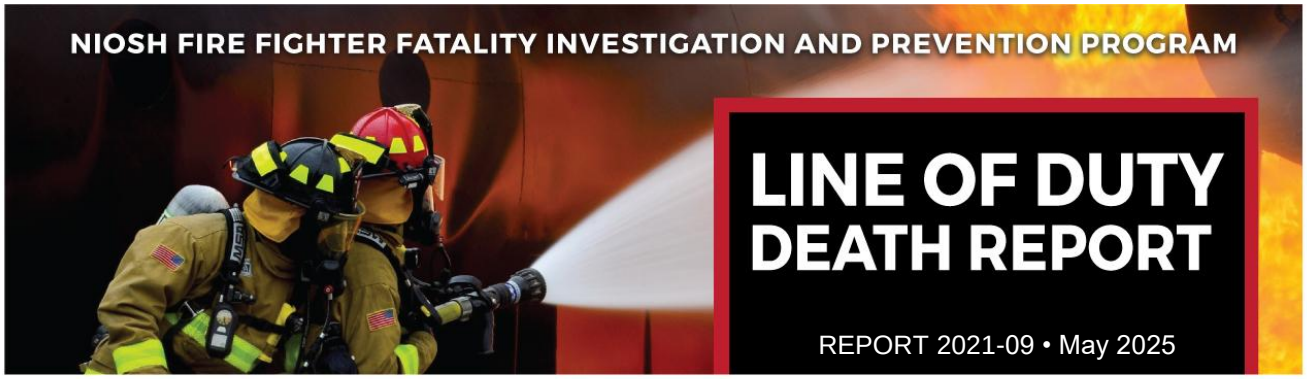
- *Scene size-up and risk assessment*
- *Collapse zone*
- *Hoseline selection and deployment*
- *Equipment malfunction*
- *Mutual aid training*

Key Recommendations

Fire departments should ensure:

- *Initial and ongoing size-ups and risk assessments are conducted throughout the incident.*
- *Fire officers and firefighters are trained to understand building performance under fire conditions and the potential for structural collapse.*
- *Safety officers with training on structural collapse are utilized for fireground incident management.*
- *Selection and use of appropriate hoseline based on conditions.*
- *Fire officers and firefighters are trained to react appropriately to equipment malfunction.*
- *Firefighters properly flush hydrants before establishing a water supply.*
- *Periodic mutual aid training is conducted.*

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



1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

Introduction

On December 27, 2020, a 30-year-old military firefighter was struck and killed by a falling structural support beam while fighting a barn fire. On January 4, 2021, the United States Fire Administration (USFA) notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. Three investigators representing the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) traveled to West Virginia to investigate this incident. The NIOSH investigators met and conducted interviews with on-scene personnel, the county fire coordinator, and an investigator from the West Virginia State Fire Marshal's Office. The NIOSH investigators visited the incident scene and reviewed the on-scene audio, training records, and fire department policies.

Fire Department

The National Guard Air Lift Wing Fire Department operates one fire station which has aircraft rescue and firefighting as well as structural firefighting apparatus. The fire department staffs 35 full-time dual status state employees and seven military firefighters. The dual status employees are assigned to the Operations Section whose members work a 24-hour duty shift with 48-hours off. Department members may be assigned to a fire apparatus or an ambulance for the entire 24-hour shift. The fire department has written policies which are available to all department members.

Training and Experience

The fire department requires the following U.S. Department of Defense certification levels at a minimum: NFPA 1001, Fire Fighter I and II; Hazardous Materials Awareness; and Hazardous Materials Operations; NFPA 1003, Airport Fire Fighter; and NFPA 1002, Driver/Operator.

RE16 firefighter 4 (deceased firefighter) obtained the following certifications: NFPA 1001, Fire Fighter I and II; Hazardous Materials Awareness; and Hazardous Materials Operations; NFPA 1061, Telecommunicator I; and EMS first responder. He participated in annual live fire training in 2019 and 2020.

Building Construction

The structure was a three-story barn, built in the civil war era (**see Photo 2**). The barn was built on an angle on the property, into the ground on Side Bravo and Side Charlie, and had a non-porous foundation. The size of the barn was approximately 50-ft wide and 100-ft long. The construction of the

barn was heavy timber. There was a barbed wire fence on Side Delta of the barn. The beam that struck RE16 firefighter 4 was a 53-ft long, 10-inch x 12-inch, heavy timber that weighed approximately 1,000 pounds. The barn was unused/vacant and in poor condition. It was destroyed by the fire.

Photo 2: The location of the three-story barn, prior to the fire. Note the power pole on the left that provided electrical service to the barn.
(Courtesy of Goggle Earth)

Apparatus and Communications

The following apparatus were dispatched to the barn fire:

Station	Apparatus	Department Type
60	Engine 61, Tanker 61	Combination fire department
80	Truck 80	U.S. Department of Veterans Affairs Fire Department
16	Rescue Engine 16	National Guard Air Lift Wing Fire Department
1	Engine 4	Career fire department
3	Engine 3	Volunteer fire department
30	Rescue Engine 31	Volunteer fire department
20	Engine 22	Volunteer fire department

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

The county's ECC is the primary answering point for 9-1-1 calls requesting emergency assistance from residents of the county and two municipalities. The ECC also monitors fire and burglar alarms for a variety of local businesses and dispatches for seven fire departments in the county.

Personal Protective Equipment

At the time of the incident, RE16 firefighter 4 was wearing his station uniform and full structural firefighting turnout, including coat, pants, boots, protective hood, helmet, and gloves. NIOSH investigators did not evaluate the turnout gear as they were not considered a contributing factor in the fatality.

Weather Conditions

On December 27, 2020, at 01:53 hours, the weather was fair. The temperature was 64°F, the dew point was 27°F, the humidity was 67%, the winds negligible, and the barometric pressure was 29.35 inches. There had been no precipitation in the past 24 hours [Weather Underground 2020].

Investigation

At approximately 01:57 hours, a motorist contacted the county ECC and reported a fully engulfed barn fire. The barn was located along a two-lane road across from a gas station/convenience store about 800-1,000 feet away. Approximately one minute later, the caller reported an explosion that was also heard on the 9-1-1 audio. The manager of the gas station/convenience store also called the county ECC and reported the explosion shook the windows and opened a door at the store. The county ECC received eight additional 9-1-1 calls reporting the fire and explosion.

At 01:59 hours, stations 60 and 80, along with county EMS, were dispatched for the barn fire. The ECC did not communicate callers' details regarding an explosion. The fire location was within the service area of station 60's first due area. Captain 60 and assistant chief 60 responded in their privately owned vehicles. While enroute, assistant chief 60 requested stations 1 and 16 be added to the barn fire call as stations 60 and 80 were already operating on-scene at a nearby residential structure fire, approximately three miles away. At 02:05 hours, station 16 was dispatched with RE16 going enroute with a crew consisting of an officer, three firefighters, and a driver/operator.

At 02:13 hours, captain 60 arrived on-scene and reported a fully involved barn fire. Assistant chief 60 advised captain 60 to establish IC while he proceeded to the station to get an engine. Captain 60 established IC and reported to the ECC that a partial roof collapse occurred on Side Delta of the barn. He also reported a powerline down on the Side Alpha/Side Bravo corner and requested the local electric company respond. Engine 61 (driven by assistant chief 60) responded. Assistant chief 60 and captain 60 wrapped the hydrant located near the road to the end of the driveway by the entrance of the barn on the Side Alpha/Side Delta corner. Tanker 61 (driver only) arrived on-scene.

Engine 3 arrived on-scene at approximately 02:15 hours. The driver/operator spotted the hydrant and the supply line laid by Engine 61. To establish a relay pumping operation; he connected to the hydrant through the front intake, connected the 5" to the discharge, and then sent water to Engine 61. The driver/operator left the pump at idle and flowed through the pump due to good static hydrant pressure

and volume. Suppression efforts began with the use of the front bumper turret of Engine 61 and the driver/operator of Tanker 61 deployed a 1 ¾" hoseline with a combination nozzle from the front bumper of Engine 61 while proceeding to the Side Alpha/Bravo corner. Engine 3's crew deployed a 1 ¾" hoseline to Side Delta.

RE16, RE31, and Engine 20 arrived on-scene at 02:18 hours. Engine 20's crew deployed 100ft of 2½" hoseline to Side Delta. RE16's crew were assigned to Side Alpha of the barn where they met the Tanker 61 driver/operator and Engine 4 crew operating the 1¾" hoseline from Engine 61. The nozzle on this hoseline became clogged resulting in reduced flow, forcing the hoseline crew to move closer to the barn for their stream to reach the fire. It was later determined (post-incident) that there was gravel and sediment clogging the nozzle. RE16's officer asked the Engine 4 crew if RE16 firefighter 4 (deceased firefighter) could take over the hoseline to get some experience. RE16 firefighter 4 was backed up on the hoseline by another RE16 firefighter.

Tanker 61's driver/operator noticed the Side Alpha wall was now unsupported. He notified Engine 4's officer and requested that the firefighters on Side Alpha be told to back away from the barn. Engine 4's officer acknowledged but stated he would keep an eye on the barn and let the firefighters know when to back away. Engine 22 arrived on-scene with their crew being split to assist Engine 3 and RE31's crews on Side Delta. Engine 22's driver/operator and RE16's officer were requested to move their engines into the driveway beside Engine 61 to initiate deck gun operations. Engine 22 was moved into place with a 2½" hoseline being deployed to Side Alpha. At approximately 02:33 hours as the hoseline was being charged, the Side Alpha wall of the barn began to collapse. Multiple firefighters yelled that the wall was collapsing, and crews attempted to retreat while an EMS officer called a Mayday.

The wall fell, striking three firefighters and knocking down seven others (RE16, Engine 4, and Engine 61). A firefighter from Engine 4 had his leg pinned under a beam, suffering a leg fracture. He was freed from the beam and moved away from the collapse area. Another firefighter sustained a shoulder injury. RE16 firefighter 4 was trapped under a large timber beam. He was unconscious and not breathing with apparent blunt force trauma to his head sustained from a fallen beam. RE16 firefighter 4 was pulled towards the road. Firefighters performed a primary assessment and began CPR. Assistant chief 60 requested four additional EMS units be dispatched. The ECC dispatched the additional EMS units as well as investigators from the West Virginia Office of the State Fire Marshal. Fire suppression efforts were halted to move the supply line and clear the driveway for EMS. RE31's officer assumed IC, focused personnel efforts on patient care of the injured firefighters, and initiated a personnel accountability report. RE16 firefighter 4 was transported to a local medical center where he was pronounced deceased. Crews remained on-scene until 05:00 hours. IC transferred to the West Virginia State Fire Marshal's Office investigators. The incident was cleared at 18:26 hours.

Fire Origin and Cause

The barn was fully involved at the time of collapse. The fire was determined to be arson by investigators with the West Virginia Office of the State Fire Marshal.

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

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 an injury or fatality. NIOSH investigators identified the following items as key contributing factors in this incident:

- Scene size-up and risk assessment
- Collapse zone
- Hoseline selection and deployment
- Equipment malfunction
- Mutual aid training

Cause of Death

According to the death certificate, the medical examiner listed the cause of RE16 firefighter 4's death as blunt force trauma to the head.

Recommendations

Fire departments should ensure:

Recommendation #1: Initial and ongoing size-ups and risk assessments are conducted throughout the incident.

Continuous communication supports effective risk assessments. It also allows the IC and all personnel operating at an incident to be aware of changing conditions and adjust to avoid hazards or mitigate risks. There were no risk assessments conducted throughout the incident. The barn was a vacant structure with no life hazard or exposures that were threatened by the fire.

Performing a 360-degree is an important component of the scene size-up and can be used in the risk assessment. The International Association of Fire Chiefs' Rules of Engagement for Structural Firefighting recommends that the first rule for ICs is to rapidly conduct or obtain a 360-degree situational size-up of the incident. Many incidents contain obstacles that prevent the viewing of all sides of a structure. When 360-degree reconnaissance is achieved, it provides the IC and personnel knowledge of the building layout, construction, access/egress points, fire location and direction of spread, and obstacles or hazards [NIOSH 2017].

A dedicated incident safety officer (ISO) can perform initial and ongoing size-ups throughout the incident. Expectations and authority for the ISO include determining hazardous incident conditions, advising the IC to modify control zones or tactics to address corresponding hazards, communicating fire behavior and forecasting growth, and estimating building/structural collapse hazards. The ISO also has the authority to stop or suspend incident operations based on imminent threats to firefighter safety [NFPA 1550 2024]. The ISO should be separate from the IC, operations, or accountability positions so they can focus on their responsibilities and the primary objective of continually assessing all on-scene hazards to firefighter life and safety [NIOSH 2025a].

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

Recommendation #2a: Fire officers and firefighters are trained to understand building performance under fire conditions and the potential for structural collapse.

At this incident, firefighters encountered a fully involved barn fire upon arrival. A collapse zone was never established.

Understanding a building's design and structural anatomy, construction methods and materials, and vulnerabilities under fireground conditions directly correlates to safer firefighting operations and firefighter survivability [NIOSH 2013]. Knowledge of building construction is critical to help firefighters recognize the potential for structural collapse. During the growth stage, the fire consumes combustible structural members. During the decay stage and post-suppression activities, the structure becomes further weakened due to the state of the remaining structural members and the buildup of water. The contents of a building, such as furniture or machinery, also contribute to the potential for structural collapse by [IFSTA 2015b]:

- Adding fuel load into the structure and generating higher temperatures that weaken structural components.
- Adding weight to the weakened structural members.
- Retaining water, which increases weight of contents and applies more stress on the structural members.

Recognizing and defining collapse precursors and risk through exclusion and control zones are fundamental to collapse zone management principles [NIOSH 2014]. When the structure is visibly unstable, a collapse zone equal to one and a half times the height of the building should be established at minimum. This perimeter size keeps firefighters and other personnel out of imminent danger from the collapse. When a collapse zone is established, the IC should communicate a "no re-entry" strategy until otherwise directed [NIOSH 2008a].

Recommendation #2b: Safety officers with training on structural collapse are utilized for fireground incident management.

At this incident, captain 60 arrived on-scene and assumed the role of IC. There was no dedicated ISO during this incident. ISOs with the right knowledge, skills, abilities, and experience, are invaluable assets on the fireground.

The ISO provides a fire department with a higher level of expertise to perform the necessary incident scene functions and assist the IC with fireground safety. Some ICs believe that any fire officer should be able to fill the fire department ISO function at any time under any circumstance, and therefore believe their agency does not need a predesignated ISO. Whether the ISO position is predesignated or filled by a fire officer, ISOs should be trained in how to assist the IC and other officers in fireground operations [Dodson 2021; Sullivan 2012; NIOSH 2013]. While a fire department may use an appointed officer as an ISO, they may be delayed in recognizing a hazardous situation or operation. This can be overcome by training all individuals who may be appointed as an ISO at some point in time, to ensure they have clear understanding of responsibilities and expectations if deemed necessary [NIOSH 2013].

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

Specific to this incident, ISOs should be trained to recognize hazards that may contribute to a structural collapse. When incorporated into fireground incident management, the ISO should be able to forecast or reasonably predict a collapse. Specifically, evaluating building construction, building contents and fire load, and burn time can help forecast collapse probability. Whenever a collapse is forecasted, interior operations should be halted, and firefighters removed from the structure and collapse zone immediately. The ISO should communicate forecasted predictions as hazard identification to the IC, allowing time for changes in strategy to be implemented [IFSTA 2015].

Recommendation #3: Selection and use of appropriate hoseline based on conditions.

Discussion: Selecting the correct size of hoseline is critical. At this incident, the fire department had several 1¾" hoselines and one 2½" hoseline deployed for fire suppression. The size and intensity of the fire was beyond the reach, flow, and penetration of hoselines. Multiple apparatus-mounted deck guns or master streams would have provided a greater amount of water and allowed firefighters to remain further away from the barn and outside of the collapse zone during suppression operations. Additionally, ineffective streams and insufficient water application likely led to intensified fire conditions.

Firefighters need to provide the appropriate amount of water in the initial attack to put out the fire and stop potential fire growth. Inability to provide a sufficient volume of water for the size of the fire may delay extinguishment and expose firefighters to danger from rapid fire development. Fire departments generally use a 1¾" hoseline as the initial preconnect for residential structure fires. These lines are operated to provide 160 gallons per minute. These hoselines can be effective for suppression when the fire is confined to a single room and is in either the incipient or growth stages [DeStefano 2016]. However, these size hoselines are not effective in providing enough water to control or extinguish a fully involved structure fire. Firefighters should recognize the flow rate needed for the estimate of the fire load as well as the stream capacity when a collapse zone is established. This allows firefighters to better select a hoseline that will not require them to enter the collapse zone to effectively get water on the fire.

During an incident, firefighters should select and deploy the appropriate hoseline based upon fire conditions. While monitoring fire suppression activities, the IC, ISO, or operations should evaluate whether the hose size is appropriate for the current fire conditions and other factors including [IFSTA 2015; IFSTA 2013]:

- Fire load and material involved
- Location of fire
- Size of building and fire area
- Potential fire spread

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

Recommendation #4a: Fire officers and firefighters are trained to react appropriately to equipment malfunction.

In this incident, the Engine 4 crew operating the 1¾" hoseline from Engine 61 on Side Alpha experienced issues due to gravel and sediment from the hydrant clogging the nozzle. The hoseline crew moved closer to the barn inside the collapse zone to compensate for the malfunction so their stream could reach the fire.

Effective fire suppression requires enough water exiting the nozzle at a sufficient pressure to reach the fire. Several variables can contribute to loss or gain of pressure between the pump and the nozzle. Firefighters are taught to react to malfunctions by diagnosing and troubleshooting pressure and fire stream issues on the fireground. This includes making corrections to some of the most common reasons for issues, including factors contributing to friction loss [IFSTA 2013]. When equipment fails or does not function adequately, it should not be used, and the IC should be notified. Fire departments should ensure firefighters have the necessary knowledge, skills, and abilities to react appropriately to equipment malfunction on the fireground. This includes identifying that equipment failure should not be compensated for by reducing safety in the hazard zone.

Recommendation #4b: Firefighters properly flush hydrants before establishing a water supply.

As noted directly above, it was determined post-incident that there was gravel and sediment clogging the nozzle. This clog caused the water stream reach and flow rate to be diminished. The presence of gravel and sediment in a hoseline can occur if the hydrant is not flushed.

Water mains that supply fire hydrants may experience conditions that decrease capacity, such as encrustation due to rust and degradation of pipe materials. These conditions often cause sedimentation deposits to build up such as dirt, stones, decayed vegetation, and foreign matter other than sediment. When a hydrant is opened, these deposits often are the first things to flow out with water [IFSTA 2016]. Before "hooking up" to a fire hydrant, best practice dictates that a firefighter should unscrew the "steamer cap" and open the fire hydrant to confirm it is working correctly and flushing out any debris for at least 30–45 seconds [MSI-SD Safety Bulletin. 2023]. As in this incident, if the hydrant is not flushed, debris can either damage the pump of an apparatus or pass through it to clog the nozzle of a hoseline [IFSTA 2013].

Recommendation #5: Periodic mutual aid training is conducted.

Adequate resources and staffing levels are necessary at an incident scene to accomplish stabilization tasks and be available for unexpected emergencies. Mutual aid agreements between different fire departments provide a means of assistance, including resources and staffing levels when personnel resources are insufficient. These mutual aid resources are often dispatched for immediate joint response on first alarms as part of a communication center's dispatch protocol [NFPA 1710 2020; NFPA 1720 2020]. Requesting mutual aid resources early allows for adequate resources and staffing levels before a critical need arises. Mutual aid resources can also provide specialized resources based on the unique variables of the incident [NIOSH 2025b]. But for mutual aid to be effective on-scene,

proactive steps should be taken to ensure their personnel and resources are prepared to work together. Mutual aid departments should train together before an incident occurs to ensure they can integrate as a functional team. Periodic joint-training can benefit fire departments in understanding each other's equipment, procedures, and capabilities [NIOSH 2008b].

References

DeStefano M [2016]. Big fire, big water; little fire, little fire. Fire Engineering.

Dodson D [2021]. Fire Department Incident Safety Officer, 3rd Ed. Burlington, MA: Jones & Bartlett Learning.

IFSTA [2013]. Essentials of fire fighting. 6th ed. Stillwater, OK: International Fire Service Training Association.

IFSTA [2015]. Fire and emergency services safety officer. 2nd ed. Stillwater, OK: International Fire Service Training Association.

IFSTA [2016]. Fire inspection and code enforcement. 8th ed. Stillwater, OK: International Fire Service Training Association.

MSI-SD [2023]. Fire hydrants – Opening & closing best practices. Municipal Excess Liability Joint Insurance Fund.

NFPA [2024]. NFPA 1550, Standard for emergency responder health and safety. Quincy, MA: National Fire Protection Association.

NIOSH [2008a]. Career fire fighter dies when trapped by collapsed canopy during a two alarm attached garage fire – Pennsylvania. By Koedam R, Merinar T, and Kovacevic L. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2007-08.

NIOSH [2008b]. A volunteer mutual aid captain and fire fighter die in a remodeled residential structure fire – Texas. By Bowyer ME, Berardinelli S, and Kochenderfer V. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2007-29.

NIOSH [2013]. Career lieutenant and fire fighter killed and two fire fighters injured by wall collapse at a large commercial structure fire - Pennsylvania. By Miles S., Bowyer M., Merinar T., Tarley J., Loflin M. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2012-13.

NIOSH [2014]. NIOSH Workplace Solutions: Preventing deaths and injuries to fire fighters by establishing collapse zones at structural fires. Cincinnati, OH: U.S. Department of Health and Human

Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH), Publication No. 2014-120.

NIOSH [2017]. NIOSH fire fighter fatality investigation helps incident commander choose strategy and tactics to control flow path and protect fire fighters. By Bowyer M., Loflin M., Merinar T., Miles S., Moore P., Wertman S., Orr B., and Webb S. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2017–200.

NIOSH [2025a]. Career firefighter dies in collapse involving lightweight construction with two separate maydays – South Carolina. By Attwood WR, Montague PR, and Richardson MR. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2023-07.

NIOSH [2025b]. Two career land-based firefighters die after becoming lost and running out of air during a marine vessel fire in port – New Jersey. By Attwood WR and Richardson MR. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2023-10.

Sullivan J [2012]. ISO's role when transitioning from an offensive to a defensive attack. FireRescue, April: 86–89.

Weather Underground [2020]. Weather History. The Weather Underground. Date Accessed: February 1, 2021.

Investigator Information

This report was authored by Murrey Loflin (retired), Investigator, Dr. Wesley R. Attwood, Investigator and Program Advisor, and Stephen J. Ringer, Investigator, with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH. A subject matter expert review was provided by David Guiste, Assistant Chief, VA Butler Healthcare Fire & Emergency Services, Pennsylvania. A technical review was completed by the West Virginia Office of the State Fire Marshal.

Additional Information

Preventing Deaths & Injuries to Firefighters by Establishing Collapse Zones at Structure Fires
Firefighters are at significant risk for injury or death due to structural collapse during firefighting operations. Structural collapse often occurs without warning. The National Institute for Occupational Safety and Health (NIOSH) recommends that the Incident Commander establish defensive operations and collapse zones when there is potential for a structural collapse during fire-fighting operations. Access more information at: https://www.cdc.gov/niosh/docs/wp-solutions/2014-120/.

A Military Firefighter Killed and Two Firefighters Injured by a Wall Collapse at a Barn Fire – West Virginia

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. *NIOSH Approved is a certification mark of the U.S. Department of Health and Human Services (HHS) registered in the United States and several international jurisdictions.*