



Roof Collapse in Arson Church Fire Claims the Life of Volunteer Fire Fighter - Georgia

SUMMARY

A male fire fighter, a 27 year-old Captain (the victim) on a county volunteer fire department, died when he was trapped in the sanctuary of a church when the roof collapsed. On December 31, 1998, a county volunteer fire department was dispatched to a reported church fire. The church was built sometime around 1850 with construction consisting of wood balloon-frame walls and a heavy, wood, gabled roof. The first arriving fire fighters observed smoke and fire coming from the rear of the church. After an initial size-up, the Chief ordered a defensive attack at the rear of the church. To control extension of the fire, the Chief then ordered a line be taken into the sanctuary to conduct an offensive attack. Before ventilating the roof, the Chief ordered fire fighters to locate the access hole in the ceiling of the sanctuary to determine if the fire had already extended into the attic area. The access hole was located, and an officer climbed a ladder to check the attic area. Without warning the entire roof collapsed, trapping the victim and nearly trapping two other fire fighters. NIOSH investigators have concluded that, to minimize the chances of similar occurrences, fire departments should:

- ensure that pre-fire planning and inspections cover all structural building materials (type and age), components, and renovations so Incident Command (IC) at the fire scene will have the necessary background information on the structure to make informed decisions and appropriate plan of attack
- ensure that defensive fire fighting tactics are suspended before switching the strategic mode of operation to an offensive attack to avoid opposing streams, and notify all affected personnel of the change in strategic modes
- ensure fire fighting tactics and operations do not increase hazards on the interior, e.g., hose streams being directed into concealed ceiling spaces which will add additional weight to the structure, possibly causing it to fail



Incident Site

The Fire Fighter Fatality Investigation and Prevention Program is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at:

<http://www.cdc.gov/niosh/firehome.html>

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- ensure that all standard operating procedures (SOPs) are updated and adequate for incident command and fireground operations and that all officers and fire fighters are trained and knowledgeable in all SOPs
- ensure that all officers and fire fighters wear and use a personal alert safety system (PASS) device that are involved in fire fighting, rescue, or other hazardous duty.

INTRODUCTION

On December 31, 1998, a Captain on a county volunteer fire department was fatally injured while fighting a church fire. The Captain (the victim) was assisting other fire fighters on the interior of the church in an effort to determine the extension of fire in the attic when the roof collapsed, trapping the Captain approximately 10 feet from the front door. One of the fire fighters that was buried under the burning debris from the roof collapse near the front door was immediately rescued and pulled to safety. Further rescue attempts were abandoned because the interior of the church was now fully involved, and the extreme heat forced fire fighters and the movement of the apparatus away from the church. On February 3, 1999, the Senior Fire Fighter Investigator from the NIOSH Division of Safety Research traveled to Georgia to investigate the circumstances surrounding this fatal injury of a volunteer fire fighter. Meetings and interviews were conducted with the Chief of the county volunteer fire department, the Deputy Chief, the Safety Officer, and several fire fighters who responded to this incident. A site visit was conducted and photographs of the church were obtained from the fire department.

The fire department involved in this incident serves a rural population of 14,000 in a geographic area of 221 square miles. The fire department is comprised

of approximately 78 volunteer fire fighters and two paid: the Chief, on a full time-basis, and the Deputy Chief on a part-time basis. The fire department has 9 stations throughout the county and has approximately 21 pieces of rolling apparatus, i.e., engines, tankers, and service units. All new fire fighters are required to complete Basic Firefighter: Module 1 training within a 12-month period as required by the State. Module 1 requires 60 hours of training which includes the fundamentals of fire behavior, water supplies, protective equipment and breathing apparatus, hose and nozzles, forcible entry, fire streams, suppression techniques, ventilation, and other areas necessary to provide a fire fighter with basic knowledge and skills of fire fighting. Refresher training is provided by the fire department on a scheduled basis, and each fire fighter is required to complete 40 hours annually.

INVESTIGATION

On December 31, 1998, at 2123 hours, the 911 central dispatch received a call regarding a church fire on a rural route in the county. The first responders were Tanker 322 with the Deputy Chief, and a fire fighter, Engine 321 with a Captain and a fire fighter, and the Chief's unit with the Chief and a fire fighter arriving at approximately 2133 hours. Upon arrival the Chief observed fire at the rear of the church, and he conducted an initial size-up to determine the volume of fire, exposures involved, and the utilities (gas and electric) to the church. Meanwhile fire fighters were flaking a 1 3/4-inch hose line off Engine 321 to be pulled to the rear of exposure 2 (see diagram) for a defensive attack. The Chief manned this line and began putting water through the windows at the rear of the church. He then turned the hose over to another fire fighter and went to the front of the church to assume command and ordered a second hose line pulled to the front door of the church for an offensive attack. A Lieutenant and 2 fire fighters advanced the second line into the front door and observed light smoke in the sanctuary. The Lieutenant



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and two fire fighters pulled the line into the choir area (see diagram), up the steps to a small room on the left side of the church which was becoming involved in flames. They managed to knock down most of the flames in this area. When the Lieutenant and one of the fire fighter's low-air alarms sounded, the Lieutenant ordered everyone out of the church. The Captain on Service Truck 314 was standing by, at the front of the church with the next crew. The Captain and crew entered the church and took control of the nozzle in the small room off the choir area and continued with the offensive fire attack. After knocking the fire down, the Captain ordered a positive pressure ventilation (PPV) fan for the sanctuary to clear the smoke. The PPV fan was established at the front door and salvage operations were initiated in the sanctuary. The low-air alarm was sounding on the fire fighter that was on the interior with the Captain. The Captain and the fire fighter exited the church. A third crew consisting of a Lieutenant on Engine 331, a Captain (the victim), and two fire fighters entered the building through the front door and continued the offensive attack on the interior.

At approximately 2155 hours, the Chief ordered a Deputy Chief to take a crew and line to exposure 4 and conduct an offensive attack in this area. The crew consisted of a Deputy Chief, a Captain (the victim), a Lieutenant, and a fire fighter. The crew entered a basement door at the rear of exposure 4 and encountered flames around the ceiling area. As the crew was conducting an offensive attack, the nozzle man (the victim) ran out of air and had to exit the church. The Lieutenant took over the nozzle, and within a few minutes, his low air alarm was sounding, and he exited the church. A fire fighter took the nozzle and continued to put water on the fire, backing out of the basement, putting water on hot spots.

At approximately 2206 hours, the Chief ordered all officers to the front of the church and assigned them safety officer positions. One Lieutenant was assigned exposure 2, another Lieutenant was assigned exposure 3 and the Captain (the victim) was assigned exposure 4. The Deputy Chief assembled a crew consisting of the Lieutenant, who was just assigned the safety officer for exposure 3, and 2 fire fighters to enter the middle side door of the church that led into the sanctuary to conduct an offensive attack in this area.

After considering roof ventilation, the Chief ordered a crew of three fire fighters to take a ladder and pike pole into the front door and locate the access into the attic, which was reported to be to the right of the front door (see diagram). The ladder was placed between the first and second pews and leaned against the wall of the church. The crew was to check for fire extension in the attic area. Using a pike pole, a fire fighter attempted to pull down a ceiling tile from the drop ceiling (the church had a drop style ceiling 2 feet below a wood tongue-and-groove ceiling). As the fire fighter lifted one of the ceiling tiles, several ceiling tiles were sucked up into the attic and flames shot out of the hole. The fire fighters exited the sanctuary to notify the Chief. The Chief had gone to exposure 4 corner and observed an opposing hose stream coming over the roof area and that the fire was now venting through the roof at the rear of the church.

At the same time the Deputy Chief's crew were in the sanctuary and starting to encounter flames in the ceiling area, the Chief passed back by the front door and noticed some fire involvement and light smoke beginning to enter the sanctuary. The PPV fan was unmanned and was shut down at this time. The Deputy Chief crew was pulling ceiling tiles and attacking the fire in the rear of the sanctuary. The Chief checking the opposing streams proceeded to the rear of exposure 2 for a size-up and noticed the



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Lieutenant that was assigned as a safety officer applying water with a 1-3/4 inch line. This stream was opposing the interior crews streams, and the Chief ordered the line to be shut down and to redirect the stream as a defensive attack on the burning corner of the church. The Chief noticed that another line was in operation by a Lieutenant on exposure 3. This line was also opposing the interior attack, and the Lieutenant was ordered by the Chief to shut this line down.

The Chief returned to exposure 1 and advised the Captain on Engine 321 to be prepared to relocate the apparatus if a defensive mode was ordered. The Chief also ordered a Captain to take a crew into the church to check the attic hole to look for fire extension in the attic area, and asked the Battalion Chief to be prepared to sound three blasts on the air horn on Engine 311 for an interior evacuation if conditions changed.

At approximately 2217 hours, the Captain along with a Lieutenant and two fire fighters entered the front of the church and proceeded to the access hole in the ceiling leading into the attic (see diagram). The Lieutenant climbed the ladder, which had been previously set by another crew to check conditions in the attic. The Captain (the victim) had re-entered the church and secured the ladder for the Lieutenant. The Lieutenant on the ladder observed no fire in the attic at this time and advised the Captain. Smoke conditions in the sanctuary consisted of only a light haze at this time. The Captain and one fire fighter exited the church and advised the Chief of conditions in the attic area. The Captain requested the Chief to step inside to size-up interior conditions. At the same time, the Deputy Chief, operating in the rear of the sanctuary went out of the door on exposure 2 to size-up conditions and noted flames spreading into the roof area. He re-entered and shouted for his crew to get out of the church.

The Chief had followed the Captain back inside the front door of the church at approximately 2220 hours when, without warning, the entire roof began collapsing into the interior of the church. The Lieutenant on the ladder reported seeing no fire and only a light haze in the attic, however, he noticed the drop ceiling moving toward him like a wave, and suddenly he was under a pile of burning debris, the entire roof was collapsing into the interior of the church. The Lieutenant was either blown from the ladder or was moving towards the door when this occurred, and the Captain (the victim) was trapped under heavy, burning roof timbers. The Chief stated he was approximately 10 feet inside the front door when without warning, the entire roof began coming down, blowing him towards the front door and sending a fire ball out the front door for approximately 100 feet. The Chief could hear the Lieutenant screaming for help, and grabbing the hose line, the Chief immediately applied water on him. With the help of another officer, he pulled the Lieutenant to safety. The pressure wave that vented through the side and front doors of the sanctuary could have been the result of a potential backdraft situation (ignition of hot gases in the attic) and/or the roof collapsing from the rear of the church to the front, thereby, pushing a large volume of air and flames toward the front of the church. The air and flames vented through the path of least resistance, the side and front doors.

Other fire fighters on exposure 4 helped the Deputy Chief's interior crew to safety. They had exited the side door on exposure 4, however, a Lieutenant had been trapped under burning debris in the middle of the sanctuary but was able to crawl to safety, suffering burns and minor injuries. The Deputy Chief was blown approximately 20 feet out of the door on exposure 2 as he tried to enter and warn his crew to get out.

The Chief immediately took an accountability check and found the Captain (the victim) was missing. All



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rescue attempts were abandoned due to full involvement and extreme heat conditions. The intense heat from the fully-engulfed church fire now required that all engines and tankers be moved back from the church to prevent further damage to the apparatus.

The fire was extinguished around 2320 hours, and the victim was found around 2355 hours. The victim was not removed until around 0600 hours, awaiting State and Federal officials to conduct an arson investigation.

Although other volunteer companies and fire fighters responded to this incident, only those directly involved are mentioned in this report.

CAUSE OF DEATH

The cause of death listed by the medical examiner was smoke inhalation and blunt force trauma.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Fire departments should ensure that pre-fire planning and inspections cover all structural building materials (type and age), components, and renovations so Incident Command at the fire scene will have necessary background information on the structure to make informed decisions and appropriate plan of attack. ^{1, 2}

Discussion: The church was constructed around 1850 of heavy wooden beams with wood, balloon-frame walls and was subject to age and deterioration. Older structures are subject to deterioration and shrinkage of structural members, i.e., wood, can shrink and rot over long periods of time unless an effort has been made for preservation and rehabilitation. The walls of the church were balloon frame construction (no fire breaks), which would allow rapid flame propagation, thereby decreasing structural integrity of the support members.

One of the greatest threats to fire fighters at a structure fire is collapse. Every year fire fighters die in the line of duty while conducting an offensive attack at a structure fire and a collapse occurs. One rule of thumb is the 20-minute rule for small wood frame structures, i.e., residential structures, small commercial buildings, and small churches constructed of wood frame or brick and wood construction. The 20-minute rule: If the fire is not under control in 20 minutes, you should probably begin withdrawing fire fighters and shift to a defensive attack. This rule is only a guide and should be used as such along with an adequate size-up and risk analysis before committing fire fighters to an interior attack. For example, the 20-minute rule would not be appropriate for a stripmall, which is constructed with lightweight wood or bar-joint trusses, which could possible collapse within 10 minutes.

Recommendation #2: Fire departments should ensure that defensive fire fighting tactics are suspended prior to switching the strategic mode of operation to an offensive attack to avoid opposing streams, and notify all affected personnel of the change in strategic modes. ^{3, 4}

Discussion: During the fire fighting operations at this incident, fire fighters were on the interior conducting an offensive attack toward the rear of the church, while fire fighters on the exterior (rear of the church) were conducting a defensive attack through the windows and upper part of the structure, resulting in opposing streams. It is essential that the IC notify all affected personnel of the change in strategic modes to avoid this type of opposing attack.

Recommendation #3: Fire departments should ensure fire fighting tactics and operations do not increase hazards on the interior, e.g., hose streams being directed into concealed ceiling spaces which will add additional weight to the structure, possibly causing structural failure.¹



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Discussion: The weakening of a structure from the fire, along with the additional weight of water from hose streams into concealed spaces to extinguish a spreading fire, could contribute to a collapse. One gallon of water weighs 8.3 pounds, and a hose stream discharging 250 gallons a minute is pouring 1 ton of water per minute into the concealed area, thereby additional weight which could significantly reduce the integrity of the supporting members, contributing to a collapse.

Recommendation #4: Fire departments should ensure that all standard operating procedures (SOPs) are updated and adequate for incident command and fireground operations and that all officers and fire fighters are trained and knowledgeable in all SOPs.³⁻⁵

Discussion: The standard operating procedures should include, but not be limited to, the following elements: 1) a well coordinated approach to emergency conditions/situations; 2) a plan for the overall safety of all fire fighters at the scene of an emergency; 3) fire fighter assignments/tasks; 4) fire fighting operations/tactics; 5) fireground communications; and 6) personal protective equipment. Officers and fire fighters should be trained in this system and should be provided with periodic refresher courses to review policies and procedures. Officers and fire fighters should be fully aware of all standard operating procedures, and of their individual roles, tasks, and responsibilities.

Recommendation #5: Fire departments should ensure that all officers and fire fighters wear and use a personal alert safety system (PASS) device that are involved in fire fighting, rescue, or other hazardous duty.³

Discussion: The PASS device is a small electronic device worn by the fire fighter which will emit a loud, distinctive, audible alarm if the fire fighter becomes

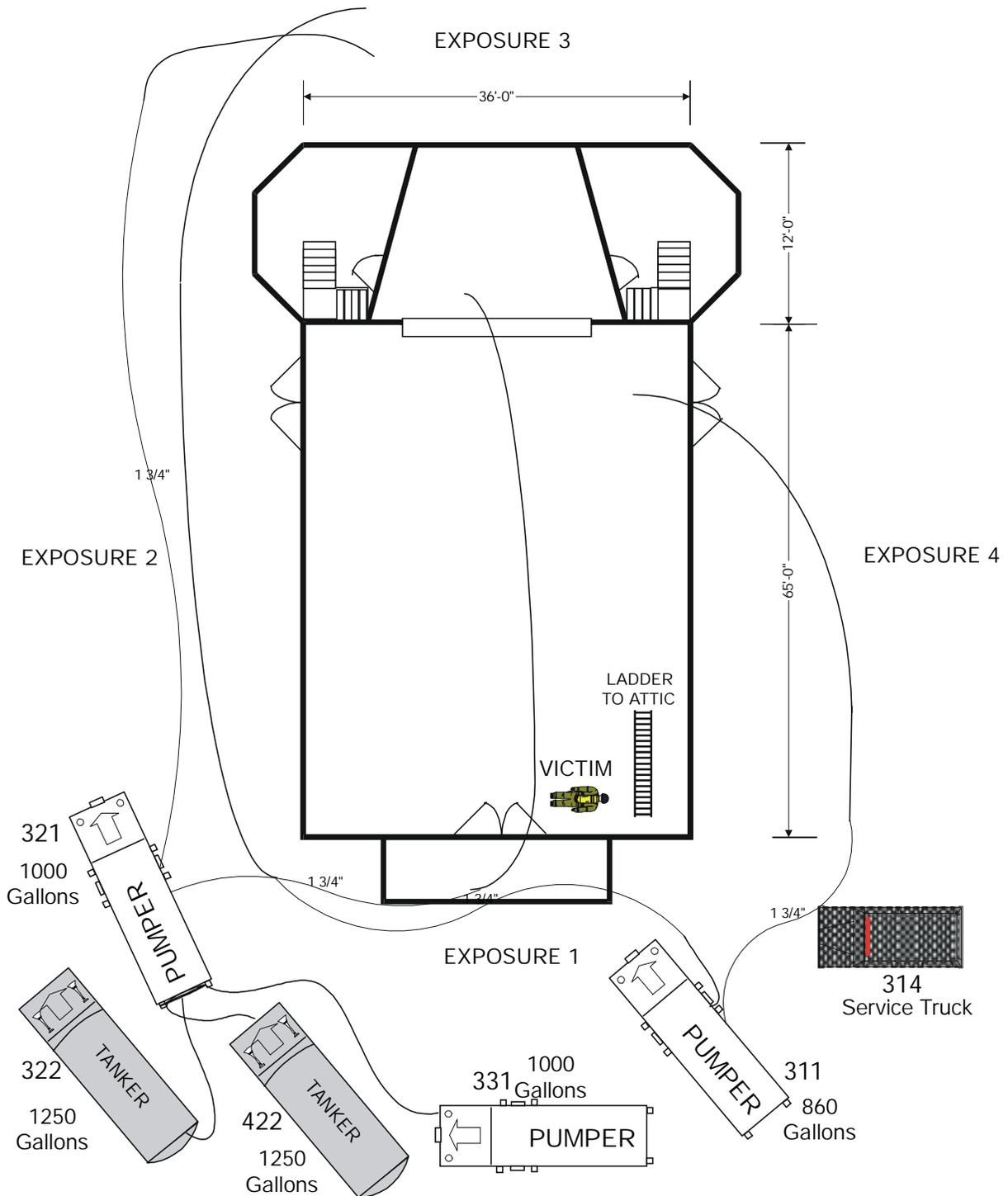
motionless for more than 30 seconds. The fire fighter can also manually activate the device if needed. If the victim was equipped with a PASS device, the fire fighters did not hear it sounding.

REFERENCES

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CHURCH DIAGRAM



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Incident Site