1000 FREDERICK LANE, MORGANTOWN, WV 26508 · 304.285.5916

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Executive Summary

Fire Structure Side Alpha
(Photo Courtesy of City Building Inspector)

On February 18, 2020, a 35-year-old career captain and a 25-year-old career firefighter died searching for a reported civilian using a walker in a public library. At 1616 hours, the communication center dispatched Engine 71, Engine 72, Truck 73, and Battalion 77 to a commercial structure fire at the library caused by arson. A minute later, a city police officer arrived, made entry, and reported the first floor was clear. At approximately 1618 hours, Engine 71 arrived with a captain, firefighter, and engineer from the fire station. The rear of the fire station shares a common wall with the rear of the library. The captain reported heavy smoke from Side Alpha. Battalion Chief 70 also responded from the adjacent fire station. A bystander informed a second police officer that a woman with a walker was on the second floor. The Engine 71 crew made entry without a hoseline and without informing Battalion Chief 70. At approximately 1621 hours, Battalion 77 arrived on scene, assumed command, and advised everyone go to Channel 2. Battalion 77 saw Engine 71 in front of the building and tried to contact the Engine 71 captain on Channel 2 to confirm they were in the building. A minute later, the Engine 71 captain contacted Battalion Chief 77 on Channel 1 and reported they cleared Division 2 and were headed to the stairwell for Division 1. At 1626 hours, fire conditions had worsened, and Battalion Chief 77 declared a defensive attack and attempted multiple times to radio the Engine 71 captain on Channels 1 and 2 with no response. At 1631 hours, a rapid intervention team (RIT) was assembled and made entry to locate the Engine 71 crew. A minute later, the fire chief arrived, and the Engine 71 captain called a Mayday from Division 2. The Engine 71 captain stated that he and his firefighter were running low on air in the banquet room and were trying to locate the stairs. At 1638 hours, the RIT reported no fire and zero visibility in the stairwell to the second floor. The RIT could hear activated PASS alarms. The Engine 71 captain was located in a bathroom and handed off to a second RIT because the first RIT was low on air.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

The captain was removed from the building and later died at the hospital. Several more RIT attempts were made to locate the Engine 71 firefighter. Efforts were suspended due to progressing fire conditions and collapse of the building. The Engine 71 firefighter was located by an urban search and rescue team (USRT) late the next day and was extricated from the building the following morning by the USRT and his fire department members.

Contributing Factors

- *Air management factors at the task and tactical level*
- *Risk assessment/size up difficulties*
- *Primary search without a tagline or hoseline in a large commercial occupancy*
- *Large area search in an occupied structure (public library)*
- *Ineffective Mayday procedures and survival techniques*
- *Residential tactics in a commercial structure*
- *Crew integrity lost during search*
- *Radio/communication difficulties*
- *Lack of sprinkler system*
- *Rapid fire growth.*

Key Recommendations

- *Fire departments should ensure all firefighters are trained on and actively practice air management principles.*
- *Fire departments should use risk management principles at all structure fires.*
- *Fire departments should ensure that primary search crews and RIT advance with a hoseline or tagline in commercial or complex structures.*
- *Fire departments should ensure all firefighters are trained in large area search procedures.*
- *Fire departments should ensure firefighters are trained in situational awareness, personal safety, and accountability.*
- *Fire departments should ensure firefighters are trained in Mayday procedures and survival techniques.*
- *Fire departments should develop and implement standard operating procedures/guidelines to define fireground strategies and tactics for commercial structures.*
- *Fire departments should ensure all members engaged in emergency operations receive annual proficiency training and evaluation on fireground operations, including operations within commercial structures.*
- *Fire departments should ensure crew integrity is properly maintained by voice or radio contact when operating in an atmosphere that is immediately dangerous to life and health (IDLH).*
- *Fire departments should ensure all firefighters are trained on radio discipline and proper use, including using the emergency alert button (EAB) on their portable radio.*
- *Fire departments should ensure firefighters and officers are trained in understanding fire development and growth during size-up, and that incendiary fires can rapidly develop and grow beyond predictions.*

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

- *Fire departments should incorporate the principles of command safety into the incident management system during the initial assumption of command to ensure strategic-level safety responsibilities are incorporated into the command functions throughout the incident.*

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).

1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Introduction

On February 18, 2020, a 35-year-old career captain and a 25-year-old career firefighter died searching for a reported civilian using a walker in a public library. On February 20, 2020, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On February 23 - March 3, 2020, a general engineer, two occupational safety and health specialists, and a technical information specialist from the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to California to investigate this incident. The NIOSH investigators met with fire department officials, including the fire chief, battalion chiefs, captains, and firefighters involved in the incident. The NIOSH investigators also met with representatives of the International Association of Fire Fighters local, representatives from the city manager's office, the buildings and inspection services inspector, and local police. The NIOSH investigators visited the city's dispatch center and obtained a copy of the fireground audio; visited the incident site; and conducted interviews with the fire department officers and firefighters directly involved in the incident, which included several mutual aid fire departments. The NIOSH investigators inspected and photographed the victims' personal protective clothing and the self-contained breathing apparatus. They also reviewed fire department training records and standard operating procedures.

Fire Department

The combination fire department provides fire protection and life safety services to an area encompassing 18.7 square miles and a population greater than 60,000. The city encompasses a diverse range of structures from populated multi-family dwellings, single-family residential occupancies, 25 schools, a college, 4 nursing homes, a hospital, numerous hotels, commercial structures, churches, and a municipal airport. Additionally, the fire department provides automatic and mutual aid within the county totaling 405,348 residents.

The fire department operates six engines, a ladder truck, a rescue vehicle, three patrol vehicles (wildland brush trucks), five command vehicles, and several utility vehicles out of three fire stations. The fire department is staffed by 42 career and 15 volunteer uniformed personnel that provide firefighting for structural and wildland fires, rescue and hazardous materials operations, and basic life support services. The minimum daily staffing is 10 front line personnel and a Battalion Chief (BC).

The fire department responded to a total of 5,359 incidents (including 369 fires and 100 hazardous material incidents) during 2019. The fires involved 40 structures, 32 vehicles, 112 vegetation, and 185

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

other classified fires. The first alarm structure fire response consists of two engines, a ladder truck, a patrol vehicle, a BC, and a county mutual aid engine driven by a firefighter.

The fire department has written policies and procedures which are available to all department members within their stations. These policies and procedures have been implemented and some were in various stages of revision at the time of this incident.

Training and Experience

The operations division has primary responsibility for emergency response and preparedness within the city. The division includes a training captain responsible for management of the department's annual training programs and coordination of emergency management response and preparedness activities with city staff. Daily supervision and leadership of the division is provided by the battalion chief of operations. Fire department personnel participate in drills and classes throughout the year, including basic firefighter skills, emergency medical technician skills, hazardous materials response, technical rescue, and disaster management.

The department also has a regional training facility that hosts courses providing instruction to students from the region and the state. These courses range from state fire training courses, a national fire academy course, public works courses, and police officer special weapons and tactics. The Fire Department's training division is also responsible for the city's National Incident Management System (NIMS) compliance program.

The state requires all firefighters be 18 years of age, have a valid driver's license, and complete California Fire Fighter 1 certification which contains three levels of professional qualifications set by the National Fire Protection Association (NFPA). The three levels are:

- NFPA 1001: Fire Fighter 1
- NFPA 1051: Wildland Fire Fighter 1
- NFPA 1072: Hazardous Material Awareness and Operations

These qualifications are documented in the Fire Fighter 1 Certification Training Standards (CTS). The State Fire Training agency coordinated the development of the CTS guide, certification, and associated curriculum. The Statewide Training and Education Advisory Committee and the State Board of Fire Services recommended these standards and qualifications for adoption by the Office of the State Fire Marshal for all new firefighters.

The recruit academy is based on the firefighter professional qualifications contained in NPFA 1001. The academy runs for a total of 16 weeks. The first 3 weeks focus on Emergency Medical Technician (EMT) training (120 hours) followed by 13 weeks of fire operations training (520 hours).

The fire department hiring process for the fire recruit position requires that applicants have a valid EMT certification from the state of California or from the National Registry of Emergency Medical Technicians before being hired. Applicants are tested in the disciplines of reading, math, video scenarios, and the national testing network's mechanical aptitude test as it pertains to the firefighter

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

position. Based on the results of the test, the most successful applicants are scheduled to perform a Physical Ability Test. The Physical Ability Test consists of completing typical firefighting tasks in a timely manner while wearing safety equipment, turnout gear, breathing apparatus, helmet, and structural firefighting gloves. Candidates are then selected to participate in potentially two rounds of interviews, the first with the fire department's fire captains and the second with the fire department's chief officers. Based on the results of the interviews, candidates receive a conditional job offer and then receive background checks and medical and psychological testing.

The firefighter that was fatality injured was a reserve firefighter for the department in 2014, became part-time in 2016, and full-time in 2017. The firefighter received his Fire Fighter II certification in October 2019.

The captain that was fatality injured was hired in 2007, promoted to engineer in 2016, lieutenant in 2018, and captain in 2019. The captain had 13 years of firefighting experience.

Equipment and Personnel

On February 18, 2020, the city dispatched the local combination fire department for a commercial structure fire. Five minutes after dispatch, the incident commander requested a second alarm which called in all off-duty personnel and a mutual aid engine and mutual battalion chief. Table 1 identifies the apparatus and staff dispatched on the first-alarm assignment. All resources in Table 1 were dispatched at 1616 hours. Engine 71 arrived on scene at 1618 hours. All other resources arrived at 1621 hours.

Table 1: First alarm Apparatus

Resource Designation	Staffing
Engine 71	captain, engineer, and firefighter
Battalion chief 77	shift battalion chief
Truck 73	captain, engineer, probationary firefighter
Engine 72	captain and engineer
Patrol 72	2 firefighters

Notes: A local police officer was first on scene at 1617 hours, made initial entry into the fire structure, and verified the first floor was clear. Battalion Chief 70 (administrative battalion chief) self-dispatched and arrived approximately at 1618 hours, responding from his office at the fire department headquarters and assumed command prior to Battalion Chief 77 arrival.

The dispatch center is in the city and employed 13 dispatchers at the time of the incident. Each dispatcher works three 12-hours days and one 8-hour day. The dispatch center also dispatches for the city police department and a neighboring city's fire, police, and EMS. The dispatch center answers over 20,000 emergency calls annually.

Training for new dispatchers includes:

- Working with a field training officer during probation.
- Completing 6 months on-the-job training.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

- Shadowing as a probationary dispatcher and dispatching animal control calls initially.
- Completing the California Public Safety Dispatcher's Basic Course within 12 months.

Personal Protective Equipment

At the time of the incident, the captain and firefighter were wearing their station uniform, turnout coat and pants, gloves, hood, helmet, boots, and self-contained breathing apparatus with integrated PASS devices. They both carried portable radios and flashlights assigned by the fire department. The NIOSH investigators examined and photographed the personal protective clothing and equipment at the fire department's headquarters facility. The firefighters' turnout gear and equipment were not considered to be a contributing factor in this incident.

Weather and Road Conditions

The weather was clear with an approximate temperature of 67°F, winds WNW at 7 mph, and the relative humidity was 47%. Weather was not considered to be a factor in this incident.

Structure

The non-sprinklered, 2-story commercial structure was originally built in 1953, with major additions in 1957 and 1974. It totaled 19,000 square feet at the time of the incident. The two-story structure had a concrete slab, concrete block wall exterior, light steel trusses, and composition flat roof. Additions in 1957 and 1974 were made of 2x4 stud walls, plaster exterior, wood truss framing with plywood sheathing, and steel beams. The area after the 1957 addition was approximately 220 feet wide, 396 feet long, and 15 feet high and the 1974 addition was approximately 231 feet wide, 440 feet long, and 27 feet 5 inches high (this included a second floor). The floor plans are shown per Diagrams 1 and 2. Typical fuel load of a library is depicted in pre-fire photo (see Photo 1).

The library and the fire station share the same city block and a common Side C wall (see Diagram 3 on page 13).

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

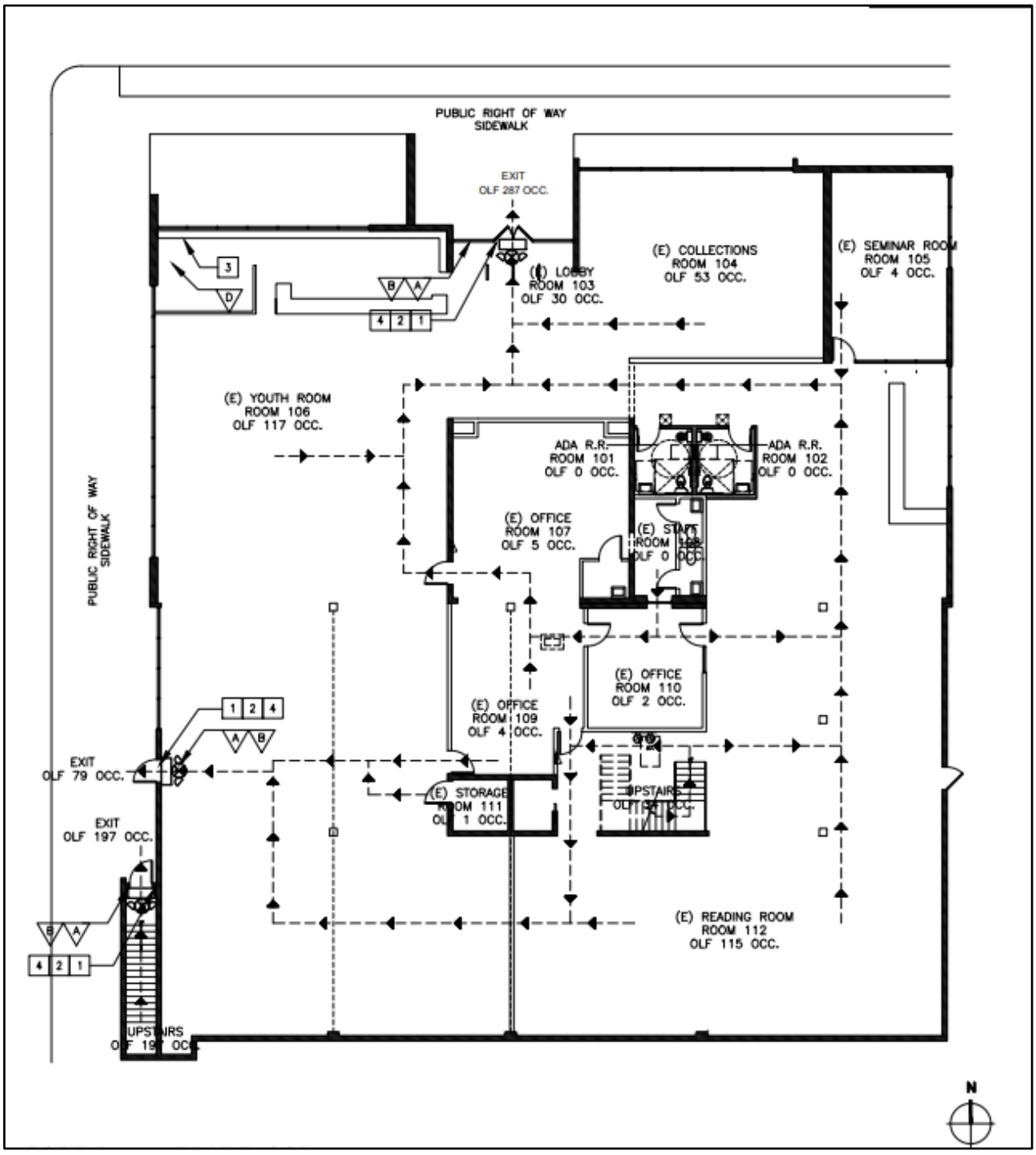


Diagram 1: First floor layout
Courtesy of city manager's office

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

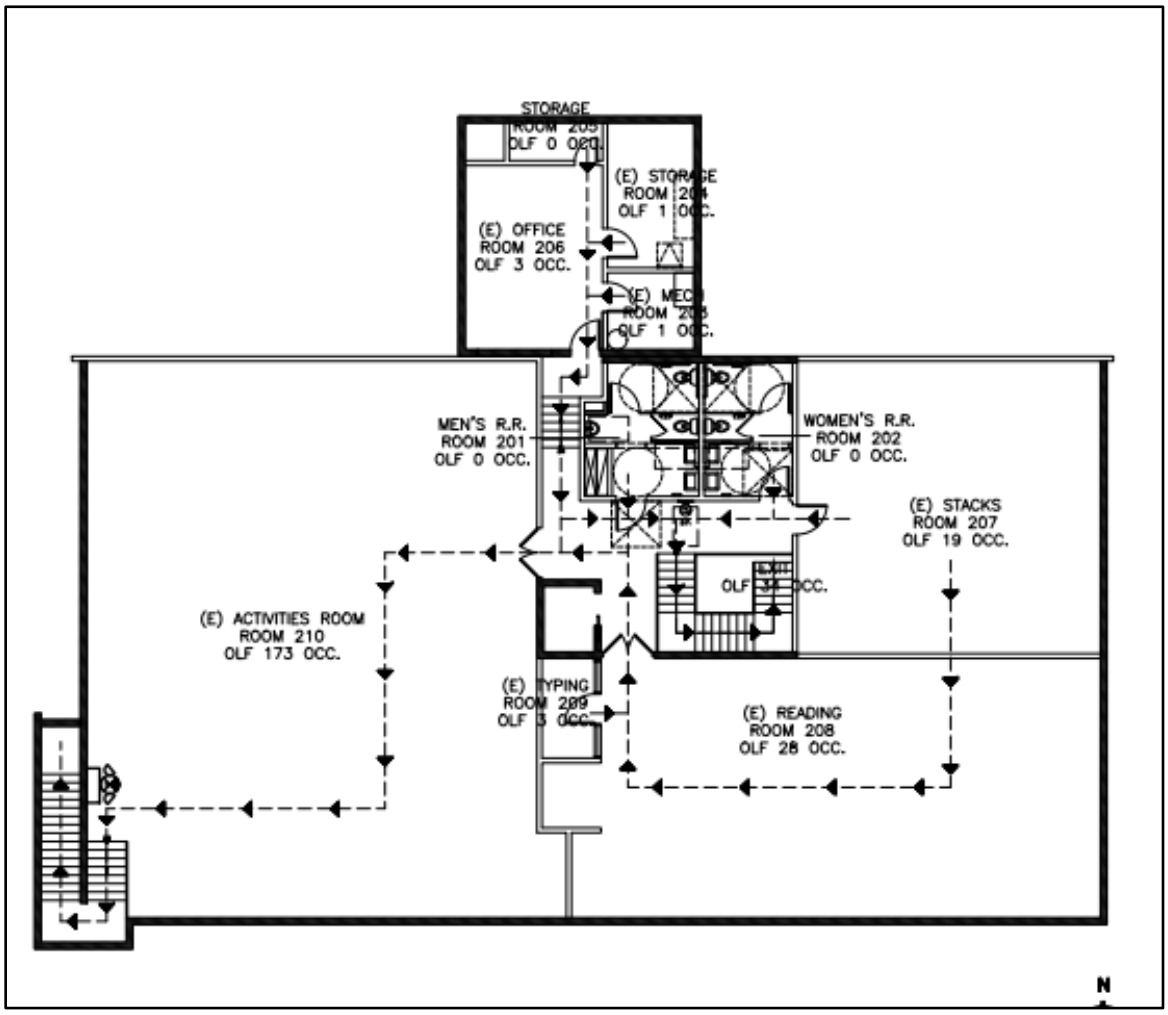


Diagram 2: Second floor layout
Courtesy of city manager's office

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Photo 1: First floor of the library pre-fire. Note the stairwell where the RIT operation occurred. ***Courtesy of the fire department.***

Timeline

The following timeline is a summary of events that occurred as the incident evolved on February 18, 2020. Not all incident events are included in this timeline. The times are approximate and were obtained by studying the dispatch records, audio recordings, witness statements, and other available information. This timeline lists the changing fire behavior indicators and conditions reported, as well as fire department response and fireground operations. All times are approximate and rounded to the closest minute.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Fire Behavior Indicators & Conditions	Time	Response & Fireground Operations
911 call received	1616	Engine 71, Engine 72, Truck 73, and Battalion 77 were dispatched to commercial structure fire.
	1617	Local police officer on scene and cleared first floor of structure.
Engine 71 captain reported heavy smoke from Side Alpha. Battalion Chief 70 confirmed heavy smoke Side Alpha and requested traffic control, notified utilities, and staged ambulance.	1618	Engine 71 arrived on scene; Battalion Chief 70 arrived on scene; police officer informed Battalion Chief 70 there's no one in the building; Battalion Chief 70 directed Captain 71 to initiate fire attack; and bystanders informed second police officer that there was a woman upstairs with a walker.
	1619	Second police officer informed Engine 71 captain and firefighter that there was a woman with walker on second floor. They entered Side Alpha without a hoseline and did not inform command; Truck 73 established water supply on Side Delta; and Battalion Chief 70 established Command.
	1620	Third police officer advised Engine 71 engineer that she searched the second floor and the woman with a walker was out of the building.
Battalion Chief 77 called for a second alarm and assumed command.	1621	Battalion 77 arrived on scene and confirmed working fire and requested all radio traffic go to Channel 2 per policy; Battalion Chief 77 directed Truck 73 to initiate the fire attack through Side Delta windows; Engine 72 arrived on scene; and Battalion Chief 77 met with Engine 71 engineer.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Fire Behavior Indicators & Conditions	Time	Response & Fireground Operations
	1623	Battalion Chief 77 called Engine 71 captain on radio and asked for status report and received no response.
	1624	Engine 71 captain contacted Battalion Chief 77 on Channel 1 and informed command that they cleared Division 2 and were moving to Division 1. Captain asked command to confirm if the woman with a walker was out, command believed so but would confirm.
Engine 73 captain requested laddering the roof to vent but Battalion Chief 77 declared a defensive fire attack until fire under control.	1626	Battalion Chief 77 radioed Engine 71 captain on Channel 2, Captain 71 responded but Battalion Chief 77 did not acknowledge.
	1627	Battalion Chief 77 attempted to contact Engine 71 captain first on Channel 1 then Channel 2 and the captain replied but Battalion Chief 77 did not acknowledge.
	1628	Battalion Chief 77 attempted to contact Engine 71 captain on Channel 2 with no response; Truck 73 captain informed command that they had good knockdown on the fire, wanted to access the roof, and cut a hole along the Side Delta wall working towards the center.
	1631	Battalion Chief 77 ordered the training Captain 70 to form a RIT to locate Engine 71 crew.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Fire Behavior Indicators & Conditions	Time	Response & Fireground Operations
	1632	Fire chief arrived on scene and met with Battalion Chief 77; Engine 71 captain called a Mayday on Channel 1, reported they were in banquet room trying to locate stairwell, low on air and activating PASS; Battalion Chief 77 responded and sent in RIT.
	1634	Battalion Chief 77 and fire chief requested hold on Channel 1 for Mayday. All other traffic on Channel 2.
	1635	Fire chief assumed command and made Channel 3 Fireground tactical channel (TAC). Battalion Chief 77 stayed in command of the Mayday.
	1636	Battalion Chief 70 assigned himself as Delta command. Battalion Chief 70 sent Engine 73 captain and two firefighters to Division 2 by accessing the enclosed external stairwell on Side Delta, to attempt to locate Engine 71 crew
	1637	The Side Delta crew searched the banquet room; fire chief established a staging area near Engine 71.
	1638	RIT team led by training captain radioed command that they made it to the inside stairwell and could hear PASS alarms. There was no fire and zero visibility conditions.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Fire Behavior Indicators & Conditions	Time	Response & Fireground Operations
	1640	RIT team located Engine 71 captain in the Division 2 bathroom and requested additional manpower. RIT got Engine 71 captain halfway out the building and had to pass him off to second RIT because they were low on air.
	1650	Engine 71 captain extricated from the building. Several other RIT attempts were made to locate Engine 71 firefighter without success.
RIT operations halted and defensive operations called.	1745	
	2015 2/19/20	Urban Search and Rescue Team located Engine 71 firefighter the next night.
	0400 2/20/20	Engine 71 firefighter removed from structure by Urban Search and Rescue team and fire department members early morning the following day.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Investigation

Photo 2: Fire structure Side Alpha
(Photo by NIOSH)

On February 18, 2020, a 35-year-old career captain and a 25-year-old career firefighter died searching for a reported civilian using a walker in a public library. At 1616 hours, the communication center dispatched Engine 71, Engine 72, Truck 73, and Battalion 77 to a commercial structure fire (see Photo 2). A minute later, a city police officer arrived, made entry, and reported that the first floor was clear. At approximately 1618 hours, Engine 71 arrived with a captain, firefighter, and engineer from the fire station. Side Charlie of the fire station and Side Charlie of the library share a common wall.

The captain reported heavy smoke from Side Alpha. Engine 71 had been informed by dispatch that the reported fire was in the back of the building. The Engine 71 crew laid a 1¾-inch hoseline to the front door. Battalion Chief 70, the administrative battalion chief, was in his office at the station and responded. Upon arriving at the scene, Battalion Chief 70 reported heavy smoke from Side Alpha. A bystander informed a second police officer that a woman with a walker was on the second floor. The police officer relayed this information to the Engine 71 captain and firefighter. The Engine 71 crew made entry without a hoseline and did not inform Battalion Chief 70.

Battalion Chief 70 assumed command and instructed Truck 73 to connect to the hydrant at the Alpha/Delta corner of the block to establish a water supply. Truck 73, the second arriving apparatus, connected to the hydrant and was laying a 4-inch supply line to Engine 71, but Engine 71 was already laying their own supply line. Truck 73 supplied their own truck. A third police officer informed the Engine 71 engineer that the woman with the walker from the second floor was out of the building and in the parking lot.

At approximately 1621 hours, Battalion Chief 77 arrived on scene, assumed command, and advised everyone to go to Channel 2. Battalion Chief 70 was on Side Delta when Battalion Chief 77 arrived and on his way to brief Battalion Chief 77 when he heard Engine 71 captain say something on radio Channel 1. Battalion Chief 77 assumed command and instructed the Engine 71 captain to go to Channel 2. About this time, Side Delta's windows self-vented and Battalion Chief 70 blocked the Side Delta alley with his vehicle as he briefed Battalion Chief 77. Battalion Chief 77 asked for the location of Engine 71 captain and tried to contact Engine 71 captain on Channel 2 to confirm if they were in the building. Battalion Chief 77 confirmed with the Engine 71 engineer that his captain and firefighter were inside the fire structure. Truck 73 pulled a 1¾ -inch and a 3-inch hoseline to Side Delta (see Diagram 3). The Truck 73 captain informed his engineer to go to Channel 2 but to scan Channel 1. Engine 72 had arrived and parked behind Truck 73. The Engine 72 captain and firefighters set up mini-monitors (500-1000 gallon per minute flow rate) on the ground at the Alpha/Delta corner.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

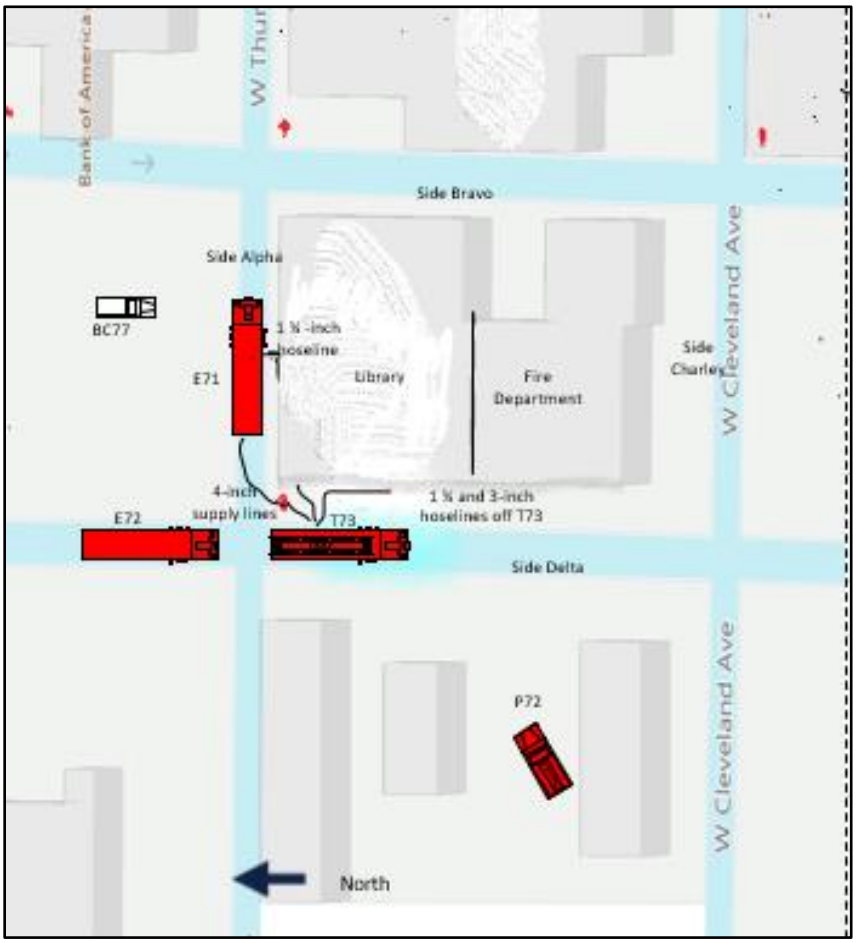


Diagram 3: First alarm apparatus and hoseline placement.

A minute later, the Engine 71 captain announced on Channel 1 that they cleared Division 2 and were headed to the stairwell for Division 1. The Engine 71 captain requested confirmation that the lady with the wheelchair (there was some confusion whether the lady was in walker or wheelchair) was still in the building. Battalion Chief 77 responded that he thought she was out but would confirm. Battalion Chief 77 reminded the captain to go to Channel 2. At 1626 hours, Battalion Chief 77 radioed the Engine 71 captain on Channel 2 and the captain responded but Battalion Chief 77 did not acknowledge at that time. The Truck 73 captain wanted to place a ladder to the roof to vent but fire conditions had worsened, and Battalion Chief 77 declared a defensive attack. Battalion Chief 77 attempted multiple times to radio the Engine 71 captain on Channel 1 but did not get a response. Battalion Chief 77 radioed the Engine 71 captain on Channel 2 but received no response.

At 1628 hours, Truck 73 captain informed Battalion Chief 77 that Side Delta was sufficiently knocked down and that they were able to place a ladder to the roof. At 1631 hours, Battalion Chief 77 had the training captain assemble a three-man RIT consisting of the Engine 72 captain, Engine 72 engineer, and himself to locate the Engine 71 crew. A minute later, the fire chief arrived on scene at the same time that the Engine 71 captain called a Mayday on Channel 1 from Division 2. The Engine 71 captain

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

stated that he and his firefighter were running low on air in the banquet room and trying to locate the stairs. Battalion Chief 77 advised he was sending in a RIT. At the Side Alpha doors, the Engine 71 engineer had a 1¾-inch hoseline and stopped flowing water as the initial RIT team made entry with a RIT bag that contained a 45-minute cylinder and facepiece. Upon entry, the initial RIT had no hoseline or tagline and only 10 feet of visibility.

The Engine 71 captain repeated they were low on air, and they were manually activating their PASS devices. Battalion Chief 77 had all units hold traffic on Channel 1 due to the Mayday and directed all other fireground communications to Channel 2. At 1635 hours, the fire chief assumed incident command and had Battalion Chief 77 run the Mayday. Incident command changed the incident tactical channel to Channel 3. The initial RIT team had made it to the stairs in the middle of the first floor where there was no fire but zero visibility. Then the Engine 72 captain headed towards the front door because he thought more people were needed. On his way back, he ran into the off-shift Engine 72 captain from C-shift (Engine 72C captain), who was the fourth man on a second RIT team and followed him back to the stairs where they searched underneath the stairs.

A minute later, on Side Delta, the Battalion Chief 70 assembled a Side Delta RIT crew of three led by the Truck 73 captain to access the Side Delta enclosed external stairwell near the Charlie/Delta corner. The Truck 73 engineer, Truck 73 probationary firefighter, and Patrol 72 firefighter forced the Side Delta stairs door. As smoke pushed out, the Truck 73 captain with a thermal imager, firefighter with a 1¾-inch hoseline, and probationary firefighter went to the second floor. The probationary firefighter stayed at the Side Delta exterior second door feeding the hoseline to the Truck 73 captain and firefighter. The Truck 73 captain informed the Battalion Chief 70 that they were in the banquet area searching in heavy smoke with 10-inch visibility while scanning with the thermal imager. The Battalion Chief 70 advised them to come back to the landing at the top of the Side Delta stairs. At 1637 hours, the fire chief established a staging area.

The initial RIT team led by the training captain took the Engine 72 engineer and started ascending the stairs. He requested the Engine 72 captain remain at the bottom of the stairs. At 1638 hours, the training captain reported that they made it to the second floor and there was no fire but zero visibility. They could hear PASS alarms sounding. The Engine 72 captain's low-air alarm was going off, and he exited to get a fresh bottle. Two minutes later, the training captain located the Engine 71 captain behind the door in a bathroom (see Diagram 4). The training captain noticed the Engine 71 captain had no mask on. He tried to grab the drag rescue device in the Engine 71 captain's turnout coat but couldn't locate it, so he grabbed the SCBA shoulder strap and started moving the captain towards the door. The training captain's low air alarm activated, and he yelled for the Engine 72 engineer to help him get the Engine 71 captain to the stairs. As they started down the stairs, the Engine 71 captain's mask mounted regulator became caught in the railing and his PASS alarm was still going off.

The Engine 72C captain showed up on the stairs as the training captain exited to get a fresh bottle. The Engine 72 engineer turned off the Engine 71 captain's PASS alarm while the Engine 72C captain got the mask mounted regulator freed. The two RIT firefighters control-rolled the Engine 71 captain down the stairs. Their low-air alarms had been going off and the Engine 72C captain only had about a minute of air left when the training captain showed back up with a mutual aid RIT crew of four. The Engine

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

72C captain grabbed the training captain's hand and put it on the Engine 71 captain's SCBA strap. The Engine 72C captain made it to the exit by unclipping his mask mounted regulator and taking breaths of smoke-filled air as he exited the fire structure. The training captain and crew were turning the corner near the computer room with the Engine 71 captain. They were accompanied by the Engine 72 engineer, (who was running out of air), and got the RIT crew headed in the right direction as the engineer exited with her mask reportedly starting to collapse to her face as she had also run out of breathing air.

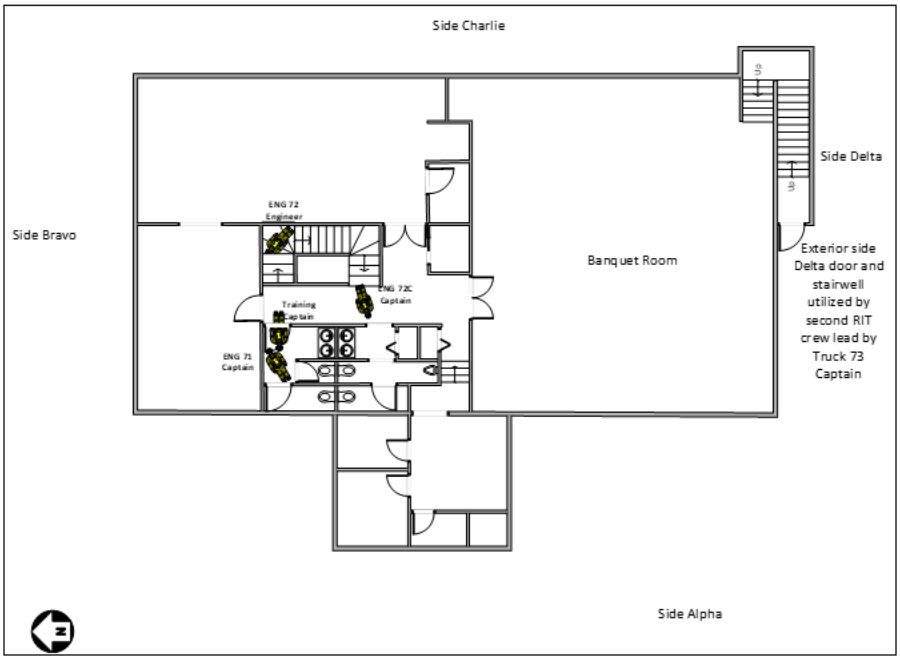


Diagram 4: RIT locating Engine 71 captain on second floor in women's bathroom.

At 1640 hours, the Engine 71 captain was extricated and taken by ambulance to the hospital and later pronounced dead. An off-duty Engine 71 captain C-shift (Engine 71C) was asked by Battalion Chief 77 to assemble a RIT to look for the Engine 71 firefighter. The Engine 71C captain teamed up with the Patrol 73 engineer and a county firefighter. They gathered the RIT and rope bags along with thermal imagers to make entry. Prior to entry, the RIT captain spoke with the training captain to verify that the Engine 71 firefighter's last known location was second floor bathroom.

Upon entry, the RIT team were using their thermal imagers and a tagline in the zero visibility conditions, but obstacles hampered their ingress and they mistakenly made entry into the computer room. Once out of the room and headed towards the stairs, the captain noticed heavy soot on his mask and the county firefighter mentioned he could hear a PASS alarm in the distance. Command called for a status update and the captain replied they were having difficulty but could hear a PASS alarm sounding. The captain was struck by falling ceiling materials, which caused him to lose his thermal

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

imager. While the captain was searching for the thermal imager, he inadvertently found the Engine 71 captain's helmet. Due to worsening conditions and collapsing ceiling they decided to back out. In doing so they ran into another RIT crew led by mutual aid Engine 19 captain and three other firefighters, who were told to back out by the exiting RIT crew. One additional RIT attempt was made to locate the Engine 71 firefighter but due to fire conditions and building collapse along the Side Charlie wall, efforts were suspended, and fire operations went fully defensive. Truck 73's ladder was put up on Side Delta and directed water through the vented roof. Mini-monitors were flowing water on Sides Alpha and Delta. The Engine 71 firefighter was located by a USRT late the next day. The Engine 71 firefighter was extradited from the building the following morning by the USRT and his fire department members.

Contributing Factors

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. NIOSH investigators identified the following items as key contributing factors in this incident that ultimately led to the fatalities:

- Air management factors at the task and tactical level
- Risk assessment/size up difficulties
- Primary search without a tagline or hoseline in a large commercial occupancy
- Large area search in an occupied structure (public library)
- Ineffective Mayday procedures and survival techniques
- Residential tactics in a commercial structure
- Crew integrity lost during search
- Radio/communication difficulties
- Lack of sprinkler system
- Rapid fire growth.

Cause of Death

According to the death certificate, the medical examiner listed the captain's and the firefighter's cause of death as asphyxiation and smoke-inhalation. Both the captain and firefighter had moderate soot throughout their lungs. The captain had no significant blunt force trauma and the firefighter had first degree burns on the front of his body and post-mortem charring on his back.

Recommendations

Recommendation #1: Fire departments should ensure all firefighters are trained on and actively practice air management principles.

Discussion: Air management is a program that the fire service can use to ensure that firefighters have enough breathing air to complete their primary mission and to escape an unforeseen emergency. Retired fire chief Bobby Halton notes, "If you run out of air in a working fire today, you are in mortal danger. There is no good air at the floor anymore, no effective filtering methods, no matter what others

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

may say to the contrary." The only protection for firefighters in the toxic smoke environments in today's fires is the air they carry on their backs. Like SCUBA divers, firefighters must manage their air effectively to leave enough reserve air to escape in case of unforeseen occurrences while inside a structure fire. They should leave IDLH atmosphere before the low-air alarm activates, which will also eliminate the noise of a low-air alarm from the fireground [Gagliano et al. 2008].

NFPA 1404 Standard for Fire Service Respiratory Protection Training states that firefighters should exit from an IDLH atmosphere before the consumption of reserve air supply begins; a low-air alarm is notification that the individual is consuming the reserve air supply and activation of the reserve air alarm requires immediate action of the individual and the firefighting team [NFPA 2018a]. It is critical that firefighters understand that the initial 67% of the air supply is the "working and exiting air" [NFPA 2018a]. This includes air used for gaining access, working toward the tactical objectives, and exiting the hazard zone.

A low-air alarm is a fireground emergency and should be treated accordingly. A crew of firefighters who enter an IDLH environment together can be expected to run low on air in rapid sequence as experienced in this incident by the initial search crew for the civilian and the RIT team. A low-air emergency for one crew member should be treated as an emergency for the entire team, requiring the entire team to exit simultaneously, maintaining crew integrity.

Generally, fire crews are able to search structures quickly, put out the fire, and exit the hazard zone on their initial 67% air supply. Multiple points of egress are usually close by if a rapid retreat to the exterior becomes necessary. However, high-rise apartment buildings, commercial structures, and large open floor plans present additional challenges that firefighters must consider, such as building contents, building materials, limited ingress/egress, and void spaces.

Company officers should frequently assess their crew's air consumption rates and estimate the crew's exit time based on the individual with the greatest assumed air consumption rate. It is the individual firefighter's responsibility to continually assess and report their air consumption to their company officer.

In this incident, the Engine 71 captain and Engine 71 firefighter ran out of air before they were able to exit the second floor of the structure. In addition, numerous RIT crew members ran out of air while they exited the structure and had to remove their masks. Findings from NIOSH investigations have indicated that the Heads-Up Display (HUD) is often over-looked and when the End-of-Service-Time-Indicator (EOSTI) activates, it may be the first time that firefighters may notice critical milestone indicators. Fire departments need to reinforce proper air management training and proper use of the HUD.

The NFPA 1981 (SCBA) Technical Committee is currently soliciting input on another alert mechanism that stimulates a second human sense, such as a unique sound in addition to the milestone flash at 50%, to make the firefighter more aware of their air supply. Also, upgrading SCBAs to the latest edition of NFPA 1981 will increase the EOSTI from 25 +/- 2% to 35% that provides more emergency reserve air by activating the EOSTI sooner. Additionally, increasing the cylinder size from

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

a 30-minute [1200 liter] cylinder to a 45-minute cylinder [1800 liter] (discussed in a later recommendation) will provide additional emergency reserve air and increase a crew's work time, especially in a commercial size structure.

Recommendation #2: Fire departments should use risk management principles at all structure fires.

Discussion: Established fire service risk management principles are based on the philosophy that greater risks will be assumed when there are lives to be saved and the level of acceptable risk to firefighters is much lower when only property is at stake. Interior offensive firefighting operations can increase the risk of traumatic injury and death to firefighters from structural collapse, burns, and asphyxiation. Established risk management principles suggest that more caution should be exercised in abandoned, vacant, and unoccupied structures and in situations where there is no clear evidence that people are trapped inside a structure and can be saved. Fire departments should establish a standardized method or approach to assess the risks encountered at each incident, especially structure fires. Structure fires are very dynamic and fast paced operations with little room for error or miscalculations of the significance of the risk encountered.

NFPA 1500 Standard on Fire Department Occupational Safety, Health, and Wellness Program, Chapter 8.4 addresses the use of risk management principles at emergency operations. Chapter 8.4.4 states, "Risk management principles shall be routinely employed by supervisory personnel at all levels of the incident management system to define the limits of acceptable and unacceptable positions and functions for all members at the incident scene".

The incident commander is responsible for managing risk at the incident. However, one person cannot be expected to apply these principles to an incident if the organization has not integrated a standard approach to risk management into its standard operating procedures (SOPs)/standard operating guidelines (SOGs) and its organizational culture. To be effective, risk management principles should be integrated into the entire operational approach of the fire department organization. They should be incorporated within the duties and responsibilities of every officer and member. The single most important reason to establish an effective incident management system is to ensure that operations are conducted safely. Every individual assigned to the incident is responsible for monitoring and evaluating risks and for keeping the Incident Commander (IC) informed of any factor that causes the system to become unbalanced. Continuous risk assessment should be done as every benchmark or task is completed until the incident ends.

A standardized evaluation of the situation should occur at each incident starting with the first arriving officer or member of the department arriving on scene of the incident. This evaluation starts with the scene size-up. The first arriving unit should look at the entire incident scene versus focusing on a small part of the situation. During the size-up, incident commanders need to consider the following incident priorities:

- Life safety
- Continuous firefighter safety
- Incident stabilization

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

- Property conservation [Rubin 1996]

The risk management plan should also consider the following:

- Risk nothing for what is already lost—choose defensive operations.
- Extend limited risk in a calculated way to protect savable property—consider offensive operations.
- Extend very calculated risk to protect savable lives—consider offensive operations.

In incidents where occupant survival isn't possible, the IC should evaluate conditions based upon the risk to firefighters and revise the strategy and Incident Action Plan (IAP). In these situations, the IC should take a more cautious approach to fireground operations. Fire control should be obtained before proceeding with the primary and secondary search efforts [Morris 2011].

A fire in a building today is not what it was 40 years ago. Yet, fireground tactics have not changed to be consistent with the effects of fire conditions on today's modern furnishings. As a result of the increased use of plastics in our buildings, today's fires are hotter and flashover occurs more quickly than in the past, releasing extreme levels of toxins. Fire models reflect that flashover can occur in less than five minutes and reach a temperature of more than 1,100°F. When exposed to fire, plastics burn hotter and produce highly toxic gases. For example, a pound of wood when burned produces 8,000 British thermal units (BTUs). On the other hand, a pound of plastic can produce 19,900 BTUs when burned. The human limit for temperature tenability is 212 degrees. On many occasions, flashover can occur as the first fire companies are arriving on the scene. In such circumstances, the survivability of any victims in the affected compartment can be very limited or nonexistent [Marsar 2010].

Additionally, the effects of carbon monoxide poisoning on a victim are well known to the fire service. Carbon monoxide blocks oxygen absorption to hemoglobin within the bloodstream. Due to the increased use of plastics and synthetic materials, carbon monoxide is produced in very high concentrations and very quickly in structure fires. As a result, victims die sooner than in the past. Burning synthetic materials also release hydrogen cyanide, creating a risk of cyanide poisoning. Cyanide kills the body's organs. A low concentration of 135 parts per million (PPM) of cyanide and carbon monoxide will kill a person in 30 minutes. At 3,400 PPM, it can kill in less than one minute. It's not uncommon for a fire in today's buildings to produce 3,400 PPM of hydrogen cyanide. A person may be resuscitated from the effects of carbon monoxide poisoning, but they may not survive the organ damage caused by cyanide poisoning [Marsar 2010].

Research findings by the Underwriters Laboratories (UL) show that modern furnishings in a fire environment can contribute to flashover occurring up to 8 times faster than with legacy furnishings. An experiment was conducted with two side by side living room fires to understand the difference between modern (today's petroleum-based furniture) and legacy (wood, cotton, and silk furniture of 40 years ago) furnishings and how they contribute to fire growth. Both rooms contained similar amounts of like furnishings. Both rooms were ignited by placing a lit candle on the right side of the sofa. The fires were allowed to grow until flashover. The modern room transitioned to flashover in 3 minutes and 30 seconds and the legacy room at 29 minutes and 30 seconds [Underwriters Laboratories Firefighter

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Safety Research Institute 2020]. For these reasons, the conditions within a fire compartment become untenable much sooner than in the past, and victims die quicker.

The IAFC *Rules of Engagement for Firefighter Survival* and the Incident Commander's Rules of Engagement for Firefighter Safety stress the need to determine the occupant survival profile. This action is ranked as the second most important action to take on the fireground, behind completion of the initial size-up [IAFC 2021] (See Diagram 6 on page 24).

In this incident, the first arriving crews were met with a rapidly developing fire in an occupied library and an immediate need to remove civilians. The Engine 71 captain reported heavy smoke from Side Alpha. Engine 71 had been informed by dispatch that the reported fire was in the back of the building. The Engine 71 crew laid a 1¾-inch hoseline to the front door. Battalion Chief 70, the administrative battalion chief, was in his office at the station and responded.

Upon arriving at the scene, Battalion Chief 70 reported heavy smoke from Side Alpha. A bystander informed a second police officer that a woman with a walker was on the second floor. The police officer relayed this information to the Engine 71 captain and firefighter. A third police officer informed the Engine 71 engineer that the woman with the walker from the second floor was out of the building and in the parking lot, however the Engine 71 crew had already made entry without a hoseline and did not inform Battalion Chief 70.

Recommendation #3: Fire departments should ensure that primary search crews and RITs advance with a hoseline or tagline in large commercial or complex structures.

Discussion: Hoselines can be the last line of defense, and the last chance for a lost firefighter to find egress from a burning building. The basic techniques taught during entry level firefighting programs describe how to escape a zero-visibility environment using only a hoseline. However, as years elapse from the time of basic training, firefighters may overlook this technique. Exiting a structure in zero visibility should be faster and easier for a firefighter with a hoseline. A firefighter operating on a hoseline should search along the hose until a coupling is found. Once found, the firefighter can "read" the coupling and determine the male and female ends [USFA 2003]. The International Fire Service Training Association (IFSTA) manual titled, "Essentials of Fire Fighting" teaches that the female coupling is on the nozzle side of the set and the male is on the water side of the set (see Diagram 5) [IFSTA 2019]**.** In most cases, the male coupling has lugs on its shank while the female does not.

There are a number of ways that a fire hose can be marked to indicate the direction to the exit, including the use of raised arrows and chevrons that provide both visual and tactile indicators. Fire departments may use a variety of techniques to train firefighters on how to identify hoseline couplings and the direction to the exit, based on the model of hose used by the department. The training needs to be repeated often so that firefighters are proficient in identifying the direction to the exit in zero visibility conditions while wearing gloves, when the hose is entangled, and there are various obstructions present.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

An attack fire hose can also be marked in a number of ways that will indicate the direction to the exit, including the use of raised arrows or chevrons that provide both visual and tactile indicators. Fire departments may use a variety of techniques to train fire fighters on how to identify hose line couplings and the direction to the exit, based on the model of the hose used by the department. This training should be conducted and repeated often so that fire fighters are proficient in identifying the direction to the exit in zero-visibility conditions while wearing gloves, when the hose is entangled, and with various obstructions present.

Manufacturers of attack fire hoses should consider marking their attack hoses (1½", 1¾", 2" and 2½") at the coupling point with raised chevrons indicating away from the male thread which will point in the direction of the exit. Manufacturers should also consider developing retro fitting indicators for current unmarked attack fire hose sizes.

A charged back-up hoseline of equal or greater size should also be established to cover the primary search crews. This cover line can also be used for a tactical withdrawal while continuing water application or as a lifeline to be followed to egress the building.

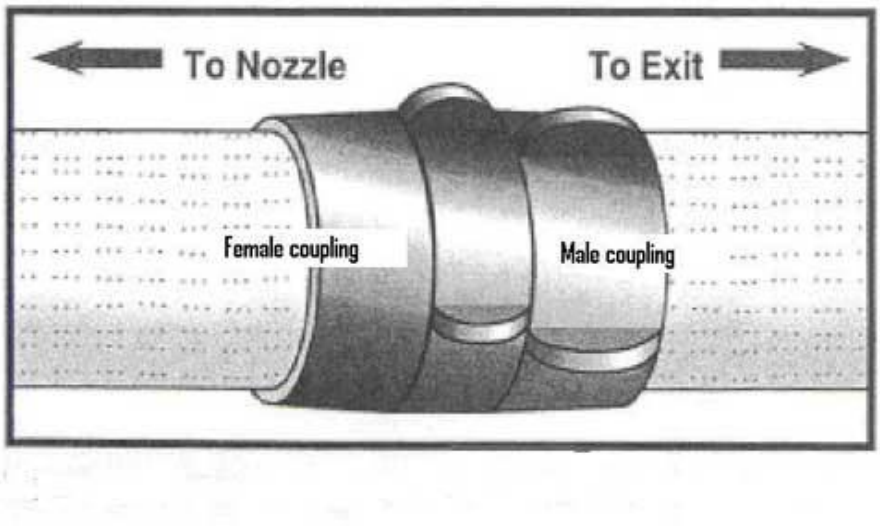


Diagram #5. Hose couplings can indicate the direction toward the exit. Adapted from IFSTA Essentials of Fire Fighting, 7th Edition.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Deploying a tagline (sometimes referred to as a search line) is a difficult but sometimes necessary task to search a complex or large area. Regardless of the reason for deployment, if not trained with the line, it can be more of a hinderance than it will be an aid [Fire Engineering 2014]. It is important for fire fighters to be proficient using a tagline during a large area search and that proficiency begins with the basic training and repetitive skill training.

There are many important considerations when choosing a tagline to complete a search operation. For example, positive communication and understanding between crew members completing the search, maintaining a tagline and keeping it taught throughout the operation to avoid confusion for the crew and to help from becoming tangled with other objects encountered throughout the occupancy [Fire Engineering 2014].

Recommendation #4: Fire departments should ensure all firefighters are trained in large area search procedures.

Discussion: The mission of search and rescue crews is to find victims in a fire as quickly as possible. However, before beginning any type of search, there needs to be a high probability of survivors. If the risk is too great, entry cannot be made. First arriving crews need to complete a 360 size-up, notifying command, and enter with a charged a hoseline or tagline.

For commercial structures, it becomes a low frequency/high risk event and training is essential. Fire conditions in a large structure can change rapidly and the search team should either have a hoseline or a tagline to facilitate exiting the structure if required. A back-up hoseline should also be established to cover the primary search crews. During a large-area search, a safety officer should be posted outside the building to time members operating inside.

A primary search is one of the most critical and dangerous tasks a firefighter can perform, thus training should be a top priority [Firehouse 2017]. Search skills should be continually practiced (to achieve an over-learned muscle memory response for SCBA controls) and include SCBA emergency maneuvers, such as low air recognition, emergency communications and procedures for buddy breathing. Instructions on emergency air replenishment (trans-fill) for a downed fire fighter through an RIC/UAC* (rapid intervention crew/universal air connection) should be provided.

When looking for a large area for training, consider large commercial structures that are vacant and may be designated for demolition (but safe enough to conduct the training exercise). Often permission can be obtained with reasonable limitations. Goals of the training should be to exercise and measure IC, air management, Mayday procedures, RIT, company officer decision making, communications, accountability, searching with an attack line, and victim/downed firefighter removal [Fire Engineering 2007].

Note—Use of the SCBA RIC/UAC is intended for emergency situations. Recharging air cylinders during routine **operations and training should follow applicable safe filling practices outlined in, but not limited to NFPA 1500, 1852 and manufacturing instructions [NFPA 2018c, 2018d, 2021].*

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Recommendation #5: Fire departments should ensure firefighters are trained in situational awareness, personal safety, and accountability.

All firefighters operating at an incident should maintain situational awareness and conduct a continuous risk assessment throughout the incident, reporting unsafe or changing conditions to the incident commander. Firefighters need to understand the importance of situational awareness and personal safety on the fireground. The fireground dangers and hazards can and do change as the incident becomes larger and the event duration increases [IFSTA 2019].

Situational awareness is the ability to perceive and understand what is happening in the environment around you, in relation to how time is passing, and then using your understanding of the situation to accurately predict future events in time to prevent bad outcomes [Gasaway 2019].

Situational awareness is defined as a process with 3 levels:

- Level 1. Perception, perceive the situation around us.
- Level 2. Comprehension, apply our knowledge and past experiences to our perception and develop an understanding of the meaning of the situation.
- Level 3. Application, taking our understanding of the situation and applying it to the future, thereby predicting how and when the situation will change and what action is appropriate on our part.

Level 1. Perception, also considered as sensing or observing, is often correlated in the fire service with size-up. While size-up is most often focused on visual observations, it is important to understand that effective perception should involve all 5 senses (hearing, taste, touch, sight, and smell) as applicable. Those senses should also be enhanced through the use of technology when possible. An example would be the use of a thermal imaging camera (TIC) to enhance the sense of sight. This first level in the situational awareness process must be deliberate, accurate, and continually ongoing.

Level 2. Comprehension, also considered as understanding, it can be part of a forgone conclusion that perception will always lead to comprehension. Unfortunately, that does not always happen and there is a potential for misinterpretation to occur. In order to fully understand the critical things that we are perceiving, firefighters and officers must have the proper knowledge which comes from education and training and also ability, which comes from experience. If they have any doubts about what they are comprehending, they should re-evaluate the process and when possible, seek the input of others. Firefighters and officers should also not just dismiss someone who has a different understanding of what others are perceiving. Comprehending different things can indicate that there is a misinterpretation or potentially multiple understandings for what is being perceived. Having a shared understanding on the fireground at the task, tactical, and strategic level is critical for success.

Level 3. Application, also considered as projecting or forecasting, is the final critical level that is only as successful as the outcomes from the first two levels. Given the fireground is a constantly changing and evolving place, plans must not only be based on what is currently taking place, but also based on what will happen in the immediate future. Firefighters and officers' ability to forecast future events will also rely heavily on their knowledge and ability. It is critical to recognize when we lack the

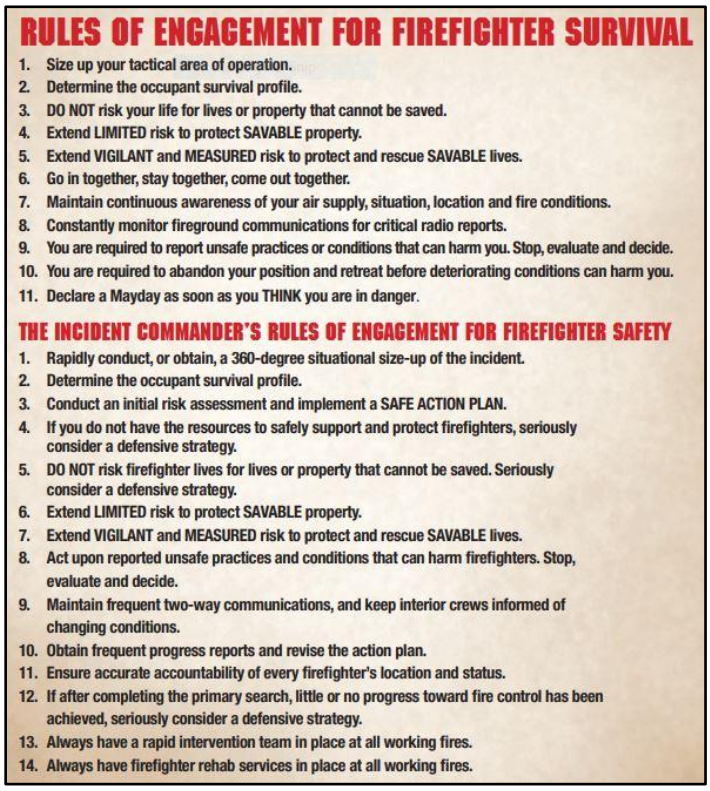
Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

necessary knowledge and/or ability for a given situation as it can negatively impact the ability to forecast. In those situations, firefighters may use another contingency such as seeking input from someone else who has the necessary knowledge and ability for the situation. Effectively utilizing level 3 forecasting can allow planning and actions to take place proactively, versus being forced to respond reactively, which increases the overall chances for success [Gasaway 2013, 2017, 2022].

Even though a safety officer may be designated for an incident, it is the obligation of all personnel to remain alert to their immediate surroundings [Clark 2008]. One of the most critical aspects of coordination between crews is maintaining situational awareness. The opposite of situational awareness is tunnel vision where the firefighters become so focused on firefighting or other operational assignments that they fail to sense changes in their environment. Firefighters must maintain their situational awareness by looking up, down, and around themselves, as well as listening for new or unusual sounds and feeling vibrations or movement. constantly working through the 3 levels until the incident is over. Firefighters and officers should communicate any key changes in their situational awareness to other members in their environment as well as to the incident commander.

The rules of engagement for structural firefighting have been developed to assist both the firefighter and the incident commander as well as command team officers in risk assessment and “Go” or “No-Go” decisions (See Diagram 6). These rules provide a recommended best practice model which fire departments can adopt and apply to enhance fireground safety [IAFC 2021]. The fireground creates a significant risk to firefighters, and it is the responsibility of incident commanders and command organization officers to minimize firefighter exposure to unsafe conditions and stop unsafe practices. The rules of engagement can assist the incident commander, company officers, and firefighters who are at the highest level of risk in assessing their situational awareness. One principle applied in the rules of engagement are that firefighters and the company officers are the members most exposed to the risk for injury or death and will be the first to identify unsafe conditions and practices. The rules integrate the firefighter into the risk assessment/decision-making process. These members should be the ultimate decision makers as to whether it is safe to proceed with assigned objectives. Where it is not safe to proceed, the rules allow a process for that decision to be made while still maintaining command unity and discipline.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California



RULES OF ENGAGEMENT FOR FIREFIGHTER SURVIVAL

1. Size up your tactical area of operation.
2. Determine the occupant survival profile.
3. DO NOT risk your life for lives or property that cannot be saved.
4. Extend LIMITED risk to protect SAVABLE property.
5. Extend VIGILANT and MEASURED risk to protect and rescue SAVABLE lives.
6. Go in together, stay together, come out together.
7. Maintain continuous awareness of your air supply, situation, location and fire conditions.
8. Constantly monitor fireground communications for critical radio reports.
9. You are required to report unsafe practices or conditions that can harm you. Stop, evaluate and decide.
10. You are required to abandon your position and retreat before deteriorating conditions can harm you.
11. Declare a Mayday as soon as you THINK you are in danger.

THE INCIDENT COMMANDER'S RULES OF ENGAGEMENT FOR FIREFIGHTER SAFETY

1. Rapidly conduct, or obtain, a 360-degree situational size-up of the incident.
2. Determine the occupant survival profile.
3. Conduct an initial risk assessment and implement a SAFE ACTION PLAN.
4. If you do not have the resources to safely support and protect firefighters, seriously consider a defensive strategy.
5. DO NOT risk firefighter lives for lives or property that cannot be saved. Seriously consider a defensive strategy.
6. Extend LIMITED risk to protect SAVABLE property.
7. Extend VIGILANT and MEASURED risk to protect and rescue SAVABLE lives.
8. Act upon reported unsafe practices and conditions that can harm firefighters. Stop, evaluate and decide.
9. Maintain frequent two-way communications, and keep interior crews informed of changing conditions.
10. Obtain frequent progress reports and revise the action plan.
11. Ensure accurate accountability of every firefighter's location and status.
12. If after completing the primary search, little or no progress toward fire control has been achieved, seriously consider a defensive strategy.
13. Always have a rapid intervention team in place at all working fires.
14. Always have firefighter rehab services in place at all working fires.

Diagram 6: The IAFC's Rules of Engagement for Firefighter Survival and the IC's Rules of Engagement for Firefighter Safety [IAFC 2021]

Recommendation #6: Fire departments should ensure firefighters are properly trained in Mayday procedures and survival techniques.

Firefighters need to be trained to recognize when they are in trouble, know how to call for help, and understand how incident commanders and others need to react to a responder in trouble [Jakubowski and Morton 2001]. A Mayday declaration is such an infrequent event in any firefighter's career that they need to frequently train to recognize when to declare the Mayday and what steps to take to improve their survival chances.

Calling a Mayday is a complicated behavior that includes the affective, cognitive, and psychomotor domains of learning and performance [Grossman and Christensen 2008; Clark 2005]. Any delay in calling a Mayday reduces the chance of survival and increases the risk to other firefighters trying to rescue the downed firefighter.

Firefighters should be 100% confident in their competency to declare a Mayday for themselves. Fire departments should ensure that any personnel who may enter an IDLH environment meet the Mayday competency standards of the authority having jurisdiction throughout their active-duty service. Presently, there are no national Mayday standards for firefighters and most states do not have Mayday

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

standards. A RIT will typically not be activated until a Mayday is declared. Any delay in calling the Mayday reduces the window of survivability and also increases the risk to the RIT [IAFF 2010, 2022 ; Clark 2005, 2008; USFA 2006].

There are no mandates on when a firefighter must call a Mayday, and Mayday training is not included in the job performance requirements in NFPA 1001 [NFPA 2019]. It is up to each authority having jurisdiction to develop parameters and performance standards for a firefighter to call a Mayday.

The National Fire Academy Mayday courses present specific parameters for when a firefighter should call a Mayday. Course number Q133, Firefighter Safety: Calling the Mayday, is a 2-hour online program covering the cognitive and affective learning domain of the firefighter Mayday doctrine. The course was based on the military methodology used to develop and teach fighter pilots ejection doctrine [Clark 2005; USFA 2006]. The courses may help fire departments in developing and teaching Mayday procedures for firefighters. The IAFC's rules of engagement for structural firefighting include rule #11: Declare a Mayday as soon as you think you are in danger (see Diagram 6).

The IAFF Fireground Survival program is another resource fire departments can use. It was developed to ensure that training for Mayday prevention and Mayday operations are consistent among all firefighters, company officers, and chief officers [IAFF 2010, 2022; NIOSH 2014].

Any Mayday communication must provide the location of the firefighter in as much detail as possible and, at a minimum, should include the division (floor) and quadrant. It is imperative that firefighters know their location when in IDLH environments at all times to effectively give their location in the event of a Mayday. Once in distress, firefighters must immediately declare a Mayday. The following example uses LUNAR (Location, Unit, Name, Assignment/Air, Resources needed) as a prompt: "Mayday, Mayday, Mayday, Division 1 Quadrant C, Engine 71, Smith, search/out of air/vomited, can't find exit." When in trouble, a firefighter's first action must be to declare the Mayday as accurately as possible. Once the incident commander and RIT know the firefighter's location, the firefighter can then try to fix the problem, such as clearing the nose cup, while the RIT is in route for rescue [USFA 2006; NIOSH 2014].

A firefighter who is breathing carbon monoxide (CO) quickly loses their cognitive ability to communicate correctly and can unknowingly move away from an exit and other firefighters before becoming unconscious. Without the accurate location of a downed firefighter, the speed at which the RIT can find them is diminished, and the window of survivability closes quickly because of lack of oxygen and high CO concentrations in an IDLH environment [Clark 2005, 2008].

Firefighters also need to understand the psychological and physiological effects of the extreme level of stress encountered when they become lost, disoriented, injured, trapped, or run low on air during rapid fire progression. Most fire training curriculum does not include discussion of the psychological and physiological effects of extreme stress, such as encountered in an imminently life-threatening situation, nor do they address key survival skills necessary for effective response. Understanding the psychology and physiology involved is an essential step in developing appropriate responses to life-threatening situations. Reaction to the extreme stress of a life-threatening situation, such as being

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

trapped, can result in sensory distortions, and decreased cognitive processing capability [Grossman and Christensen 2008].

In the book Stress and Performance in Diving, the author notes: "We know that under conditions of stress, particularly **when rapid problem-solving is crucial, overlearning responses is essential**. The properly trained individual should have learned coping behavior so well that responses become virtually automatic requiring less stop and think performance" [Bachrach and Egstrom 1987].

One of the most difficult situations a firefighter can face is when they realize they need to declare a Mayday. The word "Mayday" is designated to identify when a member is in a life-threatening situation and in need of immediate assistance [FIRESCOPE 2015, NIOSH 2014]. Recognizing that they are or about to be in a life-threatening situation is the first step in improving the firefighters' chances to survive a Mayday event. Many fire departments do not have a simple procedure for what to say when a firefighter gets into trouble—a critical situation where communications must be clear [NIOSH 2010, NIOSH 2014].

Firefighters must understand that when they are faced with a life-threatening emergency, there is a very narrow window of survivability. Training frequently is limited to breathing apparatus emergencies, egress through small openings, and emergency window egress. It is necessary to place additional emphasis on appropriate procedures for tactical withdrawal under worsening fire conditions and structural collapse situations. Firefighter training programs should include training on such topics as air management and emergency communications; familiarity with their SCBA, radio, and personal protective equipment; crew integrity; reading smoke, fire dynamics and fire behavior; entanglement hazards; building construction; and signs of pending structural collapse.

Firefighters must act promptly when they become lost, disoriented, injured, low on air, or trapped [FIRESCOPE 2015; IAFF 2010, 2022; LAFD 2016; TFRD 2012]. After quickly assessing the sustainability of their location, a firefighter should transmit a Mayday following these procedures:

- Activate the emergency alert button (EAB) on the portable radio pushing the button for 1 to 3 seconds to activate Note: All fireground radios should be equipped and programmed with EABs [NIOSH 2023]
- Declare the Mayday announced on the radio as "MAYDAY, MAYDAY, MAYDAY" followed by the unit designation, then a brief and concise statement of essential information
- Ensure the message is acknowledged by command and/or the dispatcher
- Ensure their PASS device is activated

Firefighters must transmit a Mayday while still having the capability and sufficient air, noting their location if possible. Firefighters may need to move away from untenable fire conditions before calling the Mayday. The next step is to manually activate their PASS device. To conserve air while waiting for rescue, firefighters should try to stay calm and focused on their situation and avoid unnecessary physical activity.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

After initiating a Mayday, firefighters should survey their surroundings to get their bearings and determine potential escape routes, such as windows, doors, hallways, changes in flooring surfaces, etc., and stay in radio contact with the incident commander and other rescuers. In addition, firefighters can attract attention by maximizing the sound of their PASS device (e.g., by pointing it in an open direction), pointing their flashlight toward the ceiling or moving it around, and using a tool to make tapping noises on the floor or wall. A crew member who initiates a Mayday call for another person should quickly try to communicate with the missing member via radio and, if unsuccessful, initiate another Mayday providing relevant information on the missing firefighter's last known location. Emphasis on appropriate procedures for retreat/emergency evacuation under worsening fire conditions and/or pending building collapse is necessary. An operational retreat is designed to quickly remove firefighters from operations in an unsafe or potentially unsafe environment. Incident commanders need to initiate an operational retreat whenever the operational area is deemed unsafe for emergency personnel. All personnel operating in the unsafe area need to evacuate as the operational retreat procedures are initiated. Operational retreat needs to begin with radio traffic announcing "emergency traffic" with directions for all emergency personnel to evacuate the operational area. An emergency egress signal should sound [IAFF 2010, 2022; LAFD 2016]. For example, repeat short air horn blasts of approximately 10 seconds, followed by 10 seconds of silence. This sequence should be repeated three times.

Upon hearing an operational retreat signal, all firefighters should immediately withdraw from any operations they are performing and leave the operational area. All company officers should immediately perform a personnel accountability report (PAR), of all personnel they are responsible for and report the results to the incident commander.

If firefighters find themselves in a questionable position (dangerous or not), they must be able to recognize this and know the procedures for when and how a Mayday should be called. A firefighter's knowledge, skill, and ability to declare a Mayday must be at the mastery level of performance. This performance level should be maintained throughout their career through training offered more frequently then annually [IAFF 2010, 2022; Sendelbach 2003].

As part of emergency procedures training, firefighters need to understand that their PPE and SCBA do not provide unlimited protection. PPE that is not properly donned, worn, or activated may provide reduced protection or no protection at all.

Training should include situations dealing with uncontrolled SCBA emergencies, egress through small openings, emergency window egress, building collapse, and other situations that are possibly encountered during a Mayday situation.

Recommendation #7: Fire departments should provide a Mayday tactical worksheet for incident commanders in the event of a Mayday.

Discussion: When a Mayday is transmitted, incident commanders have a very narrow window of opportunity to locate the lost, trapped, or injured member(s). The incident commander will need to restructure the strategy and tactics to include a priority rescue [NFPA 2020a].

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

A Mayday tactical worksheet serves as a guide and a tailored checklist to any fire department's Mayday procedures such as a reminder to prompt the firefighter to activate his/her EAB [emergency alert button] for priority radio transmissions and other important items such as PASS activation, air status and location information.

A Mayday tactical worksheet can be easily located the back of a tactical worksheet to assist incident commanders in ensuring the necessary steps are taken to clear the Mayday as quickly and safely as possible. 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. *An example worksheet is provided in Appendix A, Incident Commander's Tactical Worksheet for Mayday [IAFF 2010, 2022].*

Recommendation #8: Fire departments should develop and implement SOPs/SOGs to define fireground strategies and tactics for commercial structures.

Discussion: Fireground SOPs define the initial strategy and tactics for the coordinated deployment of departmental resources for specific incidents and occupancies. SOPs are based on factors including department staffing; deployment capabilities; knowledge/familiarity and skill levels the firefighting assets in those assigned protection areas; apparatus, tools, and equipment; building information including height, area, construction class, and type of occupancy; and potential life hazards (some examples could be nursing homes and/or assisted living occupancies, restricted ingress/egress properties such as mental health and other facilities designed to provide high security that limit firefighter access and occupant egress).

The first arriving resource will assume command and control of the incident. This ensures initial responding units determine the strategy (offensive or defensive), develop operational objectives, and deploy tactics at incidents with or without a chief officer on the scene. The intent is to maximize efficiencies while minimizing confusion and duplication of effort. The incident commander develops strategy and tactics based upon scene size-up and the risk assessment, including the factors listed above. This is a process that should be completed in a short period of time for a dynamic and fluid situation. Most importantly, the strategy and tactics should include an observation and/or report from all sides of the structure. The goals of effective fireground procedures are to increase the safety of the members, eliminate confusion, and prevent the loss of life [NIOSH 2014a].

Construction types/classes of construction define how the building is constructed with either combustible or non-combustible materials. Fire departments must consider numerous factors that affect operations when developing these SOPs. This will ensure essential strategic, tactical- and task level functions are performed by the incident commander, division/group supervisors, company officers, and firefighters. Additionally, this process compliments the defined knowledge, skills, abilities, competencies, and fireground experience to assist:

• The incident commander to plan and implement an effective strategy and Incident Action Plan
• Division/group supervisors to formulate and follow tactics

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

• Company officers to successfully carry out assigned tasks
• Individual members to effectively perform their duties [FDNY 2009a; FDNY 2009b; FIRESCOPE 1994]

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

• Smoke and fire conditions, with an emphasis on identifying the seat of the fire. The initial radio report from the first arriving unit for a structural fire should include the signal for a working fire, the number of stories, type of occupancy, and location of fire. This lays the foundation for additional reports and serves as notification to responding units as to the type of tactics to implement.
• If there was critical building description information through the incident dispatch system for the address, then this information would aid in implementing or adjusting SOPs. Critical incident dispatch systems may contain information that would necessitate alternative action to fulfill operational goals, including:

- Building features (e.g., number of stories)
- Basement access and type
- Any other life or safety hazards.

Any change to operational priorities or responsibilities based on the above size-up should be clearly communicated to command, all responding units, and the dispatch center via the assigned tactical radio channel [Township of Spring Fire Rescue 2013; FDNY 2011]. Command is then obligated to re-broadcast and receive acknowledgement from all operating companies.

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

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

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Personnel should recognize small commercial fires (structures around 10,000 square feet) are different from residential fires. Personnel should focus on identifying modern fire behavior, utilizing commercial construction techniques, and knowing if their resources and equipment match the fire situation. The types of construction and building features will pose different challenges, and the internal spaces in commercial fires are much larger. Fire departments are generally knowledgeable about small compartment fires (i.e., house and apartment fires). Knowing how fire behaves in larger spaces, in void spaces, and in various attic or cockloft spaces is information firefighters need to have training on.

Understanding fire indicators from an initial size-up is essential in determining not only strategy and tactics but also risk-benefit decisions. Observing smoke "push" is faster in one location over another generally provides direction to the origin of the fire. Observing gray smoke becoming darker indicates more fuel being burned, more incomplete combustion, and a general deterioration of survivable conditions. Dark smoke turning lighter can indicate water is getting on the fire, fuel is becoming consumed, or the fire is going into decay or to an under ventilated stage and creating a very dangerous time to enter because of the potential for delayed flashover, explosive growth stage, or backdraft. Fire exiting a roof or under eaves indicates fire in attic area, and exterior smoke can indicate the fire origin as well as the stage of the fire. Smooth or laminar flowing smoke that becomes turbulent is a warning that ignition is imminent. Remember that commercial structure fires typically pose a low life hazard for civilians, yet a high loss hazard for firefighters [Fire Engineering 2018].

Building construction techniques are always evolving. SOPs/SOGs should include specific recuring training on issues related to building construction and commercial structures.

A common issue for small commercial occupancies is rapid fire spread, which causes early collapse. Typically, these structures have large open spaces and common attic or cockloft spaces that are generally open and undivided, allowing rapid lateral fire to spread above. These structures generally have high ceiling spaces with one or more false or drop ceilings that can hide smoke and fire on entry. They generally have higher fire loads than single-family dwellings, which means hotter and faster burning fires. The presence of overhangs or facades are common and dangerous in fire conditions. Couple these issues with potential access/egress issues, an irregular and unfamiliar layout, and aisles of stocked items or highly combustible contents, and it becomes evident why fighting fires in these types of buildings is dangerous [Fire Engineering 2018].

Recommendation #9: Fire departments should ensure all members engaged in emergency operations receive annual proficiency training and evaluation on fireground operations, including operations within commercial structures.

Discussion: To ensure the proficiency and competency of fire department members, fire departments should conduct annual skills evaluations to verify minimum professional qualifications. This annual evaluation should address the qualifications specific to the member's assignment and job description. Evaluation of skills should take place on a recurring cycle with the goal of preventing the degradation of skills and abilities and ensuring the safety of members. Proficiency evaluation and training provides

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

an opportunity to ensure that all fire officers and firefighters are competent in fireground operation knowledge, skills, and abilities. This process should include annual live fire training.

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 member competencies are maintained to execute all responsibilities effectively, efficiently, and safely [NFPA 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 fire department's organizational structure, and the job descriptions and functions of fire department members [NFPA 2021]. As members progress through various job duties and responsibilities, the department should ensure the necessary knowledge, skills, abilities, and the required ability to demonstrate competencies for the defined position. The training and education process also should provide the ongoing development of existing skills [NFPA 2021].

NFPA 1410, *Standard on Training for Initial Emergency Scene Operations,* defines basic evolutions, which are adaptable to local conditions and serve as a method for the evaluation of minimum acceptable job performance during initial fireground operations [NFPA 2020a]. Proficiency training for fireground operations and emergency incidents should occur annually. This training should include scene size-up, situational awareness, use of an incident management system, personnel accountability system, strategy and tactics, search and rescue, hoseline operations, ladder operations, ventilation, thermal imaging cameras, fireground communications, use of RITs, and Mayday operations.

Over the past few years, fire service members have emphasized the importance of adopting strategies and tactics specifically designed and proven to work effectively at commercial fires [Fire Engineering 2017]. An article from Firefighter Nation highlights important training considerations for commercial vs. residential fire attack and search and rescue issues in commercial structures:

> *Commercial vs. Residential*
>
> *There are three main reasons why we must approach commercial fires differently than residential fires.*
>
> *Building construction: The average house has many compartments and at least some fire protection for the ceiling support members in the form of the drywall ceiling. In contrast, most modern commercial structures include lightweight open bar joist trusses that span a large, open area designed for retail or office use. Because commercial buildings lack the compartmented features of a house, the fire has the potential to grow much larger, much faster.*
>
> *Consider this: In a 2,000-square-foot house with one or two involved rooms, the walls may limit fire spread to a few hundred square feet. In a 2,000-square-foot commercial building without such "compartments," a small fire is more likely to grow at a much faster rate. Hence, buildings of the same overall size may produce vastly different sized fires. Add to this the open*

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

nature of many commercial roof assemblies, which are often unprotected from direct flame contact, and you get buildings that will fail faster than residential structures.

Hidden fire: The second major difference between residential and commercial structures is that moderate or large commercial structures can conceal a large fire without showing the classic indications of a working fire. One example: A fire in a 1,000-square-foot house will probably fill the house with a smoke layer that's close to the floor. The same size fire in a 5,000-square-foot commercial structure may present with smoke only at the ceiling level. It's the same amount of smoke; it's simply dispersed over a larger area. We tend not to feel threatened by smoke that's 12 feet above us; however, the roof assembly is directly exposed, increasing the potential for collapse.

This example shows why we cannot treat a commercial building the same way we treat a house. Moderate smoke showing from a 3,000-square-foot house may lead us to take an offensive approach. The same presentation from a commercial structure probably indicates a much larger and more dangerous fire. If we use the same offensive approach, we're likely to get into serious trouble. Add to that the inherent difficulties in finding and attacking the fire in a large building, and you can see where the risk becomes compounded. It takes more personnel with longer, larger lines a greater amount of time to attack the fire. Plus, the bigger the fire and the longer it burns, the more likely it is to bring down the structure.

Access, egress & ventilation: The third significant difference between residential and commercial structures is the ease at which we can access, egress and ventilate the buildings. Doors in commercial buildings are grouped in a way that benefits the retailer in their effort to control the customer. They are typically located in a single area and are designed for easy egress only once you reach them. They are not evenly spaced around the structure. Have you ever been out the back door of a Wal-Mart? Although the exits are required to be large enough for the customer traffic, they were never intended to be spaced evenly enough for firefighting access or egress.

As for ventilation, even the most well-staffed fire departments will find it a challenge to cut holes large enough or fast enough to keep up with the volume of smoke produced by a significant working fire in a commercial structure [Firefighter Nation 2009].

Recommendation #10: Fire departments should ensure crew integrity is properly maintained by voice or radio contact when operating in an atmosphere that is IDLH.

When an engine company enters a structure, the members should stay in contact by visual (eye-to-eye), verbal (radio or face-to-face), or direct (touch) contact. NFPA 1500 Standard on Fire Department Occupational Safety and Health Program, 8.5.5, states, "Crew members operating in a hazardous area shall be in communication with each other through visual, audible, or physical means or safety guide rope, in order to coordinate their activities." Section 8.5.4 states, "Members operating in hazardous areas at emergency incidents shall operate in crews of two or more." Additionally, NFPA 1500 8.5.6 states, "Crew members shall be in proximity to each other to provide assistance in case of an emergency" [NFPA 2021].

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

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 rests 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. They should ensure members stay together as a company or crew. If any of these elements are not adhered to, crew integrity is lost, and firefighters are placed at great risk.

NFPA 1500, 8.4.4–8.4.6 states:

• The incident commander shall maintain an awareness of the location and function of all companies or crews at the scene of the incident.

• Officers assigned the responsibility for a specific tactical-level management component at an incident shall directly supervise and account for the companies and/or crews operating in their specific area of responsibility.

• Company officers shall maintain an ongoing awareness of the location and condition of all company members [NFPA 2018b].

If a firefighter becomes separated and cannot immediately get reconnected with his/her crew, the firefighter must attempt to communicate via 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, the Mayday should be declared immediately. As part of a Mayday declaration, the firefighter should next activate the radio's emergency alert button, followed by manually turning on the PASS alarm. Similarly, if the company officer or the firefighter's partner recognizes they have a separated member, they should immediately attempt to locate the member by using their radio or by voice. If contact is not established after three attempts or within 1 minute, a Mayday must be declared immediately [IAFC 2021].

Recommendation #11: Fire departments should ensure all firefighters are trained on proper use of radios, including discipline and use of the EAB on their portable radio.

Discussion: In addition to issuing a radio to every firefighter, training should be conducted to improve fireground communication**.** The fireground radio frequency can become congested, especially during the early stages when the incident is not yet under control. Radio discipline and proper use are important and radio transmissions should be limited to those of an important tactical nature (Conditions-Actions-Needs or a CAN report), personnel accountability report (PAR), and fireground emergencies (Mayday).

Training should also encompass circumstances when an incident commander opts to change radio frequencies. This is a potentially dangerous action and should only be undertaken in the most extreme circumstances given the possibility of "losing" personnel in the movement from one channel to

another. After switching frequencies, command should conduct a PAR to confirm that the appropriate units are operating on the correct channel. When channels are changed, dispatch should make a formal announcement.

Fire departments need to ensure firefighters, officers and dispatchers are trained on fireground communications and especially emergency communications such as Mayday and priority traffic. Dispatchers need to inquire if their systems are capable of "pinging" a down firefighter's radio or remotely enabling a fire fighters EAB. Different radio systems have different features, but firefighters, officers, and dispatchers need to train on and practice emergency fireground communications. NIOSH has recently released a Safety Advisory on the importance of understanding and training on the portable radio emergency alert button (EAB) during a Mayday [NIOSH 2023].

Recommendation #12: Fire departments should incorporate the principles of command safety into the incident management system during the initial assumption of command. This ensures strategic-level safety responsibilities are incorporated into the command functions throughout the incident.

Discussion: The purpose of command safety is to provide incident commanders with the necessary guidance on how to use, follow, and incorporate safety into the incident management system at all incidents. Command safety is incorporated into the eight functions of Command developed by Fire Chief Alan V. Brunacini. The principles of command safety describe how the incident commander should use the regular, everyday command functions to complete the strategic-level safety responsibilities during incident operations. Using the command functions creates an effective way to ensure a close connection between incident safety and incident management.

The eight functions of command are:

- Deployment
- Assume, confirm, and the positioning of command
- Situation evaluation
- Strategy/incident action planning
- Communications
- Organization
- Review, evaluate, revise
- Continue, support, and terminate command [Brunacini 2002; NFPA 2020]

A vital command function involves the IC accounting for the initial scene size-up, critical factors (building type, occupancy, life safety, fire conditions, and available resources), the standard risk management plan, the forecast of incident conditions, and a standardized decision-making process. The incident's overall strategy is based on the incident's critical factors weighed against the risk management plan. The choice of strategy (offensive or defensive) is independent of location (inside or outside) as it relates to the hazard area or hazard zone. The strategy may change over the course of an incident, but only one of the two strategies is used at any one time [Blue Card 2018]. Any strategy should include a simple understandable plan that describes how close the emergency responders will get to the incident's hazards.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

The initial radio report should:

- Announce to everybody the overall incident strategy
- Eliminate any question on where firefighters will operate on the incident scene and inside the structure [Blue Card 2018]

Once the overall incident strategy is 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. The IAP should be short and simple as a complicated IAP tends to break down during this critical time.

In general, the IC tries to achieve the same basic objectives at every incident. Tactical priorities offer a regular set of tools, which the incident commander can utilize for tactical activities to develop a standard approach to solving incident problems. With this standard approach, incident commanders can manage the basic work sequence at every incident in the same manner.

Dispatch centers should contact the IC every 10–15 minutes on the assigned fireground tactical channel with elapsed-time reminders. These 10–15-minute notification reminders serve as cues for the IC to re-evaluate conditions, restate the current strategy, and consider the length of time firefighters operate in the hazard zone. Incident commanders develop the strategy and the IAP based on the initial size-up of the incident's critical factors. These critical factors are very dynamic. Incident operations either get better or worse. They never stay the same. The incident conditions drive the strategy, IAP, and risk management plan [Blue Card 2018; NFPA 2021].

An integral part of the personnel accountability system is to ensure all assigned resources working in the hazard zone are initially accounted for. Throughout the incident, it is necessary to conduct a PAR periodically to ensure that all assigned resources are accounted for by the accountability officer or resource status officer.

The accountability officer also should request a PAR from each division or group supervisor whenever a change in conditions occurs that could cause unsafe operation, such as an "emergency traffic" announcement to "all companies evacuate the building." When a division or group supervisor is requested to conduct a PAR, the supervisor is responsible for reporting on the accountability of all companies or members working within their area of responsibility [NFPA 2020]. With a strategic mode change, a PAR should occur to ensure that all assigned resources are accounted for and are out of the hazard zone. Defensive operations should not start until the PAR is completed and all members are accounted for by resource status.

The eight functions of command serve as the foundation for addressing command safety issues. Incident commanders should follow each of these functions in order without skipping or missing any function. Automatically connecting and integrating safety with command becomes an 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 fulfills the responsibility as the

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

strategic-level incident manager and the overall incident safety manager [Brunacini and Brunacini 2004].

In this incident, the incident commanders experienced several command safety issues. The fire department reported that they are increasing training (including command training) as part of its recovery process. Issues were identified in the areas of fireground communications, establishment of a stationary command post, personnel accountability, use of a tactical worksheet that compliments personnel accountability and crew integrity, and a continuous scene size-up and risk assessment.

Recommendation #13: Fire departments should ensure all company operations follow the assignments given by the incident commander to ensure tactical priorities are met.

Discussion: The IAP is a methodical process that ensures life safety, incident stabilization, and property conservation. Assigning the tactics in the order of accomplishment will aid in the coordination of the fireground activities [USFA 2006]. 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. Companies should communicate their progress reports on the tactical objectives given them by Command to complete the tactical priorities. This keeps the operation focused on making sure everyone is out and okay, potentially eliminating an incident problem, and reducing property damage. Incident operations are conducted around the completion of the tactical priorities, and incident communications should mirror this. This will help keep communications short and effective. It also maximizes the available free airtime. Incident commanders should structure unit assignments around:

- Addressing the incident's critical factors
- Completing the tactical priorities
- Having tactical reserves

The incident commander should consider the following structure when assigning any unit into the hazard zone:

- Tasks
- The location of these tasks
- The objectives of these tasks [Blue Card 2018]

An assigned tactic provides a direction to a company, which serves as the basis for feedback to the incident commander as to whether the tactic is completed. If a company is unable to complete the assignment, the incident commander needs to know as soon as possible to adjust the IAP. The incident commander also needs to 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 2006].

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

When units arrive on the scene, they should announce that they are staged. Dispatch should not acknowledge any staged units over the tactical channel. Command should contact the staged units and assign them based on the IAP.

Orders to first-alarm-staged units should follow a Task-Location-Objective format:

- Tasks
- Location of the tasks
- Objectives of the tasks

Location of those tasks should include:

- What floor to operate on
- What occupancy/exposure to operate in
- What side to make entry on
- What side to operate on (defensive)

When assigning a unit to deploy a hoseline, the incident commander should designate the following:

- What the company needs to do with their apparatus
  - Lay a supply line
  - Pump a supply line
  - Park the apparatus out of the way (manpower only)
- Where the company will get the handline from
  - Their own company
  - Another forward pumper designated by Command

The task objectives should focus on the completion of the tactical priorities (objective = completion benchmark):

- Search/rescue = primary and secondary "all clear"
- Fire control = "under control"
- Loss control = "loss stopped" [Blue Card 2018]

When assigning companies to areas that already have units assigned, incident commanders should inform the newly assigned unit of whom it will report to/work under. The incident commander also should inform the division/group supervisor of the newly assigned company(s).

Recommendation #14: Fire Departments should ensure firefighters and officers are well trained in understanding fire development and growth during size up, and that incendiary fires can rapidly develop and grow beyond predictions.

Discussion: As part of a scene size-up, firefighters and officers need to predict fire growth and development based on a number of factors. This size-up allows the officer to perform a risk assessment

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

on the specific incident and begin to plan actions that will save lives and stop loss while minimizing the risk to the first responders. Those factors include:

- Fire location, size and intensity (where is it now and where is it going?)
- Life hazard (number and location of civilians, employees, remove the fire or remove the civilians?)
- Building type and occupancy (type, age and use and built-in protection systems)
- Fire department assets (on-scene resources and additional assets and response times)
- Current fire department actions/effectiveness
- If arson or incendiary conditions are suspected, a defensive approach should be considered due to unexpected fire growth considerations

This size-up should include an observation and/or report from all sides of the structure and risk assessment should continue throughout the incident to increase the safety of the members, eliminate confusion, and prevent the loss of life.

Recommendation #15: States and municipalities should consider adopting and enforcing regulations for automatic fire sprinkler protection when renovating structures, including self-closing doors.

Fire development beyond the incipient stage is one of the greatest hazards that firefighters face in today's combustible environment. Fire development can be dramatically reduced when fires are controlled or extinguished by automatic sprinkler systems. NFPA statistics show that most fires in sprinklered buildings are controlled prior to fire department arrival by the activation of one or two sprinkler heads. The presence of automatic fire sprinklers also reduces the exposure risk to firefighters in rescue situations by allowing the safe egress of building occupants before the fire department arrives on-scene. Finally, the exposure to hazards such as building collapse and overhaul operations are greatly reduced, if not eliminated, when fire development is arrested and controlled.

The State of California requires the installation of automatic fire sprinkler systems in all newly built commercial buildings with a fire area that exceeds 5,000 square feet**,** after any remodeling or renovation that extends the fire area beyond 5,000 square feet, or any single tenant expansion requiring a new certificate of occupancy that increases the fire area beyond 12,000 square feet [Mee Design Services 2020]. The building code requiring sprinkler systems (when built or renovated) did not apply to this structure.

Recommendation #16: Fire departments should ensure a respiratory protection plan includes consideration for using larger-volume SCBA cylinders in areas that may require longer-duration work times (e.g., commercial structures, large area residential structures etc.).

Discussion: A typical 30-minute (1200L) SCBA may not provide an effective quantity of breathing air for firefighters working in high-rise buildings, commercial structures, large area residential structures, or large, complex structures.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

The 1200L cylinder in an SCBA will last an average firefighter, actively engaged in suppression activities, **about 15–18 minutes**. SCBA ratings are based on a 40 liter per minute breathing rate, however working firefighters (dragging hose lines down hallways, hooking ceilings, dragging heavy objects, rescuing civilians, etc.) can regularly breath at rates approaching 100 liters per minute. Therefore, considerations need to be given to increase the liter volume of SCBAs to achieve a desired work period of air plus the firefighter's emergency reserve air (EOSTI). Modern editions of SCBA are available in higher pressures that increase the available liter volume but are also smaller in overall size and weight.

NFPA 1852 *Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus for Emergency Services* A.5.1.5(18) states, **during extreme exertion, for example, actual service time can be reduced by 50% or more.** In addition to the degree of user exertion, other conditions that effect the SCBA service time include:

- Physical condition of the firefighter
- Emotions of the firefighter, such as fear or excitement that can increase the user's breathing rate
- Degree of training or experience the firefighter has had with such equipment
- Whether or not the cylinder is fully charged at the beginning of use
- Facepiece fit
- Use in a pressurized tunnel or caisson [at two atmospheres of pressure (29.4 psig), the duration is one-half the duration obtained at one atmosphere]
- Condition of the SCBA
- SCBA dead space [A volume proportional to the carbon dioxide (CO_2) concentration in the inhaled breathing gas. An increase of CO_2 in the inhalation air leads to increased ventilation and, consequently, shorter service time for a given air supply. Reducing CO_2 in the inhalation air by using, for example, a well-fitting nose cup, has been demonstrated to give longer service time].

Fire departments should ensure that firefighters have enough air in their SCBA's to complete the mission in their areas. The firefighters should have enough air, by volume, to effectively provide a work period inside an IDLH atmosphere and still contain enough air volume to exit the IDLH with their reserve air intact. This can be accomplished by assessing structures to identify areas in a jurisdiction that demand additional breathing air due to the type of occupancy or hazard, and companies assigned to those areas can be equipped with the larger cylinders. A modern SCBA cylinder is made of significantly lighter materials and contains higher pressure, greater volume, and a smaller profile.

SCBA manufacturers are now offering these SCBA cylinders, and some manufacturers are offering higher pressure (5500 psi) SCBA, which reduce the weight and increase the volume over existing SCBA. Currently, many fire departments perform a needs assessment for hazards, such as tunnel rescues, and provide those specialty companies with closed circuit SCBA (re-breathers) to increase the amount of time firefighters have to complete an assignment.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

The most important part of the needs assessment is to identify the areas of the jurisdiction that need the increased air volumes and then provide the equipment and training to those companies that respond or could be called upon to respond to incidents in those areas.

NFPA 1852 Standard on Selection, Care and Maintenance of Open-Circuit Self-Contained Breathing Apparatus for Emergency Services, provides fire departments with basic criteria for evaluation and selecting open-circuit SCBA [NFPA 2018c].

Additionally, the latest editions of NFPA 1981 have a higher EOSTI setting that will alarm at approximately 35% remaining volume vs 25% +/-2% in editions prior to 2013. In this incident the department was using 1200-liter (30 minute rated) cylinders but has since upgraded to 1800-liter cylinders [NFPA 2018d].

Recommendation #17: Fire departments should develop and implement a SOP/SOG on the deployment and use of RITs, including the use of a RIT bag and air supply for trapped or downed firefighter(s).

Discussion: Although there is no evidence that the following recommendation would have prevented this fatality, it is being provided as a reminder of best safety practice for the fire service. To ensure compliance with 29 CFR 1910.134 *Respiratory Protection* [OSHA 1998], fire departments must maintain a RIT or company when members are operating in an IDLH or potentially IDLH atmosphere [NFPA 2021]. In some organizations, they can be known as a RIT or a firefighter assist and search team (FAST).

The RIT function should be incorporated into the department's incident management and personnel accountability systems [NFPA 2020b]. The needs of critical fireground operations and staffing should be continuously evaluated in regard to firefighter safety. Resource assignments should be made with the goal of having the RIT function in place at all times. When the incident commanders need additional resources, the consideration of deploying the RIT for an operational assignment without additional resources on scene to function as the RIT should be carefully assessed [NFPA 2020b].

The following restrictions regarding the use of RIT should be considered by incident commanders during fireground operations:

• The RIT is dedicated to assist and, if necessary, rescue members who become lost, trapped, distressed, or involved in other serious life-threatening situations

• The RIT should not be used to provide relief for operating companies until the fire/incident has been declared "under control" by Command

• If assigned by a superior officer to other than RIT duties, the RIT unit officer should remind such officer of RIT designation [Toledo Fire & Rescue Department 2012; TSFRS 2014]

If the incident commander orders the RIT to work, the incident commander should immediately assign another on scene company to stand by as the RIT. At a minimum, the incident commander should

request an additional alarm and designate a company or companies to function as RIT. The remainder of the companies should report to staging. If no units are available, the incident commander should assign at least two members to act as a RIT while awaiting a special-called RIT to arrive. An engine company may be designated as the RIT pending arrival of an additional ladder company or rescue company. This ensures compliance with OSHA's "2 In/2 Out" rule under 29 CFR 1910.134, *Respiratory Protection* [OSHA 1998].

Many fire departments have a defined response plan for the dispatch of an additional company (engine, truck, squad, rescue, and/or command officer) to respond to an incident and stand by as the RIT. Based upon the complexity, magnitude, configuration of the structure, or geographical layout of the incident, the incident commander may deploy additional RIT by sector/division. Upon arrival or upon appointment, the RIT officer should confer with the incident commander. The RIT officer should establish an area to stage the RIT and the necessary RIT equipment.

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

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

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

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

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

To ensure firefighters and fire officers are properly trained to conduct RIT operations, they should meet the requirements of NFPA 1407, *Standard for Training Fire Service Rapid Intervention Crews* [NFPA 2020a].

RIT should consider the following tools and equipment for use:

- Thermal imagers
- Additional RIT Kits/Escape Canisters or a RIT SCBA Kit that consists of:
    - Nylon bag with sling and carrying handles, 60-minute air bottle, first stage pressure reducer with 20-feet of intermediate pressure hose, facepiece, second stage regulator, 150-feet of drop bag line, flashlight, and escape canister.
- Quartz lights to entrances and windows identified as possible exits
- Apparatus rechargeable lights to entrances and exits of the structure
- Lightweight forcible entry tools (axe, pike pole, hook, Halligan Bar)
- Rotary saws
- Chalk
- Inside ladder (12-foot or 14-foot)
- Lighted rescue lines
- A 2½-inch hoseline with straight tips to penetrate and knockdown the fire
- Mattress carrier
- Strobe lights
- Cyalume© light sticks
- Extra SCBA cylinders
- Litter basket or stokes (can be used to carry up equipment to the access point)
- Fans for ventilation when positive pressure ventilation is indicated and there is sufficient time available to reduce noise
- Tool staging tarp
- Rescue SCBA (RIT pack)
- 150-foot rope for search and rescue
- Wire cutters
- Rebar cutter
- Life belt.
- Elevator keys for buildings with elevators [FDNY 2011; LAFD 2016; TSFRS 2012]

Note: *This list of considerations is not comprehensive. It is intended to be a starting point. Fire departments should constantly strive to upgrade rapid intervention team equipment and tactics. Company officers should ensure that the rapid intervention team equipment is in a state of readiness and is appropriate for the potential rescue situation.*

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Rapid intervention operations can only be successful when skills are practiced, and swift intervention tactics are employed. Sound fireground tactics can help prevent the need to deploy rapid intervention operations. Based on these considerations, the importance of company accountability, communications, risk versus gain evaluations, and firefighter safety cannot be overstated.

As part of the recovery process, the fire department involved in this incident is evaluating their annual proficiency training and RIT training requirements for all members.

Recommendation #18: Fire departments should consider appointing shift safety officers.

Discussion: Although there is no evidence that the following recommendation would have prevented this fatality, it is being provided as a reminder of best safety practice for the fire service. NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety*, states in paragraph 5.3.1 that "The Incident Commander shall have overall authority for management of the incident." NFPA 1561 paragraph 5.3.2 states, "The incident commander shall ensure that adequate safety measures are in place" [NFPA 2020b]. With the advent of the Incident Command System (ICS), the goal is to ensure that the incident commander is responsible for the safety and welfare of all members and other first responders that are on scene at an incident.

Based upon the size and complexity of an incident, the incident commander should delegate some responsibilities that include safety. The ICS can expand to include functions necessary to effectively command and control an incident. Though the incident commander still is responsible for the safety and welfare of all members and first responders on the scene, some responsibilities can be delegated to the safety officer. A predesignated safety officer responds automatically to incidents defined by the fire department. Upon arrival at the incident, the safety officer should meet with the incident commander to confirm the safety officer assignment and become integrated into the personnel accountability system.

Upon confirmation, the safety officer should obtain the following information:

- Overall situation status, resource status, the strategy, and IAP
- Known hazards and concerns, plus the establishment of control zones
- Status of RITs
- Establishment of the rehabilitation group
- Confirmation of established radio communication channels (command channel, tactical channels) [NFPA 2020b]

Once the information above is obtained, the safety officer should don PPE appropriate for the potential hazards that the safety officer could face. The safety officer also should wear a vest or helmet for quick identification purposes. The safety officer should perform a reconnaissance of the incident and begin initiating functions of this position. If the safety officer must enter the hazard zone, they must go with another firefighter or fire officer. Based upon the size and complexity of the incident, the safety officer may request the appointment of assistant safety officers.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Types of incidents that might require expansion of the safety officer role include the following:

• Incidents covering a large geographical area (e.g., high-rise structure) that include numerous branches, divisions, or groups
• Incidents where significant acute or chronic responder health concerns require coordination and input to the planning section (responsible for accounting for the organizational structure availability of resources, deployment of resources, and the situation status reports)
• Incidents requiring interface with local, state, federal, or other health and safety representatives
• Multi-agency incidents where Unified Command is established
• Incidents where Area Command is established

Assistant safety officers assigned to branches, divisions, or groups are addressed according to their area of responsibility. For example, an assistant safety officer assigned to Division Alpha is addressed as Division Alpha assistant safety officer. The assistant safety officers assigned to branches, divisions, or groups report to and follow direction from the safety officer of the Command staff. The assistant safety officer works with the supervisory person in the assigned branch, division, or group to assure that safety conditions are met [FIRESCOPE 2015; NIMSC 2008; NFPA 2020b; NIOSH 2012b].

NFPA 1561 defines the role of the safety officer at an incident scene and identifies duties such as reconnaissance of the fireground and reporting pertinent information back to the incident commander; ensuring the department's accountability system is in place and operational; monitoring radio transmissions and identifying barriers to effective communications; and ensuring that established safety zones, collapse zones, hot zones, and other designated hazard areas are communicated to all members on scene [NFPA 2020b].

Larger fire departments should consider having one or more full-time dedicated safety officers who are on duty and can routinely respond to working fires (e.g., full-time shift safety officers). In smaller departments, every officer should have the ability to function as the safety officer when assigned by the incident commander. The presence of a safety officer does not diminish the responsibility of individual firefighters and fire officers for their own safety and the safety of others.

The safety officer serves as a key figure on fireground operations (not tactics) by gathering a broad overall perspective of the fireground and acting as extra eyes and ears for incident commanders. Since incident commanders are tasked with strategic objectives and may not have time to give full attention to every safety detail, the safety officer can assist the incident commander. A safety officer should have training beyond that of a company level officer, with increased focus on safety issues such as:

• Fire department incident safety officer training
• Fire department health and safety officer training (acute and chronic threats to firefighter health)
• Fire ground risk assessment
• Risk management
• Accountability
• Fire ground hazards and hazard recognition, evaluation, mitigation, and elimination
• Building construction and collapse

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

- Fire behavior
- Fire ground tactics and strategy
- PPE use, capabilities, and limitations
- Firefighter rehabilitation [NFPA 2020b]

Fire departments should establish a training and education program for safety officers. This ensures that officers who are appointed on scene as the safety officer have the necessary knowledge, skills, and abilities to effectively function in this position. For large scale incidents, such as this incident, departments should consider appointing assistant safety officer(s).

Recommendation #19: Fire departments should ensure a communication SOP/SOG is in place for dispatchers to support fireground operations and the incident commander.

Discussion: Although there is no evidence that the following recommendation would have prevented this fatality, it is being provided as a reminder of best safety practice for the fire service. Effective fireground radio communication is an important tool to ensure fireground command and control and help enhance firefighter safety and health. The radio system must be dependable, consistent, and functional to ensure that effective communications are maintained, especially during emergency incidents. Fire departments should have a "Communications" SOP that outlines the communication procedures for fireground operations. This SOP should be periodically reviewed and updated. Fire departments should ensure that the communication or dispatch center is part of this revision process. Another important aspect of this process is an effective education and training program for all members of the department and the dispatchers [Kunadharaju, Smith, and DeJoy 2010].

NFPA 1561, *Standard on Emergency Services Incident Management System and Command Safety* provides basic requirements for fireground communications in Chapter 6, "Communications and Information Management." The chapter addresses the key components for effective fireground communications, such as the requirements for a dispatch radio channel, a command radio channel, and a tactical radio channel; use of plain text for transmitting strategic modes of operation and situational reports; emergency traffic including a Mayday; and dispatcher support [NFPA 2020b].

One of the contributing factors in multiple line-of-duty death investigation reports is incident commanders becoming overwhelmed with fireground radio communications. This is especially true if the incident commander has to monitor the dispatch channel and the fireground tactical channel. Fire departments should ensure that the fireground radio communication system is designed and operated to take this issue into account. An incident commander may miss messages because they are engaged in face-to-face communications, operating the command board and tactical worksheet, reviewing, or preparing incident documentation. They may be unable to hear messages due to ambient noise conditions, their radio being turned down, radio failure, simultaneous transmissions on separate channels, or simply being distracted with other tasks [NFPA 2020b; Varone 2003].

There are several ways to ensure that incident commanders can effectively manage fireground communications. The best solution is to have a trained dispatcher monitoring the fireground radio channel. Dispatchers should meet the requirements of NFPA 1061, *Professional Qualifications for*

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Public Safety Telecommunications Personnel [NFPA 2018b]. The dispatcher is in a secure environment, isolated from fireground distractions and noise. The dispatcher should have access to playback technology with the ability to listen to hard-to-understand messages. The dispatcher should also have access to "identifier" information, which identifies the portable radio making the transmission. Like any other aspect of the fire service, all personnel need to be properly trained before being assigned to a critical task. In the world of fireground operations today, effective radio communications are essential, and the dispatcher is one of the most critical components in the radio communications system. Dispatchers need a thorough understanding of the incident management system, fireground strategy and tactics, and firefighting terminology. Most important, the dispatcher's responsibilities during emergency operations should include fireground benchmarks, notifying the incident commander of elapsed time intervals for a PAR, emergency traffic, Maydays, roll calls, and building evacuations. Dispatchers should understand the critical role they play in the incident management system [NFPA 2020b; Varone 2003].

Another important function for the dispatcher is to communicate with the incident commander about critical incident benchmarks. A dispatcher should ensure that a PAR is conducted every 10–15 minutes during the incident. The dispatcher should prompt the incident commander every 10–15 minutes to conduct a PAR. Other critical benchmarks that should be communicated during the incident include a complete scene size-up with a declared strategy, water is on the fire, a primary search is completed with outcome, command is being transferred, a Mayday has occurred, and a request has been made for additional tactical channels and emergency traffic, fire is knocked down, and fire is out. This is not an all-inclusive list, but an idea of critical fireground benchmarks [NFPA 2020b]. The job of dispatching should not be assigned to a new firefighter or to a police dispatcher who does not have adequate training in fireground radio communications. Effective communication involves a thorough understanding of the message. The sender (dispatcher) transmits a clear message, and the receiver (incident commander) must acknowledge the transmission, so the sender (dispatcher) knows that the transmission was understood. This process would work the same way if the incident commander transmitted a message to the dispatcher (See Diagram 7).

Diagram 7. Communications loop between the dispatcher and the incident commander [NFPA 2020b].

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Dispatching is not a job that should be assigned to a sole individual who may be called away from monitoring the fireground radio to field telephone calls or dispatch runs. Dispatchers who monitor a fireground radio channel must be able to dedicate 100% of their concentration into listening for missed messages and providing support to resources on scene. Ideally, one dispatcher should be assigned to each fireground channel in use [Varone 2003]. Many fire departments assign a tactical radio operator or dispatcher to the assigned fireground tactical channel. This dispatcher is assigned the incident until command clears the tactical channel.

Another solution is to provide the incident commander with a staff assistant or incident command technician. A battalion chief or district chief can monitor and comprehend radio traffic when in route to the incident and then while on scene. Additionally, an incident commander should address deployment issues, develop a strategy for the incident based upon communications from the first arriving resource, and develop an IAP for the incident. An incident command technician or staff aide can assist the incident commander with processing information without distraction. Once on scene, the staff assistant or staff aide can maintain fireground communications with the dispatcher. For fire departments that do not have a staff assistant or staff aide, another officer or firefighter can be designated to function in this position [NFPA 2020b]. Every firefighter and company officer should take responsibility to ensure their portable radio is turned on and is on the correct channel. It is a company officer's responsibility to ensure that all members of the crew comply with radio discipline and fire department SOPs [IAFF 2010, 2022].

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

References

Bachrach and Egstrom [1987]. Stress and performance in diving. San Pedro, CA: Best Publishing.

Blue Card [2018]. Blue card command SOPS. Phoenix, AZ: BShifter.

Brunacini AV [2002]. Fire command. Quincy, MA: National Fire Protection Association.

Brunacini AV, Brunacini N [2004]. Command safety. Phoenix, AZ: Across the Street Publications.

Clark B.A. [2005]. 500 Maydays called in rookie school. Firehouse, October 19.

Clark BA [2008]. Leadership on the line: firefighter Mayday doctrine—where are we now? . Firehouse.

FDNY [2009a]. Firefighting procedures. Vol. 1. Book 2: Brownstone and rowframe building fires. New York, NY; Fire Department of New York.

FDNY [2009b]. Firefighting procedures. Vol. 1. Book 4: Taxpayer fires June 2009. New York, NY: Fire Department of New York.

FDNY [2011]. Communications manual. Chapter 4, Critical information dispatch system **(**CIDS). New York, NY: Fire Department of New York.

Firehouse [2017]. Primary Search Techniques and Strategies. August 1, 2017.

Fire Engineering [2007]. Large-Area Search: Lessons Found in a “Big Box”.

Fire Engineering [2014]. Tagline/Searchline Essentials. October 17, 2014.

Fire Engineering [2017]. Humpday Hangout: Training for Fires in Commercial Occupancies. October 4, 2017.

Fire Engineering [2018]. Size-Up and Risk Benefit for Small Commercial Structures. November 19, 2018.

Firefighter Nation [2009]. Commercial vs. Residential Fire Attack. February 1, 2009.

FIRESCOPE [1994]. Incident command system for fire department structure fire operations. Riverside, CA: FIRESCOPE, ICS-SF.

FIRESCOPE [2015]. Incident Command System Publication, Structure Fire Operations. Riverside, CA: FIRESCOPE, ICS 500.

Gagliano M, Phillips C, Jose P, Bernocco S [2008]. Air management for the fire service. Tulsa, OK: Penn Well Corporation, Fire Engineering.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Grossman D, Christensen L [2008]. On combat: the psychology and physiology of deadly conflict in war and peace. 3rd ed. Millstadt, IL: Warrior Science Publications.

Gasaway R, [2013]. Situational Awareness for Emergency Response. Tulsa, OK: PennWell Corporation.

Gasaway R, [2017]. Flawed Situational Awareness: The Stealth Killer of First Responders. Fire Engineering, May 25, 2017.

Gasaway R, [2019]. How Smart Workers Use Situational Awareness to Improve Safety. St. Paul, MN: Gasaway Consulting Group LLC.

Gasaway R, [2022]. Situational Awareness Matters. Home Page - First Responder - Situational Awareness Matters!™ (samatters.com).

IAFF [2010]. IAFF Fireground Survival Program. Washington, DC: International Association of Fire Fighters.

IAFF [2022]. IAFF Fireground Survival Awareness on-line Program. Washington, DC: International Association of Fire Fighters.

IAFC [2021]. Rules of engagement for structural firefighting, increasing firefighter survival. Fairfax, VA: International Association of Fire Chiefs, Safety, Health, and Survival Section.

IFSTA [2013]. Essentials of Fire Fighting and Fire Department Operations. 6th ed. Stillwater, OK: International Fire Service Training Association.

IFSTA [2019]. Essentials of Fire Fighting. 7th ed. Stillwater, OK: International Fire Service Training Association.

ISFSI [2013]. International Society of Fire Service Instructors position statement--fire dynamic research in tactical operations. Press release, October 30.

Jakubowski G, Morton M [2001]. Rapid intervention teams. 1st ed. Stillwater, OK: Fire Protection Publications.

Kunadharaju K, Smith T., DeJoy D. Line-of-duty deaths among U.S. firefighters: An analysis of fatality investigations. Accident Analysis & Prevention, 2011; 43 (3): 1171 DOI: 10.1016/j.aap.2010.12.030.

LAFD [2016]. Los Angeles Fire Department, Book 101 - Rapid Intervention Company. Los Angeles, CA: Los Angeles Fire Department.

Morris [2011]. Rules of Engagement for Firefighter Survival: Determine the Occupant Survival Profile. International Association of Fire Chiefs; April 1.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Marsar [2010]. Survivability Profiling: How Long Can Victims Survive in a Fire? Fire Engineering.

NFPA [2013]. Fire service deployment: assessing community vulnerability. 2nd ed. High-rise implementation guide. Quincy, MA: National Fire Protection Association.

NFPA [2018a]. NFPA 1404 Standard for fire service respiratory protection training. Quincy, MA: National Fire Protection Association.

NFPA [2018b]. NFPA 1061 Professional qualifications for public safety telecommunications personnel. Quincy, MA: National Fire Protection Association.

NFPA [2018c]. NFPA 1852, Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA). Quincy, MA: National Fire Protection Association.

NFPA [2018d]. NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services. Quincy, MA: National Fire Protection Association.

NFPA [2019]. NFPA 1001, Standard for fire fighter professional qualifications. Quincy, MA: National Fire Protection Association.

NFPA [2020a]. NFPA 1407 Standard for training fire service rapid intervention crews. Quincy, MA: National Fire Protection Association.

NFPA [2020b]. NFPA 1561, Standard on emergency services incident management system and command safety. Quincy, MA: National Fire Protection Association.

NFPA [2021]. NFPA 1500 Standard on fire department occupational safety and health program. Quincy, MA: National Fire Protection Association.

NIOSH [2010]. Career Fire Fighter Dies While Conducting a Search in a Residential House Fire—Kansas. By Bowyer M, Miles S.T. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2010-13.

NIOSH [2014a]. Career Female Fire Fighter Dies After Becoming Lost and Running Out of Air in a Residential Structure Fire--Pennsylvania. By Bowyer M, Miles S.T. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2014-25.

NIOSH [2014b]. Lieutenant and Fire Fighter Die and 13 Fire Fighters injured in a Wind-Driven Fire in a Brownstone—Massachusetts. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2014-09.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

NIOSH [2023]. The Importance of Understanding and Training on the Portable Radio Emergency Alert Button (EAB) during a Mayday. 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 No. 2023-100, https://doi.org/10.26616/NIOSHPUB2023100.

Mee Design Services [2020]. Fire Sprinkler Requirements in California. March 2020. Mee Design Services, Los Angeles, CA 90017.

OSHA [1998]. 29 CFR Parts 1910 and 1926 Respiratory Protection; Final Rule. Federal Register Notice 1218-AA05. Vol. 63, No. 5. January 8, 1998. U.S. Department of Labor, Occupational Safety and Health Administration. Washington DC.

Rubin, DL [1996]. Duties and responsibilities of the incident commander. Firehouse, October, 1996.

Sendelbach TE [2003]. Managing the fireground Mayday: the critical link to firefighter survival. Firehouse, May.

TSFRS [2012]. Initial fireground assessment standard operating procedure, section 3. Response to alarms, subsection 3.00.01. Township of Spring, PA: Township of Spring Fire & Rescue.

USFA [2003]. Special Report: Rapid intervention teams and how to avoid needing them. USFA-TR-123/March 2003. Emmitsburg, MD: U.S. Department of Homeland Security, U.S. Fire Administration, National Fire Academy.

USFA [2006]. Mayday CD Q133 Firefighter safety: calling the Mayday and H134 Calling the Mayday: hands on training. Emmitsburg, MD: U.S. Department of Homeland Security, U.S. Fire Administration, National Fire Academy.

Varone C [2003]. Fire fighter safety and radio communication. Fire Engineering, March.

Investigator Information

This incident was investigated by Stephen T. Miles, Investigator/Safety and Occupational Health Specialist, Matt E. Bowyer, Investigator/General Engineer, and Jeff Funke, Investigator/Safety and Occupational Health Specialist (team lead) with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, West Virginia.

Additional assistance with recommendations was provided by Michael Richardson, Investigator/Safety and Occupational Health Specialist also with the Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH located in Morgantown, West Virginia, and Robert Saunders, Technical Information Specialist with the Fire Fighter Fatality Investigation and Prevention Program, Hazard Evaluations and Technical Assistance Branch, Division of Field Studies and Engineering, NIOSH located in Cincinnati, Ohio.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

An expert technical review was provided by Jeff Cook, Assistant Chief, Tomball Fire Department. A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division.

Disclaimer

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. 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.

Career Captain and Career Firefighter Die After Running Out of Air During a Search in a Public Library – California

Appendix A

Example of an Incident Commander's Tactical Worksheet for Mayday, courtesy of the IAFF Fireground Survival Program [IAFF 2010, 2022].

APPENDIX A
FIRE FIGHTER MAYDAY CHECKLIST

❑ Look at screen & document Radio Identifier _____

❑ Transmit: "All units assigned to the _____ incident, clear this channel for a MAYDAY. Unit calling MAYDAY, identify."

❑ Receive & Document:

WHO: Name _____

Unit _____

WHAT: Lost Trapped Injured Out of Air SCBA Malfunction

Other _____

WHERE: Floor _____ , Side _____

Area _____ , Division _____

❑ Transmit: "Fire Fighter _____, I copy your MAYDAY (Repeat WHO, WHAT, WHERE information). RIC is being deployed. Initiate your G-R-A-B-L-I-V-E-S procedures."

❑ Deploy RIC/RIG

❑ Transmit: (On Command and Tactical Channels): "All units on the _____ Incident, we have a fire fighter MAYDAY. Maintain your current assignments and keep this channel clear."

❑ Transmit: "Fire Fighter_____, remain calm, control your breathing, turn on your PASS alarm and shine your flashlight. RIC is coming to get you."

❑ Transmit requests to Dispatch:

- ❍ "Requesting _____ additional alarm(s), including _____ ambulances."
- ❍ "Requesting _____ Communication plan" OR "Requesting additional tactical channel(s)."

❑ Assign additional companies to RIC and RIC Group Supervisor (RICGS)

❑ Conduct a Roll-Call (PAR) prior to clearing the MAYDAY

IAFF Fire Ground Survival Manual | 105