



Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Executive Summary

On August 5, 2014, a 40-year-old male volunteer assistant fire chief died after being trapped under a roof collapse while fighting a fire in a commercial storage building. The county dispatch center transmitted Box 9101 for county Fire Station 91 at 2059 hours to a septic tank cleaning business for a confirmed commercial structure fire. The fire chief of Fire Station 91 (Chief 9101) communicated to the county dispatch center that the response was incorrect. A fire station from another county was first-due at this address. *Note: The boundary for both fire stations runs through the center of this property.* Chief 9101 also relayed to the county dispatch center that Fire Station 91 would continue their response. Chief 9101 was the first unit on the scene at 2105 hours in a vehicle designated as Battalion 9 and assumed command. The fire was in a pole barn-style building with metal siding and a roof with wood-truss supports and a pan ceiling (a metal ceiling that blocks the truss, creating a cockloft). Heavy fire was showing through the roof on Side Bravo and Side Charlie of the structure when the first-due company arrived. After a brief conversation with the assistant fire chief (victim), the incident commander decided to open the doors on the north end (Side A) of the building to set an unmanned ground monitor to keep the contents of the building cool. Access was made through both a doorway and overhead door on the north side. Smoke conditions were light with good visibility. The assistant fire chief was assigned to the north side of the building.



The storage building after the collapse, which killed an assistant fire chief and injured a fire fighter. View from Side A.

(Cover photo courtesy of Town Police Department.)

A defensive fire attack was initiated. The assistant fire chief was one of three fire fighters who had entered Side A of the structure to stretch a 2½-inch hoseline to protect equipment and acetylene cylinders. The crew was operating approximately 50 feet inside the structure and then decided to change the 2½-inch nozzle to a portable ground monitor (deck gun). During the changeover, one fire fighter left the interior to go outside and charge the hoseline. The fire was already in the overhead truss

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

system above the assistant fire chief and the fire fighter, and the fire was likely concealed by the ceiling. As the third fire fighter got to the overhead door, a loud crash occurred. The truss system failed and the ceiling and roof assembly collapsed on the assistant fire chief and fire fighter. The assistant fire chief was killed by the collapsing truss system. The fire fighter, who suffered a broken leg, was able to crawl under some equipment before being rescued by a rapid intervention crew from Squad 18.

Contributing Factors

- *Incident management*
- *Incident action plan and risk assessment*
- *Offensive action in a defensive fire (hidden fire above pan ceiling)*
- *Communications/Mutual aid*
- *Collapse/exclusion zones and situational awareness*
- *Lack of a safety officer*

Key Recommendations

- *Fire departments should ensure that a single, effective incident management system is established with a single, designated incident commander, especially when multiple fire departments respond together.*
- *Fire departments should ensure that an incident action plan is developed and a risk assessment is performed throughout the incident and the tactics match the conditions encountered.*
- *Fire departments should ensure offensive actions are not performed in a defensive strategy and enforce clear procedures for strategic mode changes.*
- *Fire departments should work together to develop mutual aid SOPs for fireground operations that include incident management, communications, and operations and train on those procedures.*
- *Incident commanders should ensure that collapse zones and exclusion zones are established, marked, and enforced on defensive fires and incidents where dangerous or hazardous conditions exist and that a RIC is assigned even on defensive fires.*
- *Fire departments should ensure that a safety officer is appointed at working structural fires.*

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

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



Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Introduction

On August 5, 2014, a 40-year-old male volunteer assistant fire chief died after being struck by a roof collapse while fighting a fire in a commercial storage building. On August 6, 2014, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research, Fire Fighter Fatality Investigation and Prevention Program of the incident. On August 11–17, 2014, two NIOSH investigators traveled to Indiana to conduct an investigation. The NIOSH investigators met with the fire chief, officers, fire fighters, and staff of the fire department involved plus members from the mutual aid departments that responded to this incident. The investigators reviewed fire department standard operating procedures, training records from the department, and audio radio transmissions from the county dispatch center. During the investigation, witness statements were reviewed. The NIOSH investigators also met with the state fire marshal, the Federal Bureau of Alcohol, Tobacco, Firearms, and Explosives, and the city’s police chief. NIOSH investigators inspected both the the assistant fire chief’s and injured fire fighter’s (E91B) personal protective clothing (turnout gear). The assistant fire chief’s SCBA was inspected at the local police evidence room and transported to the NIOSH National Personal Protective Technology Laboratory for examination. A link to the NIOSH SCBA examination report is attached in Appendix 1.

Fire Department

The fire department involved in this incident is a volunteer department consisting of 28 members that provide fire suppression and protection. One fire station is located downtown that serves a population of approximately 1,861 in a geographic area of approximately 2.09 square miles. The department also provides mutual aid fire protection to two other townships in the county. This fire station houses two engines, one tanker, one aerial ladder truck, and several small apparatus.

Training and Experience

The assistant chief in this incident had more than 20 years of experience as a volunteer fire fighter with this department. He had completed the department’s required training including the following:

- Fire Fighter 1
- Fire Fighter 2
- Fire Instructor 1
- Fire Officer 1
- First Responder
- Emergency Medical Technician
- Fire Medic 2
- Hazardous Materials Operations

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- Emergency Vehicle Operator
- Sudden infant death syndrome training
- In-service course of education and training in interacting with individuals with autism

The state of Indiana has the following minimum training requirements for volunteer fire fighters:

- NFPA 1001, Fire Fighter 1
- NFPA 1001, Fire Fighter 2
- In-service course of education and training on sudden infant death syndrome
- Vehicle emergency response driving safety
- In-service course of education and training in interacting with individuals with autism

Equipment and Personnel

Units that initially responded to the structure fire:

- Battalion 9 (driven by the Station 91 Fire Chief 9101)
- Engine 91 (three riding personnel, including the assistant chief [victim])
- Engine 191
- Rescue 91
- Tanker 91 (3,500-gallon tanker)
- Truck 91
- Squad 18 (mutual aid)

Timeline

This timeline is provided to set out, to the extent possible, the sequence of events according to recorded radio transmissions. Times are approximate and were obtained from review of the dispatch records, SCBA/PASS data logger files, witness interviews, and other available information. Some of the times have been rounded to the nearest minute. This timeline is not intended, nor should it be used, as a formal record of events.

- **2059–2101 Hours (Dispatch clock)**
Call received. Units dispatched to structure fire District 91 at an excavating company. Report of a building on fire behind the business. Neighboring county also advised. (Incident location is on the border of the two counties.)
- **2100:28 Hours (by internal data logger clock on assistant chief's SCBA/PASS)**
Assistant chief's PASS data logger indicates powered on.
- **2103 Hours (Dispatch clock)**
Battalion 9 responding with 9101 (Station 91 station chief). Dispatch advises that the neighboring county had also dispatched units. Conflicting reports on address; now appears to be on 800 East (street location).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- **2104 Hours (Dispatch clock)**
Engine 91 responding.
- **2104:55 Hours (Dispatch clock)**
Address confirmed as being in neighboring county jurisdiction, however they wish Battalion 9 and Station 91 units to continue. Rescue 91 en route.
- **2105:42 Hours (Dispatch clock)**
Dispatcher advises all units that the fire is in a very large pole barn behind the address.
- **2106 Hours (Dispatch clock)**
Battalion 9 arrives on-scene and advises a single-story, large pole barn with fire through the roof and he (Chief 9101) will assume command and accountability and asks for a fireground tactical channel. Fireground 2 is assigned by the dispatcher. Battalion 9 asks all units to switch to Channel 2 and report.
- **2106-2108 Hours (Approximate time from NIOSH interview with Battalion 9)**
Note: During interviews with NIOSH, Battalion 9 reported that early in the incident he met with Assistant Chief 9102 and told him “they were in a defensive fire and there was nothing to save at that time.”
- **2107 Hours (Dispatch clock)**
Engine 191 responds.
- **2107 Hours (Dispatch clock)**
Dispatcher advises Command (on the tactical channel) that the barn has fuel in it.
- **2108 Hours (Dispatch clock)**
Tanker 91 on-scene. Command (on tactical channel) positions Tanker 91 with drop tank.
- **2108 Hours (Dispatch clock)**
Dispatcher advises all units that there are reports of quite a bit of fuel stored inside the pole barn.
- **2108:30 Hours (Dispatch clock)**
Dispatcher tries to contact Command with radio traffic. No reply. Later repeats traffic regarding quite a bit of fuel stored in the pole barn (on tactical channel).
- **2110:09 Hours (Dispatch clock)**
Unknown “91—we need more 2½ inch on this line” (on tactical channel)
- **2110 Hours (Dispatch clock)**
“800 Command to county fire (Dispatch) requesting box alarm level” (on tactical channel).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- **2110:57 Hours (Dispatch clock)**
Engine 191 on-scene. Command calls Engine 191 (on tactical channel).
- **2111 Hours (Dispatch clock)**
Box alarm, all call for the county department transmitted (additional mutual aid units dispatched to scene includes additional chief, one tanker, one squad, two engines, and a ladder truck and medic).
- **2114 Hours (Dispatch clock)**
Tanker 191 on-scene. Command gives Tanker 191 assignment (on tactical channel).
- **2115:26 Hours (Dispatch clock)**
9101 to 9102
- **2116:06 Hours (Dispatch clock)**
Dispatcher to 800 Command with first 10-minute notification.
- **2116:42 Hours (SCBA PASS Clock)**
Assistant chief's PASS Data Logger indicates Sensing to Pre-alarm
- **2117:06 Hours (SCBA PASS Clock)**
Assistant Chief's PASS Data Logger indicates Sensing to Pre-alarm
- **2117:18 Hours (SCBA PASS Clock)**
Assistant chief's PASS Data Logger indicates Pre-alarm to Alarm. (This data log was the last entry in the PASS data logger until 08/22/2014 when the unit was examined by NIOSH lab personnel.)
- **2118:47 Hours**
Inaudible transmission.
- **2119:11 Hours**
Mutual aid Truck 6 responding.
- **2119:42 Hours**
Inaudible transmission (raised voice).
- **2120 Hours**
Dispatcher called Command and told him that they heard bits of inaudible yelling on the fireground channel and wanted to make sure everything is ok out there. Command replied it was "Just a stuck mic, thank you."

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- **2121 Hours**
Engine 91 is told to shut the master line down, many inaudible/broken transmissions and Command calls Engine 91 multiple times.
- **2122–2123 Hours**
Unknown: “Ready for water on the master stream,” many garbled transmissions then, “She’s out of water, stand bye,” garbled transmissions, “Engine 91, can we get some water on that line if you got it?”
- **2123 Hours**
Command calls Dispatch and requests box strike for second alarm.
- **2125 Hours**
Squad 18 on-scene.
- **2125 Hours**
Second alarm toned out.
- **2125:56 Hours**
Dispatch advises Command of his second 10-minute notification.
- **2127–2128 Hours**
9101—from Battalion 9 (called twice) then Battalion 9 called 9102
- **2129 Hours**
Command calls Dispatch and advises them that their repeater had gone down and they hadn’t copied any traffic.
- **2130:58 Hours**
Inaudible radio transmission through an SCBA facepiece.
- **2131 Hours**
Truck 91 responding.
- **2132 Hours**
Garbled transmission through an SCBA facepiece, then that person was talked over. The garbled radio transmission through the SCBA facepiece continued, then broken transmissions. Water Command called 9101 on the air, but no answer.
- **2134 Hours**
Truck 91 on-scene.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- **2135 Hours**
Engine 191 calls Command (twice) and relays a broken message that sounded like there was an interior attack from Engine 191, he was down to a ¼ tank, and they don't have any more water down there. *Note: The tanker relay was located at the end of the driveway, pumping up to Engine 191.* Then the message received a transmission (from an unknown unit).
- **2136:00 Hours**
Garbled transmission through an SCBA facepiece calling 9101 with inaudible message, then inaudible message through SCBA facepiece 9102.
- **2137:34 Hours**
Dispatch calls Command with third 10-minute notification. Engine 23 on-scene.
- **2139:34 Hours**
Command calls Tanker 91 and asks for his status and advises that they were almost out of water at the top of the hill.
- **2140:34 Hours**
Inaudible transmission through an SCBA facepiece.
- **2141 Hours**
Severe radio interference, but someone with an SCBA is yelling, "If you can hear me I need the 2½ blitz line charged." Then severe radio interference squealing occurs again. Dispatcher informs all units on Fireground 2 that there was an open mic, a very long period of radio squeal and then "9102, come out of the building...a small explosion."
- **2143-2144 Hours**
Open mic on Fireground 2, then screaming, "9101 we're going to activate a Mayday." (Messages are garbled but sounds like someone yelled Mayday through an SCBA facepiece and a vibre alert sounding just before the Dispatcher sounds the Mayday tone on the tac channel.) Dispatcher clears the air and announced, "Hold radio traffic, there is a Mayday on the fireground," and tells Command to go with his Mayday traffic.
- **2144-2145 (Approximate time from NIOSH interview with Battalion 9)**
Command ordered crew from Squad 18 to deploy as RIC and try and locate the Assistant Chief.
- **2144:16 Hours**
Screaming through an SCBA facepiece *Note: There are many radio mic key events with inaudible or no messages accompanying them.*
- **2144:42 Hours**
More screaming on radio, inaudible, then a unit gets on the frequency asking for a medic unit. Water Command calls 9101 on the frequency.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- **2146:09 Hours**
Tanker 18 arrives and asks for an assignment on the fireground frequency.
- **2146 Hours**
Tanker 191 conversation on the fireground frequency. This conversation and another caused radio interference.
- **2146:26 Hours**
Command calls Dispatch and advises that all units were accounted for.
- **2147 Hours**
Dispatch calls 800 Command, no answer.
- **2149 Hours**
Command tries to call 9102 on the air; no answer.
- **2150 Hours**
9101 tries to call 9102 again on the air; no answer. Command calls EMS unit. Then Command tries to call 9102 again; no answer.
- **2158 Hours**
Dispatch calls Command with another 10-minute notification.
- **2355 Hours**
Fire under control.
- **0105 Hours**
Assistant Chief 9102 located inside the structure.

Personal Protective Equipment

NIOSH investigators inspected and photographed the turnout gear of the assistant fire chief and the injured fire fighter. The only significant damage to the assistant fire chief's turnout gear was to the helmet on the left side. There was no significant damage to the fire fighter's turnout gear. The turnout coat was not available to be inspected. The personal protective equipment (turnout gear) was not considered a contributing factor in this incident. NIOSH investigators conducted no further evaluation or testing of the turnout gear.

The assistant fire chief's SCBA was inspected and photographed. Although not considered a factor in the incident, the SCBA was packaged and transported to the NIOSH National Personal Protection Technology Laboratory in Morgantown, West Virginia, for evaluation and testing (SCBA Evaluation report is available by request from NIOSH NPPTL).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Weather

At approximately 2100 hours, the weather in the immediate area was reported to be 71 degrees Fahrenheit, the dew point was 64.9 degrees F, and the relative humidity was 81%. Wind conditions were 5.8 miles per hour from the north and clear [Weather Underground 2014].

Structure

Building Occupancy and Construction

The commercial business site was a septic service company as well as a general excavation contractor. The buildings involved were a 20-foot by 40-foot building connected to a larger building approximately 60 feet wide by 150 feet long (Diagram 1). The larger building consisted of a work area as well as vehicle storage for the company. The building was a pole barn-style building with metal siding and a roof with wood-truss supports and a pan ceiling. A pan ceiling is a metal ceiling that blocks the truss, creating a void area (Photo 1). If fire gets in the void, fire fighters may not know that fire is over their heads unless the metal ceiling is opened up. The height of the metal ceiling in the building was 14–15 feet high (Photo 2 and Photo 3). The building was an interconnected storage building containing trucks and equipment and also housing a smaller office and breakroom section on the southern side (Figure 3).

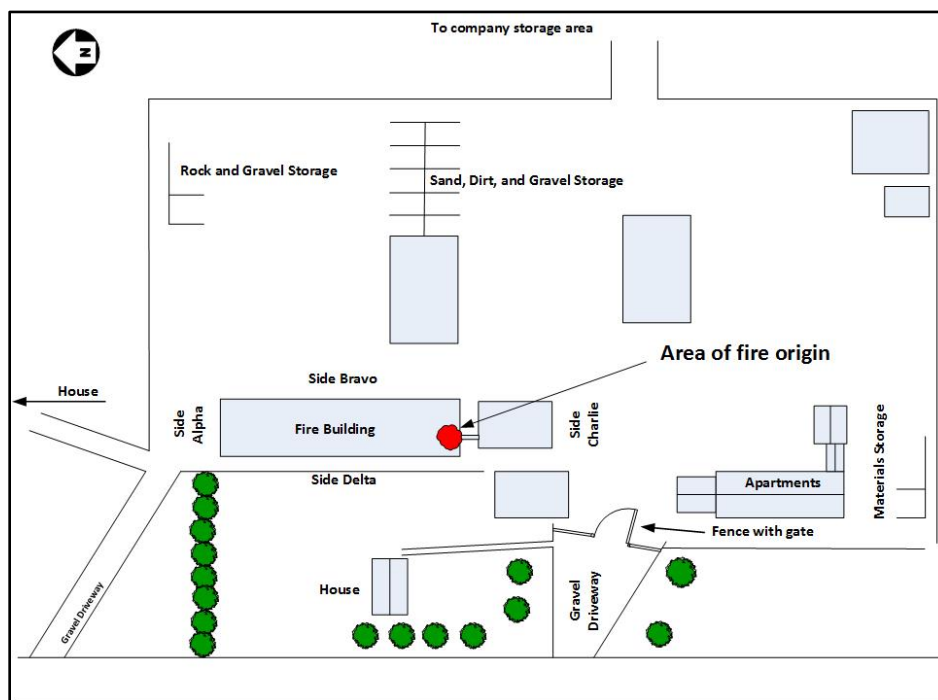


Diagram 1. Site Plan, showing layout of the building(s) with interior hall connection.
(Diagram not to scale.)

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana



Photo 1. Similar roof and pan ceiling construction. (Photo courtesy of Chief Brian Kazmierzak)

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana



Photo 2. Similar building and roof construction on the property. This is an example of a pole barn without a pan ceiling, which the fire building had. A ceiling enclosure may leave the void area wide open from end to end.

(NIOSH photo.)

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana



Photo 3. Similar building and roof construction on the property. Note the wide spacing of trusses.
(NIOSH photo.)

Investigation

On August 5, 2014, at approximately 2059 hours a 9-1-1 call reported a fire in a commercial storage building at the far end of the response area for Fire Station 91. The property that the structure was located on divided the response boundaries of Fire Station 91 and a fire department in the next county, who was actually the first-due company.

The chief of Fire Station 91 (Unit 9101 in Battalion 9) was at the fire station when the call came in and responded in the Battalion 9 command vehicle. When he was leaving the station in Battalion 9, he observed the assistant chief (victim) and another fire fighter (later functioning in role E91B) arriving at the fire station and getting Engine 91 ready. Battalion 9 arrived on-scene first at 2106 hours. He reported heavy smoke while responding. After arriving on-scene, Battalion 9 assumed command on Side A/Side B of the property. He directed Engine 91 to deploy a ground monitor (deck gun) from Side

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

A. Mutual aid department Engine 740 arrived and set up on Side C/Side D (Diagram 2). The officer of Engine 740 also established command on side Side C/Side D.

Engine 91 arrived next, pulled past Side A to the Side B (Diagram 2), and was told to put water on the fire with a deck gun. Tanker 91 arrived and pulled up behind Engine 91. Other units arrived including Engine 191 and Engine 23. Engine 191 laid a supply line up the driveway on Side A. A 1¾-inch hoseline was stretched from Engine 91 to the Side C (south end) of the building. Engine 91 was now pumping a deck gun and the 1¾ hoseline. Tanker 91 deployed their drop tank and Engine 91 stopped pumping to hook up the rear intake to the drop tank. Engine 23 positioned behind Engine 91 on the other side of the drop tank. Engine 91 then experienced pump issues and Engine 23 took over for Engine 91.

Battalion 9 reported in NIOSH interviews that they were in a defensive strategy, which was announced over the radio, and this was communicated with Assistant Chief 9102. Battalion 9 ordered the Engine 91 crew to stretch a 2½-inch hoseline with a ground monitor to Side A. Battalion 9 said he told the assistant chief that “This was a defensive fire and there was nothing to save at that time.” The assistant chief suggested to Battalion 9 that they place a ground monitor just inside the north portion of the structure (Side A). Battalion 9 told him to put it just inside the doorway and didn’t think the assistant chief would take it any further into the structure. Battalion 9 wanted to get his aerial (Tanker 91) on the scene and instructed a fire fighter to take the utility truck back to the station and pick up the ladder truck. The fire fighter took the Battalion 9 command vehicle back to the station. When the command vehicle left the scene, Command realized he had lost his radio repeater. He later used the repeater in the Rescue 91 and was able to communicate with units on-scene. Battalion 9 then assisted Engine 91 with their pump problems.

Engine 191 arrived and positioned on Side A. The Engine 191 crew assisted with opening doors on Side A. Engine 191 crew pulled a 2½-inch hoseline into the structure via the overhead door on Side A (which had been cut open by fire fighters). The crew from Engine 191 stretched inside Side A until they encountered a truck and one of the fire fighters had their low air-alarm sounding. They exited the structure. An Engine 91 fire fighter reported he and Assistant Fire Chief 9102 were told to put a monitor on the end of the 2½-inch hoseline (off Engine 191) inside the structure. Another fire fighter from Engine 191 joined them on the hoseline (E191C). This fire fighter reported during interviews that he was ordered by Command to force the door and make entry with the portable monitor. They forced the man door first and then cut the overhead door with a K12 saw. They first deployed a ground monitor at the overhead door then added a 50-foot section and moved the monitor inside. Assistant Fire Chief 9102 ordered the line charged. The Engine 191 fire fighter then left the two Engine 91 fire fighters to go outside just before the collapse occurred.

The Engine 91 fire fighter was with Assistant Fire Chief 9102 when the collapse occurred. He reported that Assistant Fire Chief 9102 tried to run but was caught in the collapse. The Engine 91 fire fighter reported during interviews that he was hit by the collapse and was lying on the ground trying to move. His helmet and facepiece were knocked off but he was able to get his flashlight off the helmet. His stated his leg was pinned, but he was able to crawl toward Side C and then toward Side D. He said he

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

was then pulled out of the building by Squad 18. At the time that Squad 18 was pulling the Engine 91 fire fighter out, there was a secondary collapse.

Once Engine 23 replaced Engine 91 and they had water flowing, Command heard there was a building collapse with a fire fighter down. Command then radioed a Mayday. Command ordered a crew from Squad 18 to try and locate the Engine 91 assistant fire chief and fire fighter. Command then called for a personnel accountability report. There was some initial confusion due to the similar first and last names of the fire fighters involved. However, Command soon realized that the assistant fire chief was missing.

The assistant fire chief was located at approximately 0105 hours. He was found in full PPE including SCBA. His facepiece and helmet were on. His PASS device was still sounding and his flash light was still working.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

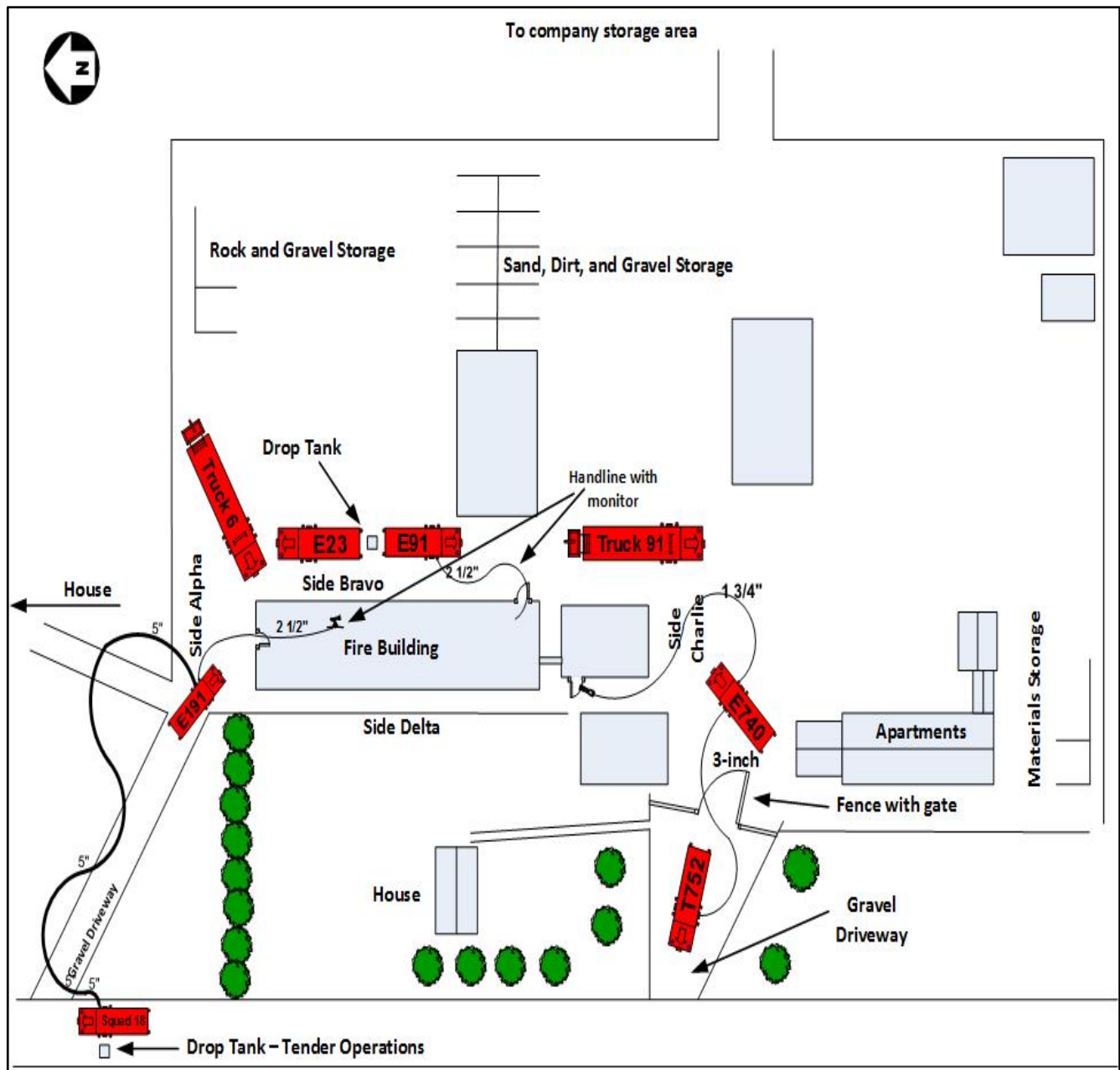


Diagram 2. Apparatus and hoseline placement prior to collapse (diagram not to scale).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

The Rapid Intervention Crew Event (RIC)

Squad 18 was dispatched for mutual aid to assist Fire Station 91 with a working structural fire. Squad 18 responded to the commercial fire along with their assistant chief responding separately. Staffing on Squad 18 was a captain (Squad 18A), two fire fighters (Squad 18B and Squad 18C), and an engineer (Squad 18D). As Squad 18 approached the scene, heavy, black smoke and flames could be seen from the roof of the fire building (about a quarter-mile north of the incident). Upon arrival, Squad 18 was given the assignment to relay pump from the street to Engine 191 by Command.

The Squad 18 engineer stayed with Squad 18 to begin the drafting operation and relay pumping operation while the Squad 18 crew went to the command post for an assignment. Squad 18 was told to staff a 1¾-inch attack line off Engine 91 and go to the southeast side of the building (Side B) and continue defensive operations. Once Squad 18 stretched the attack line of Engine 91, attempts were made to charge the line without success. Engine 91 was unable to pump at that time. The Squad 18 captain informed Command of this issue with Engine 91.

Command advised Squad 18 to pull an attack line off Engine 23 and deploy as RIC. The Squad 18 captain advised the two fire fighters from Squad 18 to get ready to go on air, when Command called for Squad 18. Command stated that there had been a collapse of the structure and that there were two fire fighters trapped inside. The Squad 18 captain reported that they were instructed to follow the 2½-inch hoseline already advanced into the building. Squad 18 went on air and entered the structure through a cutout in a garage door on the north side (Side A). As Squad 18 made entry into the building, an unknown fire fighter exited the structure. They reported conditions were good visibility and moderate to low heat. Nothing could be heard due to loud noises coming from the collapse area. Squad 18 did not report hearing any yelling from the interior or PASS devices sounding.

Squad 18 followed the hoseline up to the edge of the collapse where visibility decreased and heat increased. The east wall area of the collapse was fully involved in fire. Squad 18 was PAR 3 and no other fire fighters were in the building with them. The Squad 18 captain noticed a flashlight shining to his right and instructed Squad 18 toward the light. After a rapid visual and physical search in that area of the collapse, Squad 18 continued to search to the right, following the collapse toward the west wall (Side D) where Squad 18 found a downed fire fighter. The downed fire fighter (Engine 91 fire fighter) appeared to have his legs trapped beneath part of the collapse and was attempting to crawl forward. Either a desk or a large, wooden shelf trapped the fire fighter. The downed fire fighter appeared to be confused and disoriented. The Squad 18 captain and a fire fighter (Squad 18B) instructed the downed fire fighter to back up several times without success. The Squad 18 captain then instructed the two Squad 18 fire fighters to attempt to extricate the downed fire fighter by pulling him backward. They lifted part of the collapse to free his legs and the two fire fighters were able to free the downed fire fighter. The Squad 18 captain then focused on getting everyone out of the structure. Squad 18 checked the area for any other fire fighters in the area (did not hear or see anything) and then tried to get the downed fire fighter to a standing position a number of times without success. As the Squad 18 crew continued to remove the downed fire fighter, a loud cracking noise occurred. The Squad 18 captain believed the remaining roof structure was starting to collapse. The captain yelled, "Get out," to the two

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

fire fighters who had the downed fire fighter. A Squad 18 fire fighter (Squad 18B) grabbed the downed firefighter, who began moving toward the exit.

After the Squad 18 captain ordered his crew to exit, visibility decreased to zero and the heat increased dramatically. Debris began striking their helmets and backs. At this point, a secondary collapse of the structure occurred. Squad 18 dove toward a piece of equipment for protection from the collapse. One fire fighter (Squad 18B) was pushed up against the wall after he pushed the downed fire fighter out of the building. Another fire fighter (Squad 18C) also got out of the building. After the collapse, the Squad 18 captain and fire fighter (Squad 18B) exited the building (see Diagram 3).

After exiting the structure, the downed fire fighter was treated and transported by EMS. Squad 18 was assigned to Rehab. After Rehab, Squad 18 was assigned to Engine 23. At this time, the structure was fully involved and the Engine 91 Assistant Fire Chief was reported missing.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

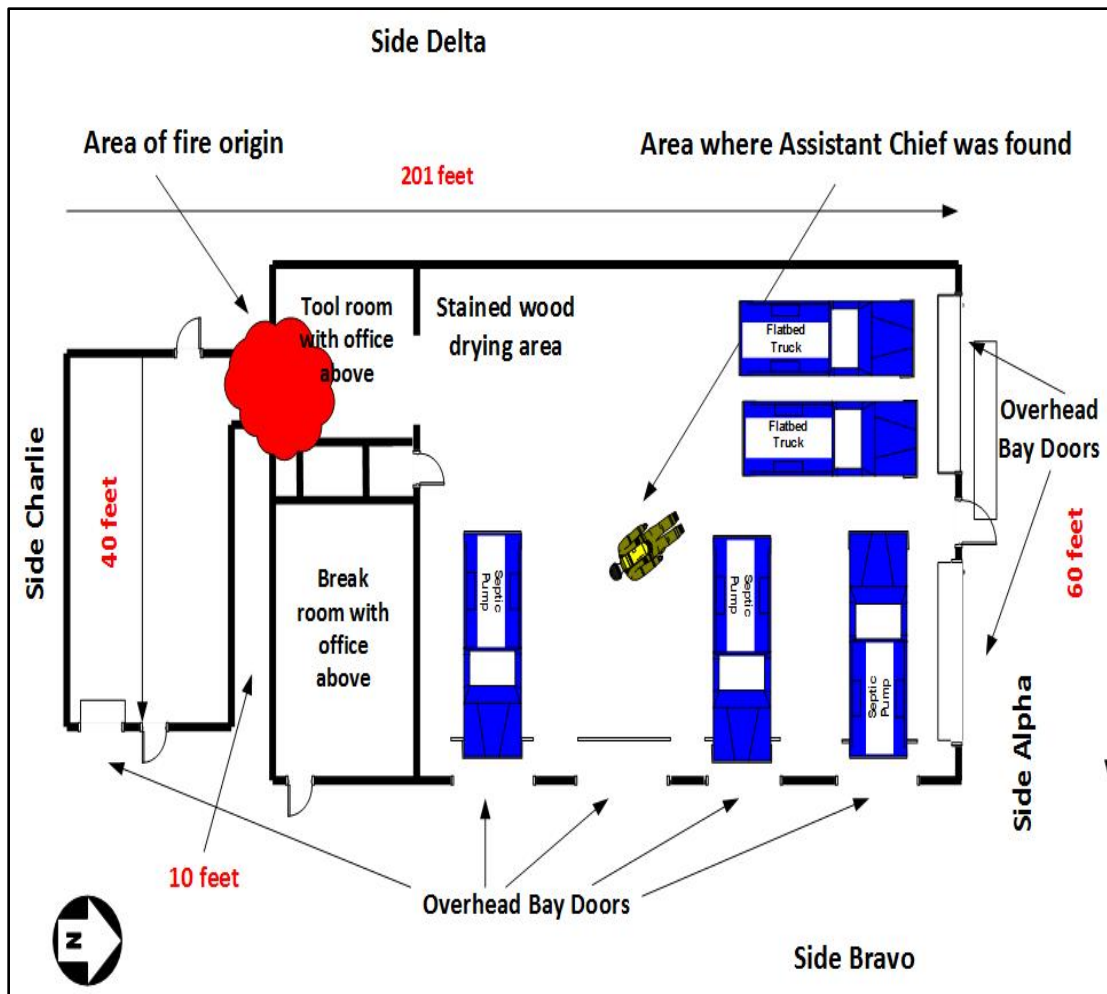


Diagram 3. Floor plan (not to scale).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Contributing Factors

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

- Incident management
- Incident action plan and risk assessment
- Offensive action in a defensive fire (hidden fire above pan ceiling)
- Communications/mutual aid
- Collapse/exclusion zones and situational awareness
- Lack of a safety officer

Cause of Death

According to the autopsy report, the victim died from a broken neck due to blunt force trauma.

Recommendations

Recommendation #1. Fire departments should ensure that a single, effective incident management system is established with a single, designated incident commander, especially when multiple fire departments respond together.

Discussion: According to Fire Chief Billy Goldfeder, “before any incident occurs, fire department leadership within any area where multiple fire departments respond with one another, be it automatic aid or mutual aid, must ensure that there is a clear policy and procedure along with regular training to ensure interoperability” (in incident management and radio operations) on the incident scene. A single, effective incident management system is crucial to the management of all emergency incidents. This system is commonly known as the Incident Command System, or ICS. The primary objective is always to manage the incident.

A single incident commander (IC) should be able to apply ICS in a manner that supports effective and efficient management of the incident. The use of ICS should not create additional challenges for the IC, but rather provide a systems approach to ensuring a successful outcome of the incident [NFPA 2014]. When different departments respond to the same incident, the incident management system or incident commander needs to blend these resources in the overall strategic plan and integrate them into the command structure (even if they have separate radio systems). This is accomplished through divisioning of the incident scene and not having separate commanders on the same incident.

An incident management system (using a single incident commander) is intended to provide a standard approach to the management of emergency incidents. The National Fire Protection Association (NFPA) *1500 Standard on Fire Department Occupational Safety and Health Program* [NFPA 2013] and NFPA *1561 Standard on Emergency Services Incident Management System and Command Safety* [NFPA 2014] both state that an incident management system shall be used at all emergency incidents.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

NFPA 1561, Chapter 3.3.29, defines an incident management system as "a system that defines the roles and responsibilities to be assumed by responders and the standard operating procedures to be used in the management and direction of emergency incidents and other functions" [NFPA 2014]. Chapter 4.1 states, "The incident management system shall provide structure and coordination to the management of emergency incident operations to provide for the safety and health of emergency services organization responders and other persons involved in those activities." Chapter 4.2 states, "The incident management system shall integrate risk management into the regular functions of incident command" [NFPA 2014].

The incident management system covers more than just fireground operations. The incident management system must ensure command/control and fire fighter safety, which includes situational evaluation, strategy and the incident action plan, personnel accountability, risk assessment and continuous evaluation, communications, rapid intervention crews, roles and responsibilities of the incident safety officer, and interoperability between multiple agencies (mutual aid departments, law enforcement, emergency medical services, state and federal government agencies, and officials, etc.) and surrounding jurisdictions (automatic aid or mutual aid responders).

One of the most critical components of this system is the development and implementation of an incident action plan (IAP) [NFPA 2014]. For the fire service, the IAP is communicated verbally the majority of times. The IAP is based on the resources immediately available and those responding. The goal is determined in accordance with the incident priority from which a strategy must emerge; tactical objectives, aimed at meeting the strategy, are determined and specific assignments made. A personnel accountability system should be established as assignments are made. The important point is that the overall IC communicates the IAP to tactical- and task-level supervisors.

In this incident, the incident commander (Battalion 9), established command on the A/B side of the property. A mutual aid department (Engine 740 on a different radio frequency) arrived and the officer of Engine 740 established command on the C/D side of the property (see Diagram 2).

The original incident commander (Battalion 9), lost his ability to communicate when his command vehicle was taken by a fire fighter back to the station to pick up an aerial ladder. Battalion 9 then used the repeater inside a rescue unit and was able to reestablish radio communications with his department's fire units. The mutual aid department was not able to communicate on the radio with Battalion 9.

Recommendation #2: Fire departments should ensure that a stationary command post is established and the incident commander is able to communicate effectively.

Discussion: Fire departments should train their command officers to establish a stationary command post and effectively communicate with the command team members. It may be easy for a command officer to command a small residential fire from the front yard when everything is going well. However, when critical communications occur or significant events occur, it is very easy to miss those communications with all of the noise and confusion that occurs on many firegrounds.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

In some cases, officers are comfortable with operating outside of the command vehicle or command post because they may have a very good comfort level developed from past experience. This comfort level can easily be challenged when faced with unexpected fireground conditions such as collapse, rapid-fire growth, or a Mayday transmission. A critical function of command is to maintain clear communications. If problems arise (such as different radio frequencies from different departments), the incident commander needs to adjust and correct communication gaps. An incident commander needs to be able to clearly communicate with his/her division officers. That may be accomplished by sending members of the IC's department to the other mutual aid divisions to distribute radios as needed. Additionally, fire departments should train in proper terminology for the incident commander to refer to only one "command". The incident commander is the only command on the scene and other functions should not refer to themselves with a designation "command" after a function. This can cause confusion on the fireground, especially when multiple radio transmissions are occurring. For example, a water supply officer should refer to themselves as the function or function "group" without the trailer command. Using terms such as water command or staging command on the radio increases the possibility that the radio designation of "command" could be missed or misinterpreted.

In addition to a stationary command post, effective communications can assist the incident commander in formulating a rescue plan. In many instances, an already established rapid intervention team can be put into action and managed by the incident commander. However, in most cases, the responsibilities may be divided and a rescue group established and given direction by a division commander. The incident commander may take the direction role or pass it to another officer at the command post. The fire-fighting units need to be coordinated and those resources not directly involved in the rescue or fire fighting may be moved to a different channel.

Muscle memory/repetitive skill training is just as important for an incident commander as it is for fire fighters to "know their SCBA." This ability to command emergency incidents is learned not only through didactic training but skill development with hands-on training. Fire officers need to resist the temptation to command from the "front yard," even on minor incidents. Command skill can be built by consistently establishing command on smaller incidents. This can benefit the experienced incident commander; however, it is a critical skill-building process for newer officers or those "acting" in the roles. Everyone on the fireground benefits from repetition, including the command officers, and while many officers can effectively command from the "front yard" or outside of the command vehicle, when a significant event such as a building collapse or Mayday occurs, a properly set up command structure is much more able to adapt and expand as needed.

Once a significant event such as a Mayday has occurred, Command needs to obtain the critical information and assign the correct resources to manage the event. Some departments have adopted the term LUNAR—location, unit assigned, name, assistance needed, and resources needed—to gain additional information in identifying a fire fighter who is in trouble and needs assistance. The incident commander, division/group supervisors, company officers, and fire fighters need to understand the seriousness of the situation. It is important to have the available resources on-scene and to have a plan established prior to the Mayday [NFPA 2013, 2014].

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

In addition to a properly set up incident command system, effective fireground communications also rely on properly operating radio equipment. Several LODD incidents involving inadequate communications were highlighted by the U.S. Fire Administration and a study was initiated on the potential causes of communication breakdowns and improving operational communications [USFA 1999, 2016].

In 2003, the National Institute for Occupational Health (NIOSH) also commissioned a study to identify and address specific deficiencies in fire fighter radio communications and to identify technologies that may address these deficiencies [TriData 2003]. Areas to be addressed were current and emerging technologies that improve fire fighter communications and fire fighter location inside of structures.

The U.S. Fire Administration and the International Association of Fire Fighters worked to develop the *Voice Radio Communication Guide for the Fire Service* to help identify the unique communications needs of the fire service [USFA 1999, 2016]. The document covers basic radio communication technology, radios, and radio systems and selection.

In this incident, Command was established by Battalion 9. However, he temporarily lost radio communication when his command vehicle was taken back to the station to pick up an aerial ladder truck. He was able to use the repeater in the rescue vehicle to get his portable to work until the vehicle returned. The mutual aid department established their own command on the C/D side of the fire building. This was due to not having a radio system that was interoperable. Fire departments need to pre-plan communications and command functions in a formal mutual aid policy. There should only be one incident commander and the communications need to be clear and coming from one source.

Recommendation #3: Fire departments should ensure that an incident action plan is developed and a risk assessment is performed throughout the incident and the tactics match the conditions encountered.

Incident Commanders must develop a strategy and then develop the incident action plan (IAP) to ensure that the correct actions are implemented to take control of the incident. The incident commander must incorporate the situational evaluation (size-up), the standard risk management plan, and forecasting in the decision-making process to define the incident strategy. This will lead to the development of the IAP, which are the tactical priorities. The IAP defines where and when resources will be assigned to the incident to control the situation [NFPA 2014].

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

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

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Creating a standard outcome for all incidents requires the incident commander to use a systematic approach for effectively managing all incidents. The IAP should be directly related to the defined strategy established by the incident commander for a particular incident. The defined strategy describes the overall approach to incident operations and drives the IAP. The IAP provides the tactical assignments required to achieve the offensive/defensive objectives. The order of occurrence is key—the strategic goals are developed first and then followed by the tactical objectives. At each incident, the incident commander should start with a standard placement-oriented operational plan that develops a strong, dependable beginning for command and control of the incident. While developing the strategic goal for the incident is the first component, the incident commander needs to produce detailed tactical objectives that can be assigned to responding companies (See Figure 1 for an example). This is the purpose of the IAP [Brunacini 2002; Fire and Rescue Departments of Northern Virginia 2013b].

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

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

- Identify the incident’s critical factors before taking any action.
- Initial and ongoing size-up of the incident’s critical factors must produce the information that becomes the basis for the current incident strategy and IAP.
- Current, accurate, and relevant information provides the foundation for effective initial and ongoing action.
- The goal of this systematic evaluation process continually produces standard, safe, well-managed incident outcomes [MABAS 2015].

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

DEVELOPING an INCIDENT ACTION PLAN

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

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

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

INCIDENT ACTION PLAN COMPONENTS

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

Tactical Worksheet

TACTICAL WORKSHEET COMPONENTS

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

**LIFE SAFETY
PRIORITY ONE**

**INCIDENT STABILIZATION
PRIORITY TWO**

**PROPERTY CONSERVATION
PRIORITY THREE**

Figure 1. A guide for developing an incident action plan at Type V and Type IV incidents. For these types of incidents, the incident action plan is most often communicated verbally. (Courtesy of FireFighterCloseCalls.com.)

Note: The acronym SLICE-RS stands for:

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

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

The acronym **S-RECEO-VS**

- Size up or estimate of the situation
- **R**escue
- **E**xposures
- **C**onfinement
- **E**xtinguishment
- **O**verhaul
- **V**entilation
- **S**alvage [Layman 1953].

The following are guidelines for developing an IAP for offensive and defensive operations.

Offensive Incident Action Planning

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

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

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

Defensive Incident Action Planning

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

Fire fighter safety is the No. 1 defensive priority.

Defensive strategy tactical priorities and their corresponding completion benchmarks:

- Define the hazard zone
- Establish cut-offs—Forward progress stopped
- Search exposures—Primary and Secondary “All Clear”
- Protect exposures—“Fire Control”—Loss Stopped

Defensive operations represent a standard organizational response to situations that cannot be controlled with offensive tactics. When conditions go beyond the safety systems required for interior operations, Command must conduct defensive operations from outside the hazard area. Command must write off lost property and decide where the cut-off will take place. If defensive operations are

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

conducted from the onset of the incident, there will not be a primary search completed for the involved structure(s). During defensive campaign operations, Command will coordinate the rotation of crews.

A basic defensive IAP includes the following tasks:

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

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

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

Throughout the incident, it is important for incident commanders to continuously perform a risk assessment to ensure that the tactics continue to support the strategy (*It can be tempting for fire fighters to engage in an offensive tactic in a defensive fire fight*) [NIOSH 2012]. This can be accomplished in a number of ways such as strong communications between divisions, effective safety officer surveillance and engagement when tactics and strategy may appear to not be in sync, or safety officer feedback to Command on collapse/exclusion zone establishment and/or enforcement [NIOSH 2008b].

The initial size-up conducted by the first arriving officer allows the officer to make an assessment of the conditions and to assist in planning the suppression strategy. The following general factors are important considerations during a size-up: occupancy type involved; potential for civilians in the structure; smoke and fire conditions; type of construction; age of structure; exposures; and time considerations, such as the time of the incident, length of time fire was burning before arrival, and time fire was burning after arrival [IFSTA 2008; NIOSH 2005]. The incident commander must perform a risk analysis to determine what hazards are present, what the risks to personnel are, how the risks can

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

be eliminated or reduced, and the benefits to be gained from interior or offensive operations [Kipp and Loflin 1996]. The size-up must include continued assessment of risk versus gain during incident operations. NFPA 1500 §A-8.3.3 states: “The acceptable level of risk is directly related to the potential to save lives or property. Where there is no potential to save lives, the risk to the fire department members must be evaluated in proportion to the ability to save property of value. When there is no ability to save lives or property, there is no justification to expose fire department members to any avoidable risk, and defensive fire suppression operations are the appropriate strategy” [NFPA 1998, 2013]. Retired New York City Fire Chief Vincent Dunn states, “When no other person’s life is in danger, the life of the firefighter has a higher priority than fire containment” [Dunn 1992].

Size-up includes assessing risk versus gain at the start and throughout the fire operations. Incident commanders should ensure that fire fighter safety is the primary consideration when changing strategy, such as switching from a defensive to an offensive mode. When an offensive operation is being performed in a defensive strategy mode, fire fighters’ lives can be placed at great risk [NIOSH 2010a]. The National Institute for Occupational Safety and Health (NIOSH) published a Risk versus Gain Alert that departments can use as an additional resource for training on size up considerations that can be accessed here: [NIOSH Risk vs. Gain Alert](https://www.cdc.gov/niosh/docs/2010-153/) <https://www.cdc.gov/niosh/docs/2010-153/> [NIOSH 2010c].

In this incident, the fire chief of Fire Station 91 assumed Command of the incident. The initial action plan was defensive operations and to attempt to extinguish the fire. The incident commander sized up the fire and choose a defensive strategy and it was announced over the radio. The radio system did not include the mutual aid companies. The incident commander told the assistant chief (victim) that it was a defensive fire and there was nothing to save. The assistant chief then suggested that they place a monitor just inside of the north portion of the structure. The incident commander was under the impression that the assistant chief and his crew would place the monitor just inside the door. However, the team stretched the 2½-inch hoseline approximately 50-75 feet inside in an attempt to protect equipment and acetylene cylinders. The fire was already in the wood trusses over the heads of this crew (likely concealed by a ceiling assembly). The truss system failed, and the ceiling and roof assembly collapsed on the assistant chief and one other fire fighter.

Recommendation #4: Fire departments should ensure offensive actions are not performed in a defensive strategy and enforce clear procedures for strategic mode changes.

Discussion: Offensive and defensive strategies should not be combined. As previously mentioned in the risk management recommendation, mixing fire attack strategies can be very dangerous to the lives of fire fighters. While strategies may need to be changed to match conditions, they should not be mixed when the strategy is defensive. An offensive operation in a defensive strategic fire fight can endanger many lives on the fireground and has been a factor in many fatality reports [NIOSH 2008a, 2008b, 2010a, 2012, 2013a, 2015]. This is especially true in long-duration or large geographic incidents.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

In large or complex fireground operations, it is important to select the strategy, announce the strategy, and enforce the strategy and the associated tactics. All personnel on the fireground should always know the operational mode, and all officers and fire fighters should ensure good communication in both directions to ensure everyone is on the same play sheet. This can be challenging during long operations as the tactics may change to preserve additional exposures or exposures earlier in the fire are no longer an issue. The incident commander needs to ensure that the strategy and tactics match the conditions encountered throughout the operation. He/she can do this through clear communication and tight discipline of division officers and tactical-level officers. Safety officers and assistant safety officers can also provide feedback of ongoing risk assessment to the incident command team.

In this incident, the incident commander choose a defensive strategy and it was announced over the radio. The radio system did not include the mutual aid companies. The incident commander told the assistant chief (victim) that it was a defensive fire and there was nothing to save, and the assistant chief suggested that they place a monitor just inside of the north portion of the structure (see cover photo).

Entering into the structure with a 2½-inch hoseline and a ground monitor could be considered an offensive operation. The crew was approximately 75 feet inside the structure. This is where clear definitions of the strategy can help an incident commander. Incident Commanders need to establish exclusion zones as well as collapse zones on defensive fires. As an example, the exclusion zone could be the entire inside of the building(s) on fire (or exclusion zones in areas outside as needed for dangerous or hazardous conditions) and the collapse zones should be established outside of the building lines. Establishing an exclusion zone also reinforces the defined strategy and helps to prevent offensive operations in a defensive fire or mixed strategies.

The incident commander has the responsibility to enforce these zones once established, and the incident safety officer is an important component of the command team for helping define, implement, and enforce these zones throughout the incident.

Recommendation #5: Fire departments should work together to develop mutual aid SOPs for fireground operations that include incident management, communications, and operations, and train on those procedures.

Discussion: Mutual aid companies should train together and not wait until an incident occurs to attempt to integrate the participating departments into a functional team. Differences in equipment and procedures need to be identified and resolved before an emergency occurs when lives may be at stake. Fire departments responding to mutual aid incidents should ensure that interior and exterior fireground operations—such as ventilation tactics and use of elevated master streams—are effectively coordinated and communicated to each other. As the incident escalates, additional staffing and resources may be needed, adding to the burden of tracking personnel. At this point, an accountability system should be in place, including an incident command board that is established and maintained by an assigned accountability officer or aide. A properly maintained incident command board allows the incident commander to readily identify the location and time of all fire fighters on the fireground. As a fire escalates and additional fire companies respond, a chief's aide or accountability officer assists the

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

incident commander with accounting for all fire-fighting companies at the fire, at the staging area, and at the rehabilitation area. The personnel accountability report (PAR) is an organized, on-scene roll call in which each supervisor reports the status of his crew when requested by the incident commander or emergency dispatcher [IFSTA 2008; NFPA 2013]. The use of a functional accountability system, as recommended by NFPA 1500 [NFPA 2013] and NFPA 1561 [NFPA 2014], requires the following:

- Development of a departmental SOP
- Training all personnel
- Strict enforcement during emergency incidents

On every response, a properly initiated and enforced accountability system that is consistently integrated into fireground command and control, enhances fire fighter safety and survival by helping to ensure a more timely and successful identification and rescue of a disoriented or downed fire fighter. Procedures and protocols that are jointly developed and have the support of the majority of participating departments will greatly enhance overall safety and efficiency on the fireground. Once methods and procedures are agreed upon, training protocols must be developed and joint training sessions conducted to relay appropriate information to all affected department members.

Recommendation #6: Incident commanders should ensure that collapse zones and exclusion zones are established, marked, and enforced on defensive fires and incidents where dangerous or hazardous conditions exist and that a RIC is assigned even on defensive fires.

Discussion: The United States Fire Administration and the National Fire Protection Association (NFPA) report that 984 fire fighters died between 2000 and 2010. Structural collapse caused 134 of these fire fighter line-of-duty deaths (13.7%). Structural collapse often results in multiple fire fighter injuries and fatalities. The potential for a structural collapse is one of the most difficult circumstances to predict. However, most instances of structural collapse result from damage to the structural system of the building caused by the fire or by fire-fighting operations. The longer a fire burns in a building, the more likely that the building will collapse [IFSTA 2008, NIOSH 2013a,b].

During initial size-up and ongoing fire-fighting operations, the incident commander must consider numerous variables to determine the structural integrity of a burning structure and integrate these variables into the risk versus gain analysis plan and consider collapse and exclusion zones when dangerous or hazardous conditions exist. The incident commander must also consider numerous variables to determine the structural integrity of a burning structure.

A collapse zone is defined as the area around a structure that would contain debris if the building were to collapse. This is generally 1½ times the height of the structure. A collapse zone, when established, should be identified by colored tape, signage cones, flashing beacons, fences, or other appropriate means. “No Entry” should be enforced by the incident commander, incident safety officer, division/group supervisors, and company officers. When it is not possible or practical to mark a collapse zone, the incident commander should identify the collapse zone area to all fireground personnel via radio or other communication methods [NIOSH 2014]. The collapse zone can be enforced by personnel positioned at entry points. No personnel or apparatus should be allowed to

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

operate in the collapse zone except to cautiously place unmanned master stream devices and then immediately withdraw once they are in operation [IFSTA 2008; NIOSH 2014]. However, an exclusion zone is much more defined in that no personnel should be allowed to enter the area and it should not only be clearly marked, but enforced.

Exclusion zones can also exist or extend into buildings, especially when roof structures are suspect (as in this incident). In addition, exclusion zones would include other areas containing imminent hazards—such as falling glass, areas containing atmospheres within or near the flammable range—and any other area that the incident commander or incident safety officer deems too hazardous to enter. Collapse and exclusion zones are not the only safety considerations regarding access. The concept of limiting access to the fire scene is defined in a variety of ways. The safe area around the fire building(s) is normally staffed by police who keep unauthorized personnel out of the inner zones.

Incident conditions must be considered when determining the dimensions of the fire perimeter. A good rule of thumb for approximating a fire perimeter is two blocks beyond the fire building in all directions [Klaene et al. 2007]. Inside a fire perimeter, there can be a number of zones much like a hazardous materials incident scene. A cold zone would be an area where personal protective equipment is not required and is usually where the command post is established and other functions such as rehabilitation and medical treatment areas are located. The hot zone would be an operating area considered safe only when wearing appropriate levels of personal protective equipment. The incident commander and the safety officer have a responsibility to establish and enforce the hot zone.

Everyone has a responsibility to abide by the decisions made for the established collapse and exclusion zones. If the fire is not contained and an exterior (defensive) attack becomes necessary, the hot zone is moved far enough away from the structure to place the fire fighters outside the collapse zone. The collapse zone then becomes an exclusion zone. In large or extended fire-fighting events, these zones must be continually adjusted as necessary and all personnel at the scene must be made aware of the locations of the exclusion or collapse zones. For incidents in which the transfer of command occurs multiple times, the incident is of long duration, or the incident scene covers a large geographical area, the collapse zones need to be continuously re-enforced [NIOSH 2014]. It is important for division supervisors and officers to not only adjust and enforce collapse or exclusion zones with their own personnel, but to also communicate changes with the incident commander.

Establishing collapse and exclusion zones are a critical role of the incident commander, and equally important is identifying, marking, and communicating them, as well as enforcing their maintenance. Frequently, these zones must be adjusted due to fireground conditions.

When initial arriving conditions indicate a defensive strategy from the start, the incident commander needs to protect personnel by establishing collapse zone and exclusion zones quickly and then modifying them as necessary during the operation. Additionally, once a defensive strategy has been established, everyone on the fireground must be aware of the collapse and exclusion zones and expect that a collapse is a likely occurrence in large defensive fires.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Additionally, an incident commander should consider establishing a rapid intervention crew even for a defensive fire. This resource should be on scene and readily available to the incident commander to be used anywhere on the fireground in case a fire fighter or crews being caught in an exclusion zone or exterior collapse, or as in this case, an offensive operation that was performed during a defensive fire fight.

In this incident, the incident commander communicated that this would be a defensive fire fighting effort. Crews extended a fire fighting line inside the structure and became trapped in a collapse. In a defensive fire, exclusion zones as well as collapse zones need to be established and enforced to prevent unsuspecting crews from entering areas that are extremely dangerous, likely to collapse or areas that have been written off by the incident commander as to dangerous to risk fire fighters lives in protecting.

Recommendation #7: Fire departments should ensure that fire fighters are trained in situational awareness and expected building performance under fire conditions.

Discussion: All officers and fire fighters 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. It is important to train fire fighters and officers to maintain their situational awareness, especially regarding expected building performance under fire conditions. The training should include what general situational awareness is and the addition of maintaining situational awareness in relation to the expected building performance under fire conditions.

Chief Christopher Naum, SFPE (Command Institute) notes, “The potential for structural collapse in a building on fire can be predicated by a building’s inherent susceptibility to a variety of factors that include fire dynamics and behavior, fire exposure and extension, environmental impact, fire suppression activities and age, deterioration and occupancy use factors. The predictability of a building’s performance and risk to structural collapse, compromise or failure must be foremost in the development and execution of incident action plans (IAP) with collapse precursors or indicators identified.”

“In most situations involving a structure fire, the probability of and anticipation for structural collapse or compromise are inevitably minimized, overlooked or at times disregarded until the catastrophic conditions present themselves with little to no time to react accordingly. The loss of situational awareness coupled with distracted attention to subtle or obvious pre-collapse building indicators and gaps in building and construction system knowledge combine to elevate operational risks to personnel on the fireground at structure fires” [Naum 2012a].

It is keenly important during strategy changes that fire fighters are trained to recognize deteriorating and/or degraded building conditions and maintain their situational awareness at all times. Building conditions change under fire conditions and the continued deterioration of the structure will place fire fighters at risk. Building performance hazards, such as hidden fires in void spaces above suspended ceilings, are always a fire spread danger that need to be considered on defensive fires as well as

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

offensive fires. Once a defensive strategy has been selected, enforced exclusion zones can keep fire crews away from these unseen hazards (such as this incident with fire spreading behind an interior crew above a suspended metal ceiling).

Experience is a very valuable tool and every incident and response should be viewed as an opportunity to learn and improve fire fighting and command skill sets. Although there is no evidence of this happening in this incident, fire fighters and officers need to resist the temptation to provide training for newer members by performing offensive task-level operations while in a defensive strategy. This includes placing crews inside a collapse zone or exclusion zone or an area that has not had a risk assessment performed. This can be a daunting challenge depending on the size and scope of the incident, but effective command safety discipline, communication, and situational awareness of all fire fighters and officers can provide effective personnel safety and accountability. Fire fighters need to understand the importance of situational awareness and personal safety on the incident scene.

The book *Essentials of Fire Fighting and Fire Department Operations* [IFSTA 2013] defines situational awareness as an awareness of the immediate surroundings. On all fire and emergency incidents, all fire fighters and emergency responders should be trained to be constantly alert for changing and unsafe conditions. Even though a safety officer may have been designated for the incident, it is the obligation of all personnel to remain alert to their immediate surroundings. They must maintain their situational awareness and be alert for unsafe building conditions.

Situational awareness can be described as a heightened consciousness of what is currently developing or occurring. One of the most critical aspects of coordination between fireground crews is maintaining situational awareness. A danger for the less experienced fire fighter in the initial stages of the event is tunnel vision where they become so focused on operational assignments that they fail to sense changes in their environment. Other barriers can include distractions, adrenaline triggers that can narrow focus (e.g., Mayday or urgent traffic over the radio), and complacency, especially after a long-duration fire or when the event is winding down.

The International Association of Fire Chiefs (IAFC), Safety, Health and Survival section developed the “Rules of Engagement for Structural Fire Fighting.” The fireground creates a significant risk to fire fighters and other emergency responders, and it is the responsibility of the incident commander and command organization officers to minimize emergency responder exposure to unsafe conditions and stop unsafe practices [IAFC 2013].

The rules of engagement can assist the incident commander, company officers, fire fighters, (who are at the highest level of risk) in assessing their situational awareness.

One principle applied in the rules of engagement is fire fighters and company officers are the members most at risk for injury or death and will be the first to identify unsafe conditions and practices. The rules integrate the fire fighter into the risk assessment decision-making process. These members should be the ultimate decision maker as to whether it is safe to proceed with assigned objectives. Where it is

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

not safe to proceed, the rules allow a process for that decision to be made while still maintaining command unity and discipline. The following are excerpts from the IAFC rules of engagement:

Rules of Engagement for Fire Fighter Survival:

- Size up your tactical area of operation. (Causes the company officer and fire fighters to pause for a moment, look over their area of operation, evaluate their individual risk exposure, and determine a safe approach to completing their tactical objectives.)
- Go in together, stay together, and come out together. (Ensures two or more fire fighters operate as a team.)
- Maintain continuous awareness of your situation, location, and emergency scene conditions.
- Constantly monitor communications for critical radio reports.
- You are required to report unsafe conditions or practices that can harm you. Stop, evaluate, decide. (Prevents exposure to unsafe conditions or practices that can harm them, allows any member to raise an alert about a safety concern without penalty, and mandates that the supervisor addresses the question to ensure safe operations.)
- You are required to abandon your position and retreat before deteriorating conditions can harm you. (Ensures awareness and causes an early exit to a safe area when they are exposed to deteriorating conditions, unacceptable risk, and a life-threatening situation.)
- Declare a Mayday as soon as you think you (*or another fire fighter*) are in danger. (Ensures the fire fighter is comfortable with declaring a Mayday as soon as they think they are in trouble.) [IAFC 2013]

The Incident Commander's Rules of Engagement for Fire Fighter Safety:

- Rapidly conduct or obtain a 360-degree situational size-up of the incident. (Determine the safest approach to tactical operations as part of the risk assessment plan and action development plan before fire fighters are placed at substantial risk.)
- Conduct an initial risk assessment and implement a safe action plan. (Use a safety officer and all command staff to perform a continuing risk assessment. Develop a safe action plan by conducting a size-up, assessing the survival profile, and completing a risk assessment before fire fighters are placed in high-risk positions on the emergency scene.)
- If you do not have the resources to safely support and protect fire fighters, seriously consider a defensive strategy. (Do not commit fire fighters to high-risk tactical objectives that cannot be accomplished safely due to inadequate resources on the scene.)
- Maintain frequent two-way communications and keep interior crews informed of changing conditions.
- Obtain frequent progress reports and revise the action plan.
- Ensure accountability of every fire fighter, their location, and status. (Maintain a constant and accurate accountability of the locations and status of all fire fighters within a small geographic area of accuracy within the hazard zone and be aware of who is presently in or out of the building or zone) [IAFC 2013].

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

It can be difficult to maintain the accountability discipline on long-duration events, but it is a necessary and vital role for command as well as all officers and fire fighters.

Recommendation #8: Fire departments should ensure that a safety officer, independent from the incident commander, is appointed at structure fires.

Discussion: A trained incident safety officer should always be established on a working structure fire. An incident safety officer should monitor the incident action plan, conditions, activities, and operations to determine whether they match with the chosen strategy and tactics. The incident safety officer can be an extra set of eyes for the incident commander to ensure that the actions match the conditions and crews do not mix strategies (offensive actions in a defensive strategy fire).

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 2014]. NFPA 1561 Paragraph 5.3.2 states, "The incident commander shall ensure that adequate safety measures are in place" [NFPA 2014]. With the advent of the incident command system, the goal is to ensure that the incident commander is responsible for the safety and welfare of all members and other first responders that were on-scene at an incident.

Based upon the size and complexity (e.g., large lightweight farm structures) of an incident, the incident commander should delegate roles and responsibilities that include safety to trained and capable officers. The incident command system can be expanded to include functions necessary to effectively command and control an incident. Fire fighter safety is one of those roles and responsibilities. However, while the safety roles and responsibilities may be performed and monitored by a safety officer, the incident commander is still responsible for the safety and welfare of all fire fighters on the fireground.[NFPA 2013].

A predesignated incident safety officer can respond automatically to incidents and assist the incident commander. Upon arrival at the incident, the safety officer should meet with the incident commander to confirm the incident safety officer assignment and be integrated into the personnel accountability system. Upon confirmation, the incident safety officer should obtain the following information:

- Overall situation status and resource status.
- Strategy and incident action plan (offensive or defensive strategy).
- Known hazards and concerns; if operating in a defensive strategy, the safety officer can assist in the identifying and establishing of collapse/exclusion zones.
- Status of rapid intervention crews.
- Establishment of the rehabilitation group.
- Confirmation of established radio communication channels (command channel, tactical channels).

Once the information is obtained, the incident safety officer should don the personal protective equipment appropriate for the potential hazards that he/she will be exposed. In addition, the incident

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

safety officer should be identified by a vest or helmet. The incident safety officer should perform a reconnaissance of the incident and begin initiating functions of this position.

NFPA 1521 *Standard for Fire Department Safety Officer* defines the role of the incident safety officer at an incident scene and identifies duties such as recon 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 established safety zones, collapse zones, hot zones, and other designated hazard areas are communicated to all members on-scene [NFPA 2015]. Additionally, the incident commander certainly benefits from information from fire fighters and the incident safety officer on fireground conditions in order to make timely, informed decisions on the strategy and tactics being used and the risk versus gain and offensive versus defensive operations [NFPA 2013].

Some departments use a predesignated incident safety officer to respond to incidents. Having a predesignated incident safety officer can help to ensure that the safety officer is trained and experienced to operate effectively and assist the incident commander on the fireground. Larger fire departments should consider one or more full-time, dedicated incident 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 be prepared to function as the incident safety officer when assigned by the incident commander.

All fire fighters and officers on the fireground are responsible for their own safety and the safety of others at all times. Just because a safety officer has been established, it does not diminish the responsibility of individual fire fighters and fire officers for their own safety and the safety of others. The dedicated incident safety officer adds a higher level of training, attention, and expertise to help the incident commander, division commanders, as well as the fire fighters and fire officers. The incident safety officer must have particular expertise in analyzing safety hazards and must know the particular uses and limitations of protective equipment [Dodson 2007; Dunn 2000; NIOSH 2010b].

The incident safety officer should understand the effects of fires on materials and building construction types [NIOSH 2012]. One of the important functions of an incident safety officer is to offer judgment about the collapse potential of buildings during incidents. To do this, incident safety officers should front-load their building construction knowledge so that they can “read” the building and predict collapse potential. This ability comes from a long-term commitment to reading and studying information on building construction. Knowledge of building construction starts with an understanding of the loads, forces, and materials found in the structural makeup of buildings. An incident safety officer with building construction knowledge and understanding of how fire can affect the buildings can provide a fire department with a higher level of expertise to perform the necessary incident scene functions and assist the incident commander with fireground safety.

There may be some incident commanders that believe any fire officer should be able to fill the incident safety officer function. However, just as incident commanders have various levels of knowledge and expertise, so do other incident safety officers, and the requirements necessary to serve as an incident

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

safety officer may change from department to department. Additionally, the emphasis placed on safety may vary from one incident commander to another [Dodson 1999].

When an officer is placed in the role as an incident safety officer, they need to guard against becoming involved in a suppression task. Chief Stephen Raynis (Chief of Safety with the New York City Fire Department) notes, “If a fire officer is not usually assigned as an ISO, it is very difficult to remove ones’ self from the thought process of being a tactical officer and concentrate on safety concerns only.”

In this incident, the department did not have a predesignated incident safety officer and the incident safety officer role was not formally established on the fireground when the collapse occurred.

Recommendation #9: When the water supply is limited or insufficient for fireground operations, the incident commander should ensure this issue is factored into the strategy and incident action plan.

Discussion: Incident Commanders should immediately consider a defensive strategy whenever water supply is a factor. Adequate water supply during fire attack operations has a critical impact on fire control outcomes. Delayed or limited water supply and inadequate fire flow leads to delayed fire control, increased risk to fire fighters and victims, and greater fire loss. The use of excessive amounts of water or leaking couplings or nozzles may increase loss inside the structure [NFPA 2017].

Command is ultimately responsible for managing attack positions in either offensive or defensive locations. The key to effective attack positioning is WATER. Water not only extinguishes the fire, but water protects fire fighters from the lethal products of combustion [MABAS 2015].

As an incident commander develops a strategy and incident action plan for an incident, the issue of water supply factors into this process. The incident commander should have an acute awareness of the following water supply factors:

- What is the required fire flows for the incident?
- What are the projected fire flows we can actually produce?
- Do we have enough water to safely extinguish the fire?
- Where is the water supply coming from?
- Are the key tactical areas adequately supplied with water?
- What units have/need a water supply?
- How many handlines can the supplied pumper(s) charge and pump?
- How many large-diameter openings can the supplied pumper(s) charge and pump?
- Is there a need for pumped supply lines [MABAS 2105]?

If there is an insufficient or an inadequate water supply, this alters the strategy and incident action plan. The incident commander must make a decision to operate in a defensive strategy, especially if the fire has been burning for a considerable time prior to the arrival of the fire department. Upon arrival, resources are deployed and operate out of the hazard zone with master and elevated streams.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Recommendation #10: Fire departments should ensure that their radio communication system is capable of providing adequate coverage and is interoperable when multiple departments respond together and complies with NFPA 1561 Standard on Emergency Services Incident Management System and Command Safety.

Discussion: Effective fireground radio communication is an important tool to ensure proper command and control of an incident including fire fighter safety and health. Not only should the radio system be dependable, consistent, and functional, it needs to be interoperable to ensure that all departments can communicate and effective communications are maintained, especially during emergency incidents.

Fire departments should have a “communications” standard operating procedure (SOP) that outlines the communication procedures for fireground operations. Fire departments should ensure that the department’s communications division and communication center and/dispatch center are part of this process. Another important aspect of this process is an effective education and training program for all members of the department.

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

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

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

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

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

When a fire department responds to an incident, the incident commander should forecast for the incident to determine if there is potential for being a complex or long-term operation that may require additional resources, including demands on the communications system. As incidents increase in size, the communication system has to keep up with the demands of the incident. The incident commander must be able to communicate with company officers and division/group supervisors [FIREScope 2017]. Before communications become an issue, the incident commander must consider options for alleviating excessive radio traffic. Several options are:

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

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

In this incident, multiple fire departments responded and had communication and radio difficulties due to different frequencies, and radio signal repeater issues. Consequently, communications between command and other units on Side C and D were not as clear and timely as they could have been. When multiple units on one emergency scene are operating on different radio frequencies, there is a possibility that actions can be performed (or not performed) without the incident commander being aware in a timely manner.

Recommendation #11: Fire departments should ensure that Incident Commanders use an incident command or a tactical worksheet during initial fireground operations and throughout the incident.

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. An incident command or a tactical worksheet can be a valuable piece of equipment to help an incident commander organize the incident from the initial onset of the incident (See example Figures 2 and 3). Some of the benefits of using a worksheet are critical information is documented and it provides reminders, prompts, and a convenient workspace for tracking companies and apparatus. For fire departments that

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

provide a staff assistant or incident command technician, the district chief or battalion chief has the ability to start the worksheet when responding to an incident. The incident commander has the ability to record vital information that may help them make future operational decisions. By documenting the assignments of company operations plus division/group supervisors and division/group resources, the incident commander creates a visual reference of the overall fireground organization and deployment [NFPA 2014].

Although incident commander can use the worksheet to help keep track of companies and the completion of tactical priorities, the incident commander's primary responsibility is to manage the overall incident strategy. This is an ongoing requirement whenever fire fighters are operating in or around hazardous conditions. The incident commander does this by basing the overall strategy (and subsequent incident action plan) on the critical factors. This evaluation is driven by the visual information, initial arriving unit radio reports, and other information gained during the size-up. The incident commander must not allow the worksheet to become a distraction from monitoring the incident conditions by radio communications and/or visual observations.

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

Some advantages of using a worksheet are:

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

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

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

The tactical worksheet should be used to record the critical incident benchmarks throughout the incident. This information can then be easily transferred to later arriving incident commanders during escalating or long-duration incidents.

Use of a tactical worksheet can assist the incident commander in maintaining documentation of the incident action plan (incident objectives), resource assignments, and personnel accountability of all resources assigned to the incident.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

<p style="text-align: center;">Tactical Objectives</p> <p>Size Up</p> <p>Call for Help (Upgrade Alarm)</p> <p>Save Lives (Search/Rescue)</p> <p>Cover and Contain <input type="checkbox"/> Fire Attack <input type="checkbox"/> Exposures</p> <p>Ventilation <input type="checkbox"/> Horizontal <input type="checkbox"/> Vertical</p> <p>Rapid Intervention Team <input type="checkbox"/> IRIT <input type="checkbox"/> RIT</p> <p>Extinguish <input type="checkbox"/> Water Supply <input type="checkbox"/> Back Up Line</p> <p>Overhaul</p> <p>Salvage</p> <div style="background-color: #ADD8E6; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">Structural Stability Check 10 min. ___ 15 ___ 20 ___ 25 ___ 30 ___</p> </div>	<div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Fire Department Strategic & Tactical Worksheet</p> <p>Incident Location _____ Time _____</p> <p>Box Card # _____ Temperature _____ Wind _____</p> <p>Staging Area _____</p> </div> <div style="text-align: center; border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>ENGAGEMENT EVALUATION</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td></td> <td colspan="4">HIGH</td> <td>LOW</td> </tr> <tr> <td>Rescue</td> <td style="background-color: #90EE90;">1</td> <td style="background-color: #ADD8E6;">2</td> <td style="background-color: #FFFF00;">3</td> <td style="background-color: #FFA500;">4</td> <td style="background-color: #FF69B4;">5</td> </tr> <tr> <td></td> <td colspan="4">EARLY</td> <td>LATE</td> </tr> <tr> <td>Fire Stage</td> <td style="background-color: #90EE90;">1</td> <td style="background-color: #ADD8E6;">2</td> <td style="background-color: #FFFF00;">3</td> <td style="background-color: #FFA500;">4</td> <td style="background-color: #FF69B4;">5</td> </tr> <tr> <td></td> <td colspan="4">HIGH</td> <td>LOW</td> </tr> <tr> <td>Savable Property</td> <td style="background-color: #90EE90;">1</td> <td style="background-color: #ADD8E6;">2</td> <td style="background-color: #FFFF00;">3</td> <td style="background-color: #FFA500;">4</td> <td style="background-color: #FF69B4;">5</td> </tr> <tr> <td></td> <td colspan="4">LOW</td> <td>HIGH</td> </tr> <tr> <td>FF Danger</td> <td style="background-color: #90EE90;">1</td> <td style="background-color: #ADD8E6;">2</td> <td style="background-color: #FFFF00;">3</td> <td style="background-color: #FFA500;">4</td> <td style="background-color: #FF69B4;">5</td> </tr> </table> </div> <div style="display: flex; justify-content: space-between; margin-bottom: 10px;"> <div style="width: 60%;"> <p style="text-align: center;">INCIDENT STRATEGY</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="background-color: #90EE90;">OFFENSIVE INTERIOR</td> <td style="background-color: #FFD700;">MARGINAL RESCUE</td> <td style="background-color: #FF69B4;">DEFENSIVE EXTERIOR</td> </tr> </table> </div> <div style="width: 35%; border: 1px solid black; padding: 5px;"> <p style="text-align: center;">Fire Flow</p> <p style="text-align: center;">_____ GPM</p> <p style="text-align: center; font-size: small;">L x W / 3 (per floor)</p> </div> </div> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center; margin-bottom: 10px;"> <tr> <td></td> <td>BENCHMARK</td> <td>COMPLETE</td> <td>PAR</td> </tr> <tr> <td>All Clear</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fire Control</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Loss Stopped</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Secondary All Clear</td> <td></td> <td></td> <td></td> </tr> <tr> <td>10 Mins</td> <td style="background-color: #A9A9A9;"></td> <td></td> <td></td> </tr> <tr> <td>20 Mins</td> <td style="background-color: #A9A9A9;"></td> <td></td> <td></td> </tr> <tr> <td>30 Mins</td> <td style="background-color: #A9A9A9;"></td> <td></td> <td></td> </tr> <tr> <td>OFF to DEF</td> <td style="background-color: #A9A9A9;"></td> <td></td> <td></td> </tr> </table> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Add. Considerations</p> <p><input type="checkbox"/> Adequate EMS</p> <p><input type="checkbox"/> REHAB Established</p> <p><input type="checkbox"/> Utilities</p> <p><input type="checkbox"/> Police</p> <p><input type="checkbox"/> Investigators</p> </div>		HIGH				LOW	Rescue	1	2	3	4	5		EARLY				LATE	Fire Stage	1	2	3	4	5		HIGH				LOW	Savable Property	1	2	3	4	5		LOW				HIGH	FF Danger	1	2	3	4	5	OFFENSIVE INTERIOR	MARGINAL RESCUE	DEFENSIVE EXTERIOR		BENCHMARK	COMPLETE	PAR	All Clear				Fire Control				Loss Stopped				Secondary All Clear				10 Mins				20 Mins				30 Mins				OFF to DEF			
	HIGH				LOW																																																																																			
Rescue	1	2	3	4	5																																																																																			
	EARLY				LATE																																																																																			
Fire Stage	1	2	3	4	5																																																																																			
	HIGH				LOW																																																																																			
Savable Property	1	2	3	4	5																																																																																			
	LOW				HIGH																																																																																			
FF Danger	1	2	3	4	5																																																																																			
OFFENSIVE INTERIOR	MARGINAL RESCUE	DEFENSIVE EXTERIOR																																																																																						
	BENCHMARK	COMPLETE	PAR																																																																																					
All Clear																																																																																								
Fire Control																																																																																								
Loss Stopped																																																																																								
Secondary All Clear																																																																																								
10 Mins																																																																																								
20 Mins																																																																																								
30 Mins																																																																																								
OFF to DEF																																																																																								
<p>MAYDAY PROCEDURES ON BACK</p>																																																																																								

Figure 2. Tactical worksheet example, (courtesy of Bing images).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

**VIRGINIA BEACH FIRE DEPARTMENT
INCIDENT COMMAND WORKSHEET**

ADDRESS:				Incident Number	Strategy						
1 st BFC:	TACTICAL CHANNEL:	TACTICAL CHANNEL:	COMMAND CHANNEL:	TOA	<input type="checkbox"/> INVESTIGATOR <input type="checkbox"/> OFFENSIVE <input type="checkbox"/> TRANSITIONAL <input type="checkbox"/> DEFENSIVE						
RESOURCES		RESOURCES		RESOURCES							
1 st ALARM	ASSIGNMENT	2 nd ALARM	ASSIGNMENT	3 rd ALARM	ASSIGNMENT						
ENG		ENG		ENG							
ENG		ENG		ENG							
ENG		ENG		ENG							
ENG		ENG		ENG							
TRK		TRK		TRK							
TRK		HVY RSC		HVY RSC							
HVY RSC		EMS		EMS							
EMS		BFC		BFC							
SPECIAL		SPECIAL		SPECIAL							
BFC 2 nd		SPECIAL		SPECIAL							
RESOURCE STATUS ACCOUNTABILITY											
Floor, Division, Group or Branch			Floor, Division, Group or Branch			Floor, Division, Group or Branch			Floor, Division, Group or Branch		
CIC, Supervisor or Manager			CIC, Supervisor or Manager			CIC, Supervisor or Manager			CIC, Supervisor or Manager		
UNIT	ACTIVITY	P #	UNIT	ACTIVITY	P #	UNIT	ACTIVITY	P #	UNIT	ACTIVITY	P #
<input type="checkbox"/> Primary Search	<input type="checkbox"/> All Clear	<input type="checkbox"/> Fire Control	<input type="checkbox"/> Secondary Search	<input type="checkbox"/> Primary Search	<input type="checkbox"/> All Clear	<input type="checkbox"/> Fire Control	<input type="checkbox"/> Secondary Search	<input type="checkbox"/> Primary Search	<input type="checkbox"/> All Clear	<input type="checkbox"/> Fire Control	<input type="checkbox"/> Secondary Search
PAR & SITUATION CHECKS											
<input type="checkbox"/> 20 MIN <input type="checkbox"/> 40 MIN <input type="checkbox"/> 60 MIN <input type="checkbox"/> 80 MIN <input type="checkbox"/> 100 MIN											
Task	✓	Task	✓	Task	✓	Task	✓	Task	✓	Task	✓
Water Supply		Preplans		Exposures		Utility Control		Confinement		Gas Company	
Ventilation		Power Company		Salvage		Public Utilities		Overhaul		Building Inspector	
Salvage		Red Cross		EMS		Police		Salvage		Fire Investigator	
Fire Investigator		VDOT		Rehabilitation		Health Department		STAGING			
SIDE BRYVO				SIDE CHARLIE				SIDE DELTA			
SIDE ALPHA				SIDE CHARLIE				SIDE DELTA			

Figure 3. Incident command worksheet example, (courtesy of Va. Beach Fire Department).

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Recommendation #12: Fire departments need to ensure that critical incident benchmarks are communicated to the incident commander throughout the incident.

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. One of the most critical incident benchmarks that all personnel on the fireground should know is the current strategy. At any given time, every fire fighter and officer on the fireground should know the current fireground strategy. This is especially true on large fires where a defensive strategy has been established, incidents where the strategy has been changed from offensive to defensive, long-duration incidents, complex incidents, highly technical incidents, and incidents where the incident commander has been changed or rotated.

On a defensive fire, it is important to maintain accountability for all of the assigned divisions throughout the duration of the fire. This can be accomplished through the division or group leaders. These same division or group leaders, along with the safety officers, can help to ensure that the current strategy is known to all members operating and newer companies arriving in their divisions.

Additionally, on defensive fires building collapse is likely always a concern and enforcement of collapse and exclusion zones need to be communicated. Frequently those collapse and exclusion zones will need to be evaluated and changed on long-duration incidents.

It is critical that division or group leaders keep the incident commander informed of changing collapse or exclusion zones. Fire fighters have been killed when an exclusion zone change was not communicated to command [NIOSH 2013b].

On offensive fires, the size-up of interior conditions is just as important as exterior size-up. Water on the fire is a critical benchmark just as a search completion. The incident commander monitors exterior conditions while the company officers monitor interior conditions and communicate these conditions to the incident commander as soon as possible. Knowing the location and the size of the fire inside the building lays the foundation for all subsequent operations. Interior conditions could change the incident commander's initial strategy [Klaene and Sanders 2007].

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

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

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

plan will be out of sequence with the phase of the fire and the incident commander will be constantly surprised by changing conditions [Brunacini 2002; NIOSH 2015; Smith 2002].

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

The incident commander should develop the habit of using the critical factors in their order of importance as the basis for assigning the specific assignments that make up the incident action plan. The incident commander can never assume the action-oriented responder engaged in operational activities will stop what they are doing so they can feed the incident commander with a continuous supply of top-grade objective information. It is the incident commander's responsibility to do whatever is required to stay effectively informed [NIOSH 2015].

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

Recommendation #13: Fire departments should ensure the incident commander uses a Mayday tactical checklist in the event of a Mayday.

Discussion: When a Mayday is transmitted for whatever reason, the incident commander has a very narrow window of opportunity to locate the lost, trapped, or injured member(s). The incident commander must restructure the strategy and incident action plan (tactics) to include a priority rescue [NFPA 2014]. The use of a checklist in times of high anxiety or extreme pressure can help to ensure that critical tasks or items are considered. Many industries (such as transport agencies) use a checklist to help decision makers calmly initiate the necessary steps to try to resolve or deal with the emergency.

Some departments have adopted the term "LUNAR"—location, unit assigned, name, assistance needed, and resources needed—to gain additional information in identifying a fire fighter who is in trouble and in need of assistance. The incident commander, division/group supervisors, company officers, and fire fighters need to understand the seriousness of the situation. It is important to have the available resources on-scene and to have a plan established prior to the Mayday [Brunacini and Brunacini 2004; NFPA 2014].

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

A sample checklist is provided in “Appendix 1: Command Worksheet for Mayday.” This checklist can assist the incident commander in ensuring the necessary steps are taken to clear the Mayday as quickly and safely possible. This checklist serves as a guide and can be tailored to any fire department’s Mayday procedures. Some departments store the Mayday checklist under glass on the command board. The intent of the checklist is to provide the incident commander with the essential actions to be taken in the event of Mayday. This format allows the incident commander to follow a structured worksheet. This process is too important to operate from memory and risk missing a vital step that could jeopardize the outcome of the rescue of a fire fighter who is missing, trapped, or injured.

At this incident, when the Mayday was sounded, there was initial confusion as to which fire fighters were missing. There were fire fighters on-scene with the same first names and same last name as the assistant fire chief. Once the confusion was resolved, a rapid intervention crew from Squad 18 entered the building to locate the missing fire fighters.

References

- Brunacini AV [2002]. Fire command. Quincy, MA: National Fire Protection Association.
- Brunacini AV, Brunacini N [2004]. Command safety. Phoenix, AZ: Across the Street Publications.
- Dodson D [1999]. Fire department incident safety officer. 1st edition. Clifton Park, NY: Thomson Delmar Learning.
- Dodson D [2007]. Fire department incident safety officer. 2nd ed. Boston, MA: Centage Learning.
- Dunn V [1992]. Safety and survival on the fireground. Saddle Brook NJ: Fire Engineering Books and Videos.
- Dunn V [2000]. Command and control of fires and emergencies. Saddle Brook, NJ: Fire Engineering Book and Videos.
- Fire and Rescue Departments of Northern Virginia [2013]. Engine company operations. In: Fire and Rescue Departments of Northern Virginia, Firefighting and emergency operations manual. 2nd ed. Fairfax County, VA: Fire and Rescue Departments of Northern Virginia.
- FIRESCOPE [2015]. Incident command system for structure fire operations, ICS 500. Riverside, CA; FIRESCOPE. <http://firescope.org/>. [FIRESCOPE Downloadable Documents](#)
- FIRESCOPE [2017]. [Field operations guide](#), ICS 420-1. Riverside, CA; FIRESCOPE. [FIRESCOPE Downloadable Documents](#)
- IAFC [2013]. . [Rules of Engagement Training Poster](#). Fairfax, VA: International Association of Fire Chiefs, Health, and Survival Section
- IAFF [2010]. [IAFF Fire Ground Survival Training Program](#). Washington, DC: International Association of Fire Fighters.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

IFSTA [2008]. Essentials of fire fighting and fire department operations. 5th ed. Stillwater, OK: Fire Protection Publications, International Fire Service Training Association.

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

Kipp JD, Loflin ME [1996]. Emergency incident risk management. New York: Van Nostrand Reinhold.

Klaene B, Sanders R, NFPA [2007]. Structural firefighting strategy and tactics. 2nd ed. Sudbury, MA: Jones & Bartlett Learning.

Layman L [1953]. *Firefighting tactics*. Boston, MA: National Fire Protection Association.

MABAS [2015]. MABAS Division 201, operations manual. Mishawaka, IN: Mutual Aid Box Alarm System.

Modern Fire Behavior [2014]. [SLICE-RS](#). ModernFireBehavior.com.

Naum CJ [2012a]. Building anatomy: types and classifications. Firehouse Mag, July.

NFPA [1998]. Fire department occupational health and safety standards handbook. By Foley S. Quincy, MA: National Fire Protection Association.

NFPA [2013]. NFPA 1500 standard on fire department occupational safety and health program. Quincy, MA: National Fire Protection Association.

NFPA [2014]. NFPA 1561 standard on emergency services incident management system and command safety. Quincy, MA: National Fire Protection Association.

NFPA [2015]. NFPA 1521 standard for fire department safety officer and professional qualifications. Quincy, MA: National Fire Protection Association.

NFPA [2017]. NFPA 1142, *Standard on water supplies for suburban and rural fire fighting*. Quincy, MA: National Fire Protection Association.

NIOSH [2005]. [Career fire fighter dies and two career captains are injured while fighting night club arson fire—Texas](#). By McFall M, Tarley J. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2004-14.

NIOSH [2008a]. [Two career fire fighters die and captain is burned when trapped during fire suppression operations at a millwork facility—North Carolina](#). By Merinar T, Bowyer M. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2008-07.

NIOSH [2008b]. [Volunteer fire chief killed when buried by brick parapet wall collapse—Texas](#). By Merinar T., 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, F2008-21.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

NIOSH [2010a]. [Career fire fighter dies after being trapped in a roof collapse during overhaul of a vacant/abandoned building—Michigan](#). By Miles S.T., Bowyer M. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2008–37.

NIOSH [2010b]. [Career lieutenant dies following floor collapse into basement fire and a career fire fighter dies attempting to rescue the career lieutenant—New York](#). By Wertman S. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2009-23.

NIOSH [2010c]. NIOSH Alert: Preventing deaths and injuries of fire fighters using risk management principles at structure fires. Cincinnati, OH: 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. 2010-153, [NIOSH Alert Using Risk Management principals](#) <https://www.cdc.gov/niosh/docs/2010-153/> Date accessed 07/07/2018.

NIOSH [2012]. [Career lieutenant and fire fighter killed and two fire fighters injured by wall collapse at a large commercial structure fire—Pennsylvania](#). By Miles S.T., Merinar T., Loflin M., Bowyer M. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2012–13.

NIOSH [2013a]. Career fire lieutenant killed by roof/ceiling collapse during overhaul - Georgia. By Miles S.T., Merinar T., Tarley J. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute of Occupational Safety and Health, F2013-27. [Career fire lieutenant killed by roof/ceiling collapse during overhaul - Georgia](#). <https://www.cdc.gov/niosh/fire/reports/face201327.html>

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

NIOSH [2014]. NIOSH workplace solution: preventing deaths and injuries to fire fighters by establishing collapse zones at structural fires. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2014-120. [NIOSH workplace solution: preventing deaths and injuries to fire fighters by establishing collapse zones at structural fires](#). <https://www.cdc.gov/niosh/docs/wp-solutions/2014-120/pdfs/2014-120.pdf?id=10.26616/NIOSH PUB2014120>. Date accessed 07/07/2018.

NIOSH [2015]. [Two fire fighters die and two fire fighters are injured at multi-occupancy fire with structural collapse—Missouri](#). By Loflin M, 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, F2015–15.

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Smith JP [2002]. Strategic and tactical considerations on the fireground. Upper Saddle River, NJ: Prentice Hall.

TriData Corporation [2003]. [Current status, knowledge gaps, and research needs pertaining to fire fighter radio communication systems](#). Report prepared for NIOSH. Arlington, VA: TriData Corporation.

USFA [1999]. Special Report: Improving Firefighter Communications. Emmitsburg, MD; United States Fire Administration.

USFA/IAFF [2016]. [Voice radio communications guide for the fire service](#). Emmitsburg, MD: U.S. Department of Homeland Security, U.S. Fire Administration. Washington, DC: International Association of Fire Fighters.

Varone JC [2003]. Firefighter safety and radio communication. *Fire Engineering* 156(3), <http://www.fireengineering.com/articles/print/volume-156/issue-3/features/firefighter-safety-and-radio-communication.html>.

Weather Underground [2014]. [Weather history for New Carlisle, August 5, 2014](#). Atlanta, GA: The Weather Channel Interactive, Inc.

Investigator Information

This incident was investigated by Stephen Miles and Murrey Loflin with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, located in Morgantown, West Virginia. An expert technical review was provided by Deputy Fire Chief William Goldfeder of the Loveland-Symmes (OH) Fire Department and editor of FireFighterCloseCalls.com. A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division. This report was authored by Stephen Miles.

Additional Information

Situational Awareness: Think past, present and future.

<http://www.samatters.com/situational-awareness-think-past-present-future/>

CommandSafety.com [2010]. [Predictability of occupancy performance during suppression operations](#).

<http://commandsafety.com/2010/02/predictability-of-occupancy-performance-during-suppression-operations/>

CommandSafety.com [2009]. [“Building Knowledge = Firefighter Safety”, Know Your District and its Risk](#). <http://commandsafety.com/2009/06/fireems-safety-health-and-survival-week-day-two-building-knowledge-firefighter-safety-know-your-district-and-its-risk/>

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

NIOSH [2011]. Paid-on-call fire fighter killed by exterior wall collapse during defensive operations at a commercial structure fire—Illinois. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report F2011-15. [Paid-on-call fire fighter killed by exterior wall collapse during defensive operations at a commercial structure fire—Illinois](https://www.cdc.gov/niosh/fire/reports/face201115.html). <https://www.cdc.gov/niosh/fire/reports/face201115.html>

NIOSH [2012]. Career fire fighter dies following structure collapse at a triple-decker residential fire—Massachusetts. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report F2011-30. [Career fire fighter dies following structure collapse at a triple-decker residential fire—Massachusetts](http://www.cdc.gov/niosh/fire/reports/face201130.html). <http://www.cdc.gov/niosh/fire/reports/face201130.html>

NIOSH [2013]. Career lieutenant and fire fighter killed and two fire fighters injured by wall collapse at a large commercial structure fire—Pennsylvania. By Miles S. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Fatality Assessment and Control Evaluation (FACE) Report F2012-13. <http://www.cdc.gov/niosh/fire/pdfs/face201213.pdf>

National Institute for Occupational Safety and Health, *NIOSH Alert: Preventing Injuries and Deaths of Fire Fighters due to Structural Collapse*, **DHHS (NIOSH) Publication No. 99-146** (August 1, 1999).

The National Institute of Standards and Technology (NIST) [Building and Fire Research Laboratory](http://www.fire.nist.gov/) maintains a website with links to publications on a number of fire safety topics: <http://www.fire.nist.gov/>

NIST [2003]. [Building and Fire Research Laboratory](http://www.fire.nist.gov/) Early warning capabilities for firefighters: testing of collapse prediction technologies. http://www.fire.nist.gov

NIST [2003]. [Trends in Firefighter Fatalities Due to Structural Collapse](http://www.fire.nist.gov/bfrlpubs/fire03/art024.html), 1979–2002. <http://www.fire.nist.gov/bfrlpubs/fire03/art024.html>.

Structural Collapse Research at NIST. Volume 1. Interflam 2007. (Interflam '07). International Interflam Conference, 11th Proceedings. Volume 1. September 3–5, 2007, London, England, 593–604 pp, 2007. Stroup, D. W.; Bryner, N. P.

Disclaimer

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

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Additional Photos:



Additional Photo #1, taken while driving by.
(Photo courtesy off duty mutual aid Fire Chief Al Kirsits.)

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana



Additional Photo #2, taken from highway showing heavy fire involvement prior to FD units arriving. (Photo courtesy off duty mutual aid Fire Chief Al Kirsits.)

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

Appendix 1

COMMAND WORKSHEET FOR “MAYDAY”

■ Gather

- Location _____
- Unit _____
- Name _____
- Air Supply _____
- Resources Needed _____

■ Are other crew members or crews involved?

■ Deploy RIT to area reported or last known work area

■ Announce URGENT radio traffic only

■ Have Dispatch:

Initiate the May-Day Protocol

- Send one additional alarm
- Send tech rescue vehicle
- Send one more ambulance than the number of missing or trapped Fire Fighters
- Duty Officer (duty officer will callback other chief officers to support operation)
- Contact special rescue teams if requested
- Monitor all radio channels

■ Change the Incident Action Plan to high priority rescue effort

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

- Tell fire fighter(s) calling May-Day, crew members' nearby and the RIT team to stay on the fire ground channel. The I/C will become the Rescue Branch Director
- Announce the name _____ of the new I/C and tell everyone else to move to channel _____

■ New IC

- Assure that everyone changes to the new fire ground channel and conduct a PAR – withdraw only if NECESSARY – DO NOT abandon fire fighting positions
- Move up or Reinforce fire fighting efforts to support the Rescue Branch
- Backup RIT for deployed RIT
- Coordinate a staging area with Rescue Branch for equipment and 2nd alarm companies
- Next Chief Officer on scene will take COMMAND
- Assign a Safety Officer

■ Monitor Structural Stability of Building

- Consider the Pro's and Con's on ventilation, forcible entry and fire stream placement on the rescue
- Consider writing off parts of the building or pushing or drawing the fire into uninvolved areas to support rescue
- Consider a secondary means of egress for the rescue operation – *while considering how opening the building may negatively affect rescue efforts*

■ Rescue Support

- Rescue Branch Director will have a support person log times of personnel entering and exiting rescue area
- Stage equipment near the entry/exit point
- Stage EMS and ambulances near the entry/exit point
- Stage crews to support the RIT/Rescue operation near the entry/exit point
- Provide lighting at the entry/exit point

Volunteer Assistant Chief Killed and One Fire Fighter Injured by Roof Collapse in a Commercial Storage Building—Indiana

■ Changes on the Fireground

- Conduct a PAR after the rescue operation is completed
- Conduct a PAR if an emergency retreat is ordered due to structural stability or fire condition issues

■ Assign PIO

- Chief Officer
- Set-up Media Area
- Control information releases

Command Worksheet for Mayday, Courtesy of the Virginia Beach Fire Department.