1000 FREDERICK LANE, MORGANTOWN, WV 26508 • 304.285.5916

Career Firefighter Seriously Injured During Search Operations in a Residential Structure Fire – Oregon

Executive Summary

On May 30, 2024, a 33-year-old career firefighter (E31FF1), was seriously injured during flashover while conducting search operations in a one-story residential structure. A second firefighter (E31FF2), partnered with E31FF1, also suffered injuries during the event. At 21:02 hours, multiple 9-1-1 calls were received reporting a structure fire. Several of the calls reported occupants in the structure. The following units were dispatched: Engine 31 (E31), Engine 74 (E74), Engine 73 (E73), Engine 71 (E71), Truck 71 (T71), and Battalion Chief 7 (BC7). Rescue 31 (R31) was also added. At 21:07 hours, E31 arrived on-scene. The E31 officer gave a quick size-up and assumed Command. E31's crew, E31FF1 and E31FF2, were assigned fire suppression. As they were preparing to enter the structure, multiple civilians indicated a child with disabilities was trapped in the home. They decided to make a quick entry without a hoseline from the Side Alpha entry door. R31 arrived on-scene and was assigned to proceed with establishing a backup hoseline. Command reported E31's change of assignment confirming they were not in possession of a hoseline when they entered the structure. Command then ordered R31 to perform fire suppression; however, there was a delay in R31 initiating a fire attack. The occupant approached R31's crew frantically telling them her child was in the structure. As an E31 crew entered the structure, they traveled down a center wall and made a right turn to a hallway. As they proceeded down the hallway, they encountered a bedroom on the right side (Side Alpha). E31FF2 entered the first bedroom on Side Alpha while E31FF1 proceeded to look in the second bedroom located on Side Alpha/Delta corner. Conditions were rapidly changing and E31FF1 informed E31FF2 that "we need to get out of here." During this time, an R31 crew retrieved and put a hoseline in service outside the structure, but there was no water pressure. The preconnected hoseline was kinked at the

Photo 1: Side Alpha of the structure post-fire.
(Courtesy of the fire department)

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discharge located on the right side of the pumper. As E31's crew started to exit the structure they traveled down the hallway toward Side Bravo. A flashover occurred with fire traveling throughout the entire interior open space consisting of the living room, dining area, and kitchen. When E31FF2 got to the end of the hallway he turned left, leading him to the Side Alpha entry door exiting the structure. However, E31FF1 became disoriented and traveled across the living room toward the Side Bravo wall. Becoming more confused and disoriented he reversed direction, returning down the hallway, until he got to the end. He reentered the bedroom at the Side Alpha/Delta Corner which he was searching previously and exited out of the bedroom window. Once on the exterior of the building, he was treated by advanced life support (ALS) personnel and was transported to a hospital burn center. The fire was extinguished, and no occupants were inside the structure. E31FF1 sustained third degree burns covering 45% of his body.

Contributing Factors

- *Size-up and risk assessment*
- *Risk-benefit analysis*
- *Fire behavior/fire dynamics and tactics*
- *Freelancing/fireground operations procedures*
- *Incident Safety Officer (ISO)*
- *On-scene radio communications*
- *Uncoordinated ventilation by occupants/flow path.*

Key Recommendations

Fire departments should ensure:

- *Initial and ongoing size-ups and risk assessments are conducted throughout the incident.*
- *Initial arriving firefighters to a fire with a report of trapped occupant(s) consider the risk-benefit analysis of commencing a search versus committing to fire suppression operations, if staffing is limited.*
- *Firefighters and fire officers are trained in fire dynamics, recognition of flow paths, and interior fire attack techniques utilizing door control.*
- *Fireground operations procedures are developed, trained on, and followed by fire officers and firefighters.*
- *Response plans include a dedicated and trained ISO.*
- *Firefighters protect new and older radios and cables by wearing radio straps under their turnout coat, with the radio extended below the bottom of the coat and the antenna tilted away to protect the cable from damage.*
- *Fire prevention efforts educate the community to help change knowledge, attitudes, and behaviors that can reduce risks, injuries, and fires within the community.*

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

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Introduction

On May 30, 2024, a 33-year-old firefighter (E31FF1) was seriously injured during a rapid-fire progression while searching for a reported trapped child in a residential structure fire. His injuries consisted of burns to 45% of his body. E31FF1's partner was a 28-year-old firefighter (E31FF2) and was injured with minor burns to his upper body. On June 4, 2024, the chief of the fire department notified the National Institute for Occupational Safety and Health (NIOSH) of this serious injury (SI) incident and requested an investigation. On July 14-19, 2024, two investigators from the NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) along with a representative from the International Association of Firefighters (IAFF) traveled to Oregon to investigate this SI incident. The investigators conducted interviews with command officers, fire officers, firefighters, and other emergency personnel who were on-scene during the response. Also, the investigators inspected the personal protective equipment (PPE) used by the firefighters and reviewed fire department standard operating guidelines (SOGs), training, dispatch, and other records.

Fire Department

The career fire department in this SI incident has a 60 square mile jurisdiction, serves a population of 110,000 residents, responds to an average of 22,000 calls annually, and provides emergency medical services (EMS). The fire department is comprised of 114 uniformed personnel and seven staffed stations. There are three shifts (A, B, and C) which operate on a 24-hours on, 72-hours off, 48-hours on, 72-hours off schedule. Each shift is led by a battalion chief and includes station captains, lieutenants, and firefighters. The fire department is led by a fire chief and assistant chief.

Divisions overseen by the assistant chief include:

- **Emergency operations division:** Responsible for emergency medical calls, fire suppression services, and specialized responses including confined space, high angle rope rescue, structural collapse, water rescue, hazardous materials response, and wildland firefighting.
- **Training and safety division:** Responsible for providing the department's minimum training standards for all levels of certifications.
- **Life safety division:** Responsible for applying fires codes to new construction, ensuring appropriate fire access, water supply, safety features, including fire alarm systems, and sprinklers systems are code compliant. The fire marshal leads the division, which handles all fire investigations, determining cause for known arson fires, significant fire loss, and fire fatalities.

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Training, Education, and Professional Development

The fire department maintains a training division that provides initial training and continuing skills development for all firefighters, fire officers, and EMS personnel. Newly hired firefighters go through a 13-week academy at the training center and follow the curriculum in *NFPA 1001 Firefighter Task* book, which was adopted by Oregon Department of Public Safety. Upon completion, new firefighters are paired with a senior firefighter and spend the next four shifts at a fire station. After four shifts with a senior firefighter, the new firefighters are deemed fit to be the lone firefighter in the back of an apparatus. After the training academy, firefighters receive a minimum of 60 hours of fire training every two years. All firefighters in the department are trained at the minimum level of Emergency Medical Technician (EMT) Basic through state certification. All engine companies are ALS units, which means each has a firefighter/paramedic on board.

E31FF1 had three years of total fire service with the department. He maintained training in and held numerous certifications as Fire Fighter I, Fire Fighter II, Fire Apparatus Driver/Operator, Hazmat Awareness, and EMT provider.

Apparatus, Staffing, and Communications

At 21:03 hours, the following units were dispatched for Box 3118:

Apparatus	Staffing	Arrival On-Scene
Engine 31 (E31)	4	21:07
Rescue 31 (R31) *added*	2	21:07
Battalion Chief 7 (BC7)	1	21:08
Engine 71 (E71)	3	21:08
Engine 74 (E74)	3	21:09
Truck 71 (T71)	4	21:09
Engine 73 (E73)	3	21:10

The flashover in this incident occurred at 21:08 hours, prior to the arrival of five of the dispatched units.

Building Construction

The one-story residential structure was a type V, wood-frame constructed building (**see Photos 2 and 3**). It was 936 sq ft and built in 1956. There was a 992 sq ft attached garage on the Bravo/Charlie corner of the building. In 2010, the garage was converted into a fully functional residence. There was no access from the main home to the converted garage. The fire building contained three bedrooms and one full bathroom. The living room, dining room, and kitchen were designed with an open floor plan. The interior finishes consisted of gypsum board walls and vinyl laminated flooring.

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Photo 2: Side Alpha of the structure pre-fire.
(Courtesy of the fire department)

Photo 3: Side Charlie of the structure pre-fire.
(Courtesy of the fire department)

Personal Protective Equipment

At the time of the SI incident, the seriously injured firefighter (E31FF1) was wearing full structural firefighting turnout gear and a NIOSH Approved® SCBA. The investigators examined and photographed the PPE (**see Photos 4a, 4b, and 4c**). Investigators noted that the portable radio worn by E31FF1 was worn in a radio pocket of the turnout coat with the remote speaker microphone (RSM) cable positioned around the firefighter's collar. This positioning first, directly exposed the cable to fire conditions and second, caused the radio to unintentionally transmit, which rendered the channel useless for fireground communications. Extensive thermal damage was noted to both the portable radio and RSM.

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Photos 4a, b, and c: E31FF1's structural turnout gear (4a), gloves (4b), and portable radio showing extent of damage (4c).
(Courtesy of NIOSH)

Weather Conditions

On May 30, 2024, at 20:53 hours, the weather condition was fair, winds out of the Northwest at 9 mph with no reported wind gust. The temperature was 60°F, the dew point was 40°F, the humidity was 55%, and there was no precipitation in the last 24 hours leading up to the incident [Weather Underground 2024].

Investigation

At 21:02 hours, the first of several 9-1-1 calls were received by dispatch reporting a one-story residential structure on fire. The initial condition was described by the caller as smoke coming from the structure. Additional calls were received with many of the callers unsure of the exact address and indicating they saw a person in the front door. At 21:03, hours, Box 3118 was dispatched for a structure fire. The dispatcher, unable to determine the exact address, shared two possible locations. E31, E74, E73, E71, T71 and BC7 were dispatched with Operations 4 as the designated radio channel. At 21:05, R31 requested to be added to the assignment. At 21:06 hours, dispatch provided an update regarding the correct location and the report of possible people inside the structure. Medic 346 was also added to the assignment. Prior to the arrival of the responding units, occupants attempted to perform ventilation to air out the building which inadvertently facilitated a significant change in fire behavior.

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E31 arrived on-scene at 21:07 hours, reporting a one-story wood-frame house with smoke showing from Side Alpha. The E31 officer established Command and began to operate from the inside of E31's cab. Command ordered E31's crew, consisting of E31FF1 (seriously injured firefighter) and E31FF2 (injured firefighter), to perform fire suppression. Additionally, Command assigned R31 to establish a backup hoseline. As E31's crew exited the unit, one civilian told them there was a child with disabilities in the bedroom on Side Alpha. At the same time, two other civilians notified Command that there were people inside the house. As the incident continued, the civilians began to scream in both English and Spanish about the trapped occupants which added stress to the firefighters operating on-scene. Based upon these reports, E31FF1 and E31FF2 donned their SCBA facepieces at the front door of Side Alpha. The two firefighters went into "rescue mode" to enter and rapidly search the structure without the protection of a hoseline.

Photo 5: E31FF1 and E31FF2 preparing to enter the structure. ***(Courtesy of the fire department)***

As E31FF1 and E31FF2 prepared to enter the structure (**see Photo 5**), R31 arrived on-scene. After hearing reports of a trapped child, a R31 firefighter (R31FF1) went to Side Charlie without notifying Command. Once he arrived on Side Charlie, a bystander stated there was a child in the bedroom that was hearing impaired. R31FF1 entered the structure on Side Charlie searching for the child. R31FF2 proceeded to E31 as E31's driver/operator (E31DO) pulled a 1¾ hoseline from the officer's side of the crosslay. The line was severely kinked due to failure of the webbing that secures the hose bed during travel releasing from the retention ring. As E31FF1 and E31FF2 entered the structure, Command realized the firefighters did not have a hoseline. Command made an announcement on the radio stating the E31 crew entered the structure without a handline and requested R31 to perform fire suppression on Side Alpha. At the same time, R31FF1 observed worsening conditions, exited Side Charlie, and returned to Side Alpha.

E31FF1 and E31FF2 proceed through the front door and made their way along the righthand wall of the open living room to reach a hallway (**see Diagram 1**). They made a right turn down the hallway. E31FF2 entered a bedroom on the right side of the hallway (Side Alpha) to conduct a search. While he was searching the bedroom, E31FF1 remained in the hallway but proceeded further down to look in the next bedroom (Alpha/Delta corner). He observed worsening conditions inside with a rapid increase in heat as firefighters on the outside observed the smoke coming from the Side Alpha door change from gray to black with a glow visible below the smoke layer. E31FF1 returned to the first bedroom and told E31FF2 that they need to exit the structure. E31FF1 led the way with E31FF2 following after exiting the bedroom. At the same time, E31DO charged the handline pulled from the crosslay. R31FF2 advised that there was no pressure in the line.

E31FF1 followed the righthand wall of the hallway, entered the middle of the living room, and became disoriented. E31FF2 followed the lefthand wall (keeping one shoulder on the wall) of the hallway,

making the left when entering the living room, and exited through the Side Alpha door in a standing position. E31FF1 reversed direction and proceeded down the hallway towards the second bedroom that he previously attempted to search (Side Alpha/Delta corner).

BC7 arrived on-scene and assumed Command. He directed E31's officer to join his crew for fire suppression. E31FF2 proceeded to Side Bravo to observe conditions where he was asked whether E31FF1 was also out of the structure. Having observed another firefighter on Side Alpha, he indicated that E31FF1 was clear. E71 arrived on-scene and began to secure a water supply to the hydrant and assist with fire suppression. The handline R31FF2 operated on Side Alpha still had no pressure. He was joined with E31FF2 and an E71 firefighter. The E31DO increased discharge pressure to fix the issue as T71 arrived on-scene and was assigned primary search. They proceeded with flaking out the hose with little results. It was determined the hose was kinked at the preconnected hoseline at the discharge located on the officer's side of E31.

Engine 74 arrived on-scene and was tasked with providing a 360 size-up. An unintelligible radio transmission was heard from E31FF1 with an open mic that lasts 55 seconds. Dispatch confirmed to Command that an E31 radio had an open mic which disabled all fireground communications. E74 firefighters proceeded with their size-up, moving counterclockwise (from Side Delta to Side Charlie). At the same time, E31FF1 exited the structure through the bedroom 2 window of Side Alpha T71 who had been advised there was a trapped child in the bedroom of Side Alpha proceeded to the window of bedroom 2 and cleared it with a hook with the intent of entering for a search. Taking the window caused the smoke layer to transition to flaming combustion. Based upon conditions observed, they decided to enter the structure from Side Charlie instead. Dispatch again relayed that an E31 radio had an open mic.

E31FFI proceeded to the Side Alpha/Bravo corner and was met by the E31 officer who was checking on him based on his visual condition. At 21:10 hours, E31's officer radioed Command that he had a firefighter who needed immediate medical attention. E73 arrived on-scene, taking the medical assignment, as Command requested a second alarm. They rushed to E31FF1 with ALS equipment. Engine 74 firefighters pulled a booster line from E31 and applied water to E31FF1 to cool down his turnout gear and SCBA. With E73 firefighters, they began to remove his PPE and cut his turnout pants off. He was placed on oxygen by a non-rebreather mask while waiting for Medic 340 to arrives on-scene. At 21:13 hours, Medic arrived and E31FF1 was loaded and transported to a hospital burn center for his injuries. The fire was soon declared under control with additional searches not finding the reported trapped child.

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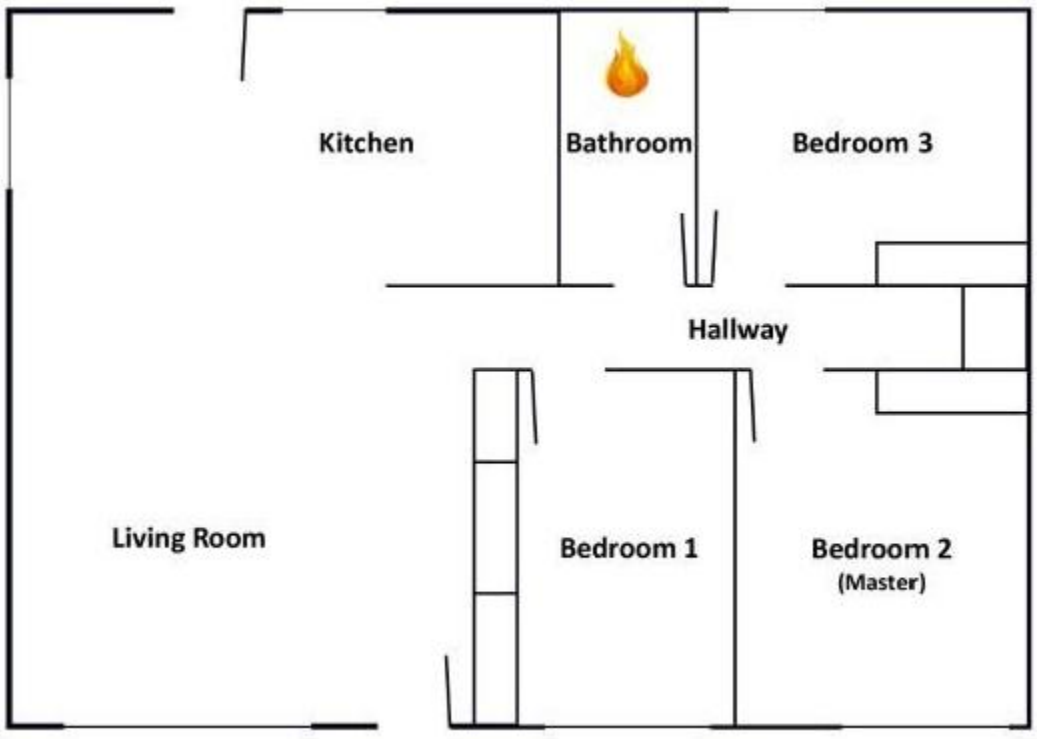

Diagram 1: Floor plan, view from Side Alpha.
(Courtesy of the fire department)

Fire Cause and Origin

According to the fire department's life safety division, the fire was started when a burning candle ignited plastic shower curtains in the bathroom. Prior to the arrival of the responding units, occupants attempted to perform ventilation to air out the building which inadvertently facilitated a significant change in fire behavior which led to the flashover.

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 serious injuries or fatalities. NIOSH investigators identified the following items as key contributing factors in this SI incident that ultimately led to the SI:

- Size-up and risk assessment
- Risk-benefit analysis
- Fire behavior/fire dynamics and tactics
- Freelancing/fireground operations procedures
- ISO
- On-scene radio communications
- Uncoordinated ventilation by occupants/flow path

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Cause of Serious Injury

According to the fire department, E31FF1 sustained third degree burns covering 45% of his body due to the flashover.

Recommendations

Fire departments should ensure:

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

Discussion: Dispatch advised responding units to this SI incident there was a possibility of occupants inside the structure. Once the units arrived, an occupant indicated a child with disabilities was trapped in the structure. Additional bystanders approached fire personnel reporting trapped occupants. There was a rapid entry into the structure without the protection of a hoseline. The speed of the decision prevented a full scene-size up and risk assessment to be completed prior to entry. Once C7 arrived, he gave an order to E74 to conduct a 360; however, the flashover had already occurred, and no updated fire conditions were transmitted as a result of the 360.

Continuous communication supports effective risk assessments. It also allows the incident commander and all personnel operating at an incident to be aware of changing conditions and adjust to avoid hazards or mitigate risks. Performing the 360° is an important component of the scene size-up and can be used in the risk assessment. The International Association of Fire Chiefs' *Rules of Engagement for Structural Firefighting* recommends that the first rule for ICs is to rapidly conduct or obtain a 360° situational size-up of the incident. Many incidents contain obstacles to prevent the viewing of all sides of a structure. This included the attached garage and fence that obstructed the view to Side Charlie. When the 360° reconnaissance is achieved, it provides the incident commander and personnel knowledge of the building layout, construction, access/egress points, fire location and direction of spread, and obstacles or hazards. It allows the incident commander and personnel to know how much air is entering the structure from existing openings and what options are available for future ventilation [NIOSH 2017].

Recommendation #2: Initial arriving firefighters to a fire with a report of trapped occupant(s) consider the risk-benefit analysis of commencing a search versus committing to fire suppression operations, if staffing is limited.

Discussion: Ongoing research from the Fire Safety Research Institute (FSRI), a part of UL Research Institutes, shows the importance of getting effective water on the fire as quickly as possible from a position of advantage. If staffing and resources permit, both search and suppression operations should occur simultaneously and without delay. Should the initial arriving unit be limited in staffing, strategy and tactics may need to incorporate sequential versus simultaneous operations until more personnel are on the scene and available. As such, a decision will need to be made as to whether the personnel and resources will commence a search for the reported occupant or engage in fire suppression [Weinschenk et al 2022; Regan et al. 2020; Zevotek 2018].

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Prior to making a decision to commence a search, possibly without the protection of a hoseline, several things need considered:

- The current fire location and progression in the structure
- The reported location of the occupant(s)
- The estimated arrival of the next unit capable of beginning suppression operations
- The ability to isolate and compartmentalize spaces during the search

If the first arriving fire officer decides to commence a search without the protection of a hoseline, in lieu of suppression operations, the following actions should occur:

- Communicate this decision via fireground radio including the need for immediate suppression operations upon the arrival of the next unit capable of doing so
- Upon entering the structure, attempts should be made to enact door control at the entry point to limit the available fresh air and subsequent fire growth
- As the search crews move throughout the structure, all compartmentalizable spaces should be isolated if possible
- If the fire room(s) are located during the search, attempts should be made to isolate the fire areas from the remainder of the searchable space
- Pressurized water can(s) should be brought with the search crew to provide protection as needed

Recommendation #3: Firefighters and fire officers are trained in fire dynamics, recognition of flow paths, and interior fire attack techniques utilizing door control.

Discussion: In 2009, the fire academy removed training on fire behavior and fire dynamics from its curriculum to accommodate a shortage of instructors. Upon observing the location of the fire, E31FF1 did not close the bathroom door to isolate it. R31FF1 entered the Side Charlie of the structure and other firefighters cleared additional windows which created additional flow paths.

Research has been conducted by NIST, FSRI, and the International Society of Fire Service Instructors on modern fire dynamics involving heat release rates, new building construction techniques, and the composition of modern home furnishings. In years past, these home furnishings were largely composed of natural products such as wood and cotton. Today, many of these home furnishings are now manufactured using petroleum-based synthetic materials that generate high heat release rates as well as toxic and flammable smoke. Consequently, common, everyday structure fires can create an oxygen depleted environment with fuel rich smoke that can sustain combustion given the appropriate mixture of air and heat.

A flow path is defined by NFPA as “the movement of heat and smoke from the higher pressure within the fire area towards the lower pressure areas accessible via doors, window openings, and roof structures” [NFPA 1410 2020]. Flow paths consist of an inlet and an exhaust with the direction of travel being determined by pressure. Heat and smoke in a high-pressure area will travel to an area of lower pressure. It is possible to have multiple flow paths within a structure dependent upon the size of the building, openings, closures such as fire doors, and overall structure design. Personnel working in the

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flow path (between the seat of the fire and the exhaust) are operating in a significantly risky environment. Coordinated ventilation tactics should be utilized to redirect the flow path from interior operations.

The International Fire Service Training Association (IFSTA) notes in the 7th Edition of the Essentials of Firefighting that, "when firefighters advance a hoseline or ventilate windows to make entry into a building, they establish new flow paths between the fire compartment (in this case the location) and exterior vents of the building" (**see Figure 1**) [IFSTA 2018].

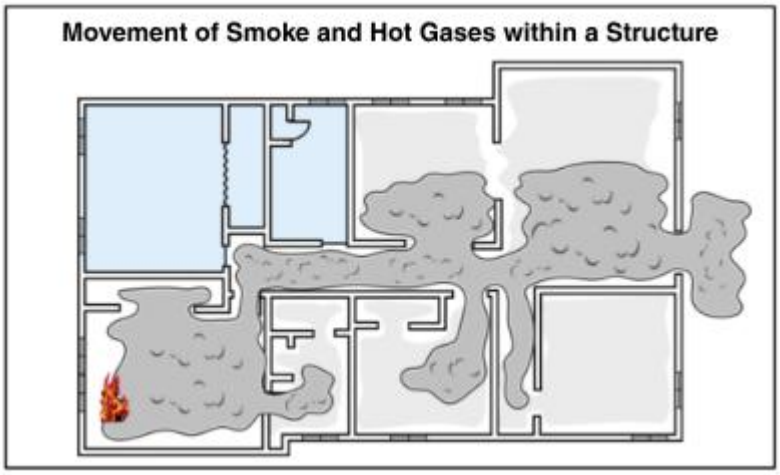

Figure 1. Movement of Smoke. (*Courtesy of IFSTA*)

When identifying the flow path within a structure, personnel should be mindful to wind conditions. Wind can create pressure changes within a structure or building which could spread both smoke and fire into non impacted parts of the structure or building. Interior firefighting personnel should be mindful to these changes in conditions that place the interior firefighting personnel in the exhaust portion of the flow path. Sudden changes in temperature and smoke are factors that should alert interior personnel of imminent changes to conditions.

Understanding that modern fuel loads inside of residential structures creates flammable gasses that will sustain combustion interior fire attacks should utilize thermal imaging devices. Water should be applied to the fire as quickly as possible utilizing the reach of an effective fire stream that is delivering an appropriate volume of water to overcome the heat release rate. In some cases, it may be appropriate to introduce water from the exterior of a structure through a window/door with an attack line or begin the fire attack from the exterior with a coordinated blitz attack flowing 300 gallons per minute or greater before committing personnel to the interior. Fire departments should be cooling interior spaces from the safest and closest location possible, especially in vent limited spaces.

Maintaining door control is critical during interior operations. Opening a door changes the ventilation profile of the structure and may have an adverse effect on fire behavior [IFSTA 2013]. Controlling the door limits the fresh air available to the fire and reduces the flow path. Door control is a critical

component of coordinated ventilation and fire attack. Once water is applied to the fire, it is no longer ventilation limited. This allows for more rapid and safer ventilation [Gray and Norwood 2024]. The use of a pressurized water extinguisher to reduce the amount of fire to gain control of the fire room door can be effective. This would isolate the fire. Even if the door was partially burned through, it would limit fire growth and spread and provide time for primary search.

Fire departments can develop training from available resources or requisition existing training. Fire behavior/fire dynamics trainings are available through FSRI, fire academies, and private fire training organizations. Fire departments can develop SOGs using the information and response techniques learned from these trainings.

Recommendation #4: Fireground operations procedures are developed, trained on, and followed by fire officers and firefighters.

Discussion: During this SI incident, multiple firefighters engaged in freelancing and employed a number of different tactics and strategies based upon individual decisions. This began with the two firefighters going into "rescue mode" to enter and rapidly search the structure without the protection of a hoseline. NIOSH investigators found that "rescue mode" was a tactic that was not defined in any procedure or policy for fireground operations. After realizing he was in danger, E31FF1 did not activate his PASS device or employ Mayday/firefighter survival techniques.

Fire departments should develop fireground operations procedures that are clear and understood by all firefighters. Established procedures create better structure and accountability of actions during an incident. These procedures should include the following areas relative to this incident:

Transfer of Command

When command is transferred, it is the responsibility of the IC to communicate critical information to the person taking over. This includes the current accountability, assignments, and actions of on-scene personnel; current incident conditions, incident conditions, safety concerns, and benchmarks [NIOSH 2024]. This includes any other critical information that may have been missed while other units are enroute to the incident.

Communications

Effective fireground radio communication is an important tool to ensure fireground command and control as well as helping to enhance fire fighter safety and health. The radio system must be dependable, consistent, and functional to ensure that effective communications are maintained, especially during emergency incidents. Key components for effective fireground communications include requirements for transmitting strategic modes of operation and situational reports; personnel accountability reports, emergency traffic including Mayday; and receipt of critical transmissions [NFPA 1550 2024].

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Mayday/Firefighter Survival

Firefighters should be trained in how to call a Mayday when in danger. Any delay in calling a Mayday reduces the chance of survival and increases the risk to other firefighters trying to rescue the "downed" firefighter. Firefighters should have 100% confidence in their competency to declare a Mayday and follow the GRAB LIVES Mayday procedures. Fire departments should ensure that any personnel who enter a hazard zone have been trained and are proficient in Mayday competencies [IAFF 2010a; 2010b].

Training on Fireground Operations

To ensure the proficiency and competency of fire department members, fire departments should conduct annual training and skills evaluations to verify firefighters understand the established fireground operations procedures. NFPA 1550, *Standard for Emergency Responder Health and Safety*, requires a fire department to establish and maintain a training, education, and professional development program with the goal of preventing occupational deaths, injuries, and illnesses. This ensures member competencies are maintained to execute all responsibilities effectively, efficiently, and safely [NFPA 1550 2024]. NFPA 1410, *Standard on Training for Emergency Scene Operations*, defines basic evolutions, which are adaptable to local conditions and serves as a method for the evaluation of minimum acceptable job performance during training for fire suppression and rescue activities [NFPA 1410 2020]. Proficiency training for fireground operations and emergency incidents should occur annually. This training should include scene size-up, situational awareness, use of an incident management system, personnel accountability system, strategy and tactics, search and rescue, hoseline operations, ladder operations, ventilation, thermal imaging cameras, fireground communications, use of rapid intervention teams, and Mayday operations [NIOSH 2024].

Recommendation #5: Response plans include a dedicated and trained ISO.

Discussion: During this SI incident, the first IC operated from the cab of E31. Additional firefighters on-scene were tasked with fire suppression and search. A number of firefighters began tasks without notifying the incident commander of their actions or where they would be operating. At no time was a dedicated ISO established to supervise operations, fire behavior, and conduct accountability.

An ISO should be trained to NFPA 1550 which defines the requirements for the IC, including establishing a fixed command post, personnel accountability, the use of staff aides and RICs, and the appointment of an ISO and assistant safety officer(s) (as needed). The standard addresses the expectations and authority of the ISO. Expectations and authority include determining hazardous incident conditions, advising the incident commander to modify control zones or tactics to address corresponding hazards, communicate fire behavior and forecast growth, and estimate building/structural collapse hazards. This also includes the authority to stop or suspend incident operations based on imminent threats posed to firefighter safety [NFPA 1550 2024]. The ISO should be separate from the IC, operations, or accountability positions so they can focus on their responsibilities and the primary objective of continually assessing any and all on-scene hazards to firefighter life and safety.

A personnel accountability system is a system that readily identifies both the location and function of all members operating at an incident scene [NFPA 1550 2024]. This system is implemented during an

incident to collect and maintain the status and location of the resources working in, or potentially working in, an immediately dangerous to life and health IDLH environment. All members operating at an incident are responsible for understanding and participating in this system. The IC is responsible for but may delegate certain responsibilities to another person such as the ISO. An integral part of the accountability system is to make sure that the firefighters who are assigned and operating in the hazard zone are accounted for throughout the entire incident. A properly initiated and enforced personnel accountability system can enhance firefighter safety and survival [NIOSH 2024]. A functional personnel accountability system should have the ability to identify:

- Members operating in the hazard zone (who)
- Where members are in the hazard zone (where)
- Conditions in the hazard zone (conditions)
- Actions used in the hazard zone (actions)
- Paths of access and egress in and out of the hazard zone (exits)
- RICs and their assignments

Different methods and tools are available for resource accountability, including:

- Tactical worksheets
- Command boards
- Apparatus riding lists
- Company responding boards
- Electronic bar-coding systems
- Accountability tags or keys

Recommendation #6: Firefighters protect new and older radios and cables by wearing radio straps under their turnout coat, with the radio extended below the bottom of the coat, and with the antenna tilted away to protect the cable from damage.

Discussion: In this incident, E31FF1 was able to self-rescue out of a window but sustained significant burn injuries. The portable radio he had was placed in a radio pocket of his turnout coat with the RSM cable positioned around his collar. This positioning directly exposed the cable to fire conditions, eventually causing the radio to unintentionally transmit, rendering the channel useless for fireground communications. Extensive thermal damage was noted to both the portable radio and RSM.

Portable radios serve as an essential safety device allowing each firefighter to immediately report, or be notified of, changing conditions and emergencies that can affect their survival. As such, it is critical firefighters understand the conditions in which these devices may fail and how to protect them. Between 2004 and 2014, NIST conducted studies to determine the effect of high temperatures (160°C/320°F) on portable radios. Some of these studies demonstrated that direct exposure to high temperatures can melt the RSM and cable, resulting in loss of functionality for interior firefighters and disabled broader fireground communications due to unintentional transmissions. In these studies, failures occurred most often when portable radios were worn on the exterior of structural firefighting turnout gear with the RSM cable directly exposed to high temperatures (which was also the case in this current SI incident) [NIST 2006]. NIST findings from user-centered interviews noted that firefighters reported

being aware that the RSM cable is known to melt in high temperature environments, with a number of firefighter fatalities related to failure of radios and subsequent loss of communications [NIST 2018]. These studies led to the development of NFPA 1802. The standard includes a requirement for portable radios and their accessories to withstand temperatures up to 500°F for five minutes [NFPA 1802 2021].

Radios meeting the NFPA 1802 standard were first certified in 2022. It is likely that older radios are still in use and may not offer the same heat tolerance as newer radios designed to meet the standard. Firefighters may employ additional protection or other tactics for both new and older radios and cables with PPE.

Based on other studies, the NFPA 1802 standard, and this SI incident, proper placement of portable radios entails wearing the radio on straps, under the turnout coat, and with the radio extended below the bottom of the coat with the antenna tilted away to protect the RSM cable from melting (**see Photo 6**). This placement of the portable radio allows the RSM cable to be protected from direct exposure. Additionally, this placement significantly reduces the possibility of an entanglement hazard involving the RSM cable and improves signal strength from the radio antenna. A 2013 report by the Fairfax County Fire & Rescue Department includes diagrams for proper wearing of a radio strap and portable radio for interior firefighting operations. Fire departments may consider equipping firefighters with radio straps and updating standard operating procedures or guidelines to include proper use during interior firefighting operations. Fire academies and fire instructors may opt to include radio strap use in both entry level and advanced firefighter training.

Photo 6: Firefighter wearing portable radio on a strap under coat.
(Courtesy of the National Volunteer Fire Council)

Recommendation #7: Fire prevention efforts educate the community to help change knowledge, attitudes, and behaviors that can reduce risks, injuries, and fires within the community.

Discussion: In this incident, occupants attempted to perform ventilation to air out the building which inadvertently facilitated a significant change in fire behavior which led to the flashover.

Fire and life safety education is a critical element of community-risk reduction. This effort works to change knowledge, attitudes, and behaviors among community residents to reduce risks, injuries, and fires [IFSTA 2015a]. Fire departments act on this effort by training firefighters and other personnel as Fire and Life Safety Educators (FLSEs). FLSEs coordinate and deliver educational programs that teach people about a particular hazard and how to reduce or prevent the risks [NFPA 1030 2024].

Career Firefighter Seriously Injured During Search Operations in a Residential Structure Fire – Oregon

Fire and life safety education initiatives can teach community members about fire and injury prevention, including what actions they can take during an emergency. Example topics of these programs include:

- The importance of smoke alarms to reduce deaths in structure fires
- The use of child safety seats to lessen injuries of children involved in vehicle accidents
- The need for carbon monoxide detectors and proper use of gas-powered appliances
- Closing bedroom doors while sleeping or closing doors upon egressing during a fire incident

Specific to this incident, an applicable topic could be teaching community members to close doors during an evacuation to limit oxygen ingress and to report fires as soon as possible to get firefighters dispatched immediately. Fire Safety Research Institute's '*Close Your Door*' encourages those both trapped in a room during a fire as well as those who can safely leave a home to close as many doors as possible to limit the growth and spread of the fire. The webpage, https://fsri.org/programs/close-before-you-doze offers a series of free resources, including videos that fire departments can use to educate the public. These types of initiatives can be provided by fire departments in the form of scheduled lectures at community centers or fire stations, school visits by firefighters for fire prevention week, or through posting informational graphics on social media [IFSTA 2015a].

References

Fairfax County Fire & Rescue Department [2013]. Portable radio placement in the IDLH. Fairfax, VA: Fairfax County Fire & Rescue Department, Communications Division.

Gray S and Norwood PJ [2024]. Modern firefighting tactics in residential structures: Ventilation, coordination, and control. Fire Engineering.

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

IAFF [2010b]. Self-survival procedure. Washington, DC: International Association of Fire Fighters.

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

IFSTA [2015a]. Fire and life safety educator. 3rd ed. Stillwater, OK: International Fire Service Training Association.

IFSTA [2018]. Essentials of fire fighting. 7th ed. Stillwater, OK: International Fire Service Training Association.

NFPA [2020]. NFPA 1410, Standard on training for emergency scene operations. Quincy, MA: National Fire Protection Association.

NFPA [2021]. NFPA 1802, Standard on two-way, portable RF voice communications devices for use by emergency services personnel in the hazard zone. Quincy, MA: National Fire Protection Association.

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

NFPA [2024]. NFPA 1030, Standard for professional qualifications for fire prevention program positions, Quincy, MA: National Fire Protection Association.

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

NIOSH [2024]. Volunteer firefighter killed after becoming trapped at an assisted living facility fire and two firefighters injured – New York. By Loflin M and Attwood W. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2021-10.

NIST [2006]. NIST Technical note 1477: Testing of portable radios in a fire fighting environment. By Davis WD, Donnelly MK, and Selepak MJ. Gaithersburg, MD: U.S. Department of Commerce, National Institute of Standards and Technology.

NIST [2018]. Voices of first responders -identifying public safety communications problems: Findings from user-centered interviews phase 1, volume 1. By Choong YY, Dawkins S, Furman S, Greene KK, Prettyman SS, and Theofanos MF. Gaithersburg, MD: U.S. Department of Commerce, National Institute of Standards and Technology.

Regan J, Bryant J, and Weinschenk C [2020]. Analysis of the coordination of suppression and ventilation in single-family homes. Columbia, MD: UL Fire Safety Research Institute.

SKCFTC [2023]. South King County Fire Training Consortium, Command Procedures: Structure Fires. Kent, WA. South King County Fire Training Consortium. March 2023.

Weather Underground [2024]. Weather History. The Weather Underground. Date accessed: November 14, 2024.

Weinschenk C and Stakes K [2022]. Analysis of search and rescue tactics in single-story single-family homes part III: Tactical considerations. Columbia, MD: UL Fire Safety Research Institute.

Zevotek R, Stakes K, and Willi J [2018]. Impact of fire attack utilizing interior and exterior streams on firefighter safety and occupant survival: Full-scale experiments. Columbia, MD: UL Firefighter Safety Research Institute.

Investigator Information

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Dan Madrzykowski from the Fire Safety Research Institute, part of the UL Research Institutes, provided an expert review of the investigation report. A subject matter expert review was provided by Brian Chalfant, Staff Fire Instructor, Allegheny County Emergency Services – Fire Academy, Pennsylvania. The NFPA Emergency Response & Responder Safety Division provided a technical review.

Additional Information

Underwriters Laboratories (UL)
The Fire Safety Research Institute (FSRI), part of the UL Research Institutes, continues to work with fire departments and fire service organizations to conduct research on fire dynamics, fire safety issues, and fire ground operations. Access to reports from completed studies and information from on-going studies can be found at https://fsri.org. Access to free online training on evidence-based firefighting (more than 30 course modules in all) can be found at https://training.fsri.org.

Disclaimer

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