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Death in the line of duty...

NIOSH
Fire Fighter Fatality Investigation and Prevention Program

A summary of a NIOSH fire fighter fatality investigation

December 12, 2011

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire —Texas

## Executive Summary

On April 15, 2011, a 50-year-old male volunteer fire fighter (the victim) died at a wildland urban interface incident from blunt force trauma from either being struck by or run over by a fire vehicle during fire-fighting operations in smoky conditions with very limited visibility. The victim was trying to escape from a fire that was about to overrun and consume the brush truck that he was driving. The victim left the brush truck and attempted to escape on foot. At the time of the incident, five other brush trucks and five tankers were attempting to leave the area at the same time. Visibility deteriorated very quickly due to the advancing fire, smoke, and wind conditions. Due to heavy smoke conditions, the victim was not located until after the fire had burned through the area. A fire chief from a neighboring department found the deceased fire fighter in the ditch line of a county roadway.


**Attack 5 was overrun by the fire crossing CR323 from east to west.**
***(Photo courtesy of the Texas Forest Service.)***

Additionally, five fire fighters were injured during various fire-fighting operations throughout this incident.

## Contributing Factors

- *Ineffective incident management*
- *Ineffective personnel accountability system*
- *Lack of situational awareness*
- *Lack of common radio frequency*
- *A safety zone and escape route were not effectively communicated to all fire fighters*
- *Failure to use a fire shelter from the approaching fire*
- *Weather conditions.*

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## Key Recommendations

- *An Incident Management System should be used to manage wildland urban interface incidents*
- *The Incident Commander should use division/group supervisors to ensure effective tactical level management*
- *A personnel accountability system should be used to account for all fire fighters and first responders assigned to the incident*
- *Fire departments should ensure that the communication system meets the requirements for daily and complex incidents*
- *Lookouts, communications, escape routes, and safety zone (LCES) should be established and used at each wildland incident*
- *Provide fire fighters with approved fire shelters and provide training on the proper deployment of the fire shelters*
- *Fire fighters who engage in wildland fire-fighting should use personal protective equipment which meets NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting*
- *Fire fighters who engage in wildland fire-fighting should be trained to meet the minimum training requirements as required by the National Wildfire Coordinating Group (NWCG) or NFPA 1051, Standard for Wildland Fire Fighter Professional Qualifications*
- *Fire departments and fire service agencies should ensure that fire fighters fully comply with "The 10 Standard Fire Orders "and are aware of the "18 Watchout Situations" and "Common Denominators of Fire Behavior on Tragedy Fires."*

Additionally, states, municipalities, and authorities having jurisdiction

- *Should consider requiring mandatory wildland fire training for fire fighters.*

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 Web site at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

## Introduction

On April 15, 2011, a 50-year-old male volunteer fire fighter (the victim) died at a wildland urban interface (WUI) incident from blunt force trauma from either being struck by or run over by a vehicle during wildland fire-fighting operations. On April 18, 2011, the United States Fire Administration (USFA) notified the National Institute for Occupational Safety and Health (NIOSH) of this incident. On May 2–4, 2011, one safety and occupational health specialist and one investigator from the NIOSH Fire Fighter Fatality Investigation and Prevention Program and one occupational safety and health specialist from the NIOSH Western States Office traveled to Texas to investigate this incident. The NIOSH investigators met with representatives of the victim's fire department, other responding fire departments, representatives from the Texas Highway Patrol, and a representative from the Texas Department of Insurance, State Fire Marshal's Office. During the investigation, witness statements were reviewed and interviews were conducted with the fire fighters and officers involved in the incident. NIOSH investigators also reviewed the fire department's standard operating procedures (SOPs), training requirements, and the training records of the victim and the Incident Commander (IC). The victim's turnout gear was inspected and photographed, the incident scene was visited and photographed, and investigators reviewed incident scene photographs and video, fire ground dispatch records, and area maps.

## Fire Department

The combination department, which the victim was a member, consists of one fire station staffed with three career fire fighters (one fire fighter per shift) and 25 volunteer fire fighters. The department provides fire protection for approximately 3,800 residents in a geographic area consisting of 2.8 square miles. This department along with seven other fire departments provides fire protection for the entire county, which encompasses 930 square miles.

## Training and Experience

In Texas, all volunteer fire fighter training requirements, certification requirements, and standards are determined by local fire departments. The fire department involved in this incident requires their candidates to be at least 18 years of age, be able to pass a background investigation, possess a valid state driver's license, and have a high school diploma or equivalent.

The victim was a volunteer fire fighter with over 20 years of fire-fighting experience in Texas. He joined his current fire department in August 2000. His training records indicated that he had attended numerous fire schools and department training classes. His certifications included EMT/Basic, American Heart Association CPR, and IS-700a. He did not have any specific documented wildland fire-fighting or wildland urban interface (WUI) training.

Many of the fire fighters interviewed had limited training on the Incident Command System (ICS) and wildland fire-fighting. Fire fighters reported that training programs for both structural and wildland fire-fighting were being initiated though no implementation had occurred.

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## Equipment and Personnel

| Resource Designation | Resource Typing | Staffing |
|---|---|---|
| Tanker 1 | Type 2 Water Tender | Chief 1 (Fire Chief & Incident Commander) and fire fighter |
| Brush 11 | Type 6 Wildland Engine | 2 fire fighters |
| Brush 12 | Type 6 Wildland Engine | 2 fire fighters |
| Brush 13 | Type 6 Wildland Engine | 2 fire fighters |
| Brush 5 | Type 6 Wildland Engine | 2 fire fighters |
| Brush 52 | Type 6 Wildland Engine | 2 fire fighters |
| Brush 53 | Type 6 Wildland Engine | 2 fire fighters |
| Attack 5 | Type 5 Wildland Engine | Chief 5 (Fire Chief) and 2 fire fighters |
| Tanker 5 | Type 2 Water Tender | 2 fire fighters |
| Chief 6 | Command Vehicle | Chief 6 (Fire Chief) |
| Tanker 620 | Type 2 Water Tender | 1 fire fighter |
| Brush 621 | Type 6 Wildland Engine | Driver (victim) and fire fighter |
| Tanker 7 | Type 2 Water Tender | Chief 7 (Fire Chief) and 2 fire fighters |
| Brush 82 | Type 6 Wildland Engine | 1 fire fighter and 1 civilian |
| Tanker 8 | Type 2 Water Tender | 2 fire fighters |
| Precinct 2 County Tanker | Tanker (4,000 gallons) (Operated by the County Department of Highways, which is used for highway maintenance); Responds to fires at the request of the incident commander; | 2 county civilian employees |

Note: *There were eight fire departments in the county. The victim's department was designated as Station 6; all fire apparatus and officer call numbers had identification beginning with "6" (e.g., Tanker 620, Brush 621, Chief 6).*

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## Personal Protective Equipment

The victim was wearing structural turnout pants and boots over street clothes when he was found. He had also been wearing a radio headset, which was later found in the middle of road CR 323. His helmet, hood, gloves, and turnout coat were found in the cab of Brush 621. NIOSH investigators inspected the turnout gear and boots worn by the victim. The investigators determined that the personal protective equipment worn by the victim was not a contributing factor to the outcome of this incident. NIOSH did not initiate performance testing on the turnout gear.

## Timeline

*Note: This timeline is a summary of events that occurred as the incident evolved. Not all events are included in this timeline. The times are approximate and were obtained by studying the dispatch records, witness statements, and other available information. In some cases, the times are rounded to the nearest minute. Also, due to incomplete dispatch records, the dispatch, response, and arrival times for some of the apparatus are unknown.*

| Fire Behavior Indicators & Conditions | Time | Response & Fireground Operations |
|---|---|---|
| County dispatcher receives a 911 call for a wildland fire on FM 2563 road.<br>Most of the units that respond to the incident (later identified as the "323 Fire") are leaving a structure fire in a neighboring community. | 1215–1220 | Various units notify the dispatcher they are responding to the fire on road FM 2563: Tanker 1, Brush 5, Brush 11, Brush 12, Brush 52, and Brush 53; |
| | 1222–1224 | Brush 11 arrives on scene and conducts a scene size-up. Brush 11 advises dispatch that the fire is manageable and approximately 6–8 acres are burning.<br>Chief 1 reports a large working fire at FM 2563. |
| | 1231 | Brush 621 on scene (FM 2563). |
| | 1247 | Tanker 620 on scene (FM 2563). |
| | 1309 | Trooper from the Texas Highway Patrol arrives on scene and drives south on CR 323; he locates and stays with Attack 5 and Tanker 1 in front of a single family dwelling on CR 323. |

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| Fire Behavior Indicators & Conditions | Time | Response & Fireground Operations |
|---|---|---|
| The fields of bluestem grass, oak trees, weeping lovegrass, and coastal grass ignite, causing extreme fire behavior and rapid rates of spread. The winds start gusting to more than 45 mph, which moves the fire rapidly across the open fields. | **1313** | Brush 5, Brush 52, Brush 53 Brush 621, and Brush 82 are initiating fire-fighting operations in a field of coastal grass (Field A) to the west of CR 323.<br><br>When the fire erupts, all the brush trucks attempt to exit through a gate onto CR 323. |
| Poor visibility due to dense smoke hinders the movement of apparatus trying to escape the fire. | **1320** | Brush 5, Brush 52, and Brush 53 exit the field and drive onto CR 323. Brush 82 is unable to exit the field and stops at the gate in front of Brush 621. |
| | **1321** | Both personnel in Brush 82 and the passenger in Brush 621 abandon their apparatus and run towards CR 323; the victim is last seen sitting in the cab of Brush 621 talking on the radio. |
| | **1326** | Passenger of Brush 621 jumps on Tanker 8. When the apparatus does not move, he runs to Tanker 620 and jumps on the running board by the driver's door. Tanker 620 starts to drive south, but due to the smoke and fire, backs north on CR 323 away from the fire.<br><br>Other apparatus exit the area in both directions (north and south); Tanker 7 drives into an adjacent field east of CR 323. |
| | **1329** | After the fire passes, Chief 7 in Tanker 7 drives out of the field and is going north on CR 323. He finds the victim lying in the ditch line on the west side of the road. |
| | **1344** | A county judge is notified of the fire fighter fatality. |

| Fire Behavior Indicators & Conditions | Time | Response & Fireground Operations |
|---|---|---|
| | 1350 | Chief 7 contacts Chief 6 (fire chief of the victim's department) and advises him of the fatality, asking him to respond to the incident. |
| | 2300 | Fire declared under control. |

## Weather and Fire Conditions

The weather on April 15, 2011, was hot, dry, and windy. The temperature at the time of the incident was approximately 72 degrees Fahrenheit, relative humidity was 9%, barometric pressure was 29.96, and winds were 35 miles per hour (mph) gusting to 47 mph[1] (see **Appendix One**).

Based on the extreme fire danger in the region and a *red flag warning* issued the day of the fire, most fire fighters reported being aware of the fire potential in the region. *Red Flag Warning* is a term used by fire-weather forecasters to call attention to limited weather conditions of particular importance that may result in extreme burning conditions. It is issued when there is an on-going event or the fire weather forecaster has a high degree of confidence that Red Flag criteria will occur within 24 hours of issuance.

Red Flag criteria occurs whenever a geographical area has been in a dry spell for a week or two, or for a shorter period, if before spring green-up or after fall color, and the National Fire Danger Rating System (NFDRS) is high to extreme and the following forecast weather parameters are forecasted to be met:

- a sustained wind average 15 mph or greater;
- relative humidity less than or equal to 25 percent;
- a temperature of greater than 75 degrees F. [2]

The intent is to ensure that the daily *fire weather forecasts* be readily available to all fire departments through the use of the internet/email. The local dispatch center can also alert fire fighters to the *Red Flag Warning* as they respond to an incident.

## Investigation

At approximately 1217 hours, the county fire dispatcher alerted three fire departments of a wildland urban interface (WUI) fire near the intersection of FM 2563 and CR 323.

*Note: CR 323 is a gravel/dirt farm access road that served as the main access point to the area where activities described in this investigation occurred.*

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CR 323 runs north and south, splitting FM 2563 (to the north) and FM 2526 (to the south); one residential structure (single-family dwelling with outbuildings) is accessible from CR 323. Ditches, lined by barbed wire fence, run along both sides of CR 323 and are comprised primarily of loose sand.

A grass fire, identified as the "323 Fire," started near the intersection of CR 323 and FM 2526, due to high winds blowing power lines into a strand of trees. The initial response included six Type 6 Wildland Engines (Brush 11, Brush 12, Brush 13, Brush 5, Brush 52, and Brush 53) and two tenders (Tanker 1 and Tanker 8). *Note: Per the National Incident Management System (NIMS) and the Incident Command System (ICS), the term for an apparatus that carries water is a tender. A tender is defined as a truck with a permanently mounted water tank with the capabilities of dispensing potable or non-potable water. The dispensing is handled through gravity or a pump. A tanker is defined as a fixed-wing aircraft certified by the Federal Aviation Administration as being capable of transport and delivery of fire retardant solutions. During this incident, responding fire departments referred to the fire apparatus that carried water as a tanker, which is the term used throughout this report.*

The fuels for this fire consisted of bluestem grass, coastal grass, weeping lovegrass, oak trees, and western juniper trees. Several of the fire departments who were dispatched to the WUI fire had been working on a structure fire in a neighboring community. Once they were cleared from the structural fire, they responded to the WUI fire. *Note: The two types of grass identified in this investigation report are coastal grass and weeping lovegrass.*

*"Coastal" Bermuda grass (Cynodon dactylon) is a hybrid Bermuda grass that is often used for cattle forage in the southeastern/southwestern United States. Coastal grass often grows in pastures and fields and in the understory of open woods, forests, orchards, and pine. Coastal grass is an introduced, perennial, mat-forming, warm season grass that grows 4–16 inches tall.*

*Weeping Lovegrass (Eragrostis curvula) was an introduced perennial grass most common in Arizona, New Mexico, Oklahoma, and Texas and has been planted most often for erosion control and livestock forage. Weeping lovegrass is a large bunchgrass that can reach up to 75 inches tall* http://www.fs.fed.us/database/feis/plants/graminoid/eracur/all.html

Two fire fighters in Brush 11 were the first to arrive on scene and began initial fire attack. A fire fighter from Brush 11 sized up the initial fire as "manageable"— between 6 and 8 acres and in medium fuel (light brush and small trees). Brush 11 began initial attack efforts, attempting to flank the fire; however, the brush truck soon overheated and the fire fighters parked Brush 11 and joined fire fighters on two other brush trucks (Brush 12 and Brush 13) which had arrived a few minutes later.

Three fire fighters in Brush 13 proceeded to an adjacent field to extinguish the fire. The three fire fighters in Brush 12 were the first to attempt to extinguish the eastern edge of the fire by entering a field of coastal grass (Field A, see Photo 1) through a gate off CR 323, midway between FM 2563 and FM 2526. They cut a fence and proceeded north into a field of weeping lovegrass (Field B) and began attacking the fire. *Note: The fire fighters should have identified an "anchor point" to prevent the fire from coming around behind them. This is especially important during windy conditions. An "anchor point" is defined as an advantageous location, usually a barrier to fire spread, from which to start*

*constructing a fireline. The anchor point is used to minimize the chance of being flanked by the fire while the fireline is being constructed.*[3]

*Note: The "Attack from the Black" training video is available to fire departments across the country from the Texas Forest Service. The training video encourages fire fighters to think ahead – not just in the moment – while fighting wildfires and stresses the importance of wearing proper Personal Protective Equipment (PPE). The DVD includes fire re-enactment on sand tables, which are proven training tools used by the Texas Forest Service. This learning tool helps firefighters think about initial attack strategies, contingency plans, and safety zones. The DVD is available by sending an email to: AttackFromTheBlack@tfs.tamu.edu requesting a DVD and include your name, fire department name and mailing address.*

Their tactics consisted of driving in front of the fire while a passenger who was riding on the back of the truck sprayed water in front of the fire along the fire's border. This tactic is reportedly used in this region by fire fighters on brush trucks when attacking fast-moving grass fires. *Note: NFPA 1500, Standard of Fire Department Occupational Safety and Health Program states in Paragraph 6.3.1. states, "all persons riding in fire apparatus shall be seated and belted securely by seat belts in approved riding positions at any time the vehicle is in motion. Standing or riding on tail steps, sidesteps, running boards, or in any other exposed position shall be specifically prohibited."*[4]

The fire chief in Tanker 1 responded to the "323 Fire" and, while en route, ordered additional resources from the neighboring counties to aid in the fire-fighting operations. Upon arriving at the fire, Chief 1 observed the fire and fire operations in the field for approximately ten minutes, and then moved Tanker 1 to provide structural protection for the residential structure approximately 0.5 miles south of the weeping lovegrass field (Field B).

Approximately 30 minutes after arriving at the fire, Chief 1 reported establishing "Command" of this incident. Very few of the responding fire fighters who were interviewed during this investigation reported being aware that "Command" had been established or that this chief was the incident commander (IC).

While Brush 12 and Brush 13 were conducting fire-fighting operations, other fire fighters with brush trucks and tankers from neighboring fire departments began to arrive. A staging area and staging area manager were not identified to coordinate and direct these additional resources. Before the extreme fire behavior and rapid rates of spread, five tankers had arrived and parked on CR 323, adjacent to the entry to the coastal grass field (Field A). The tankers were parked facing both north and south in topographical areas where maneuvering and parking the heavy tankers and providing water to the brush trucks were feasible. Thick western juniper bushes and oak trees lining the road prevented clear visibility of the fire area.

Some of the fire fighters did report checking in with "Command" upon arrival. Others fire fighters did not and were reportedly unaware that "Command" had been established. Several fire fighters also reported that, upon arriving at the fire, they were told, typically by another fire fighter, to proceed to

the area where the tankers were parked and to assist the brush trucks with fire-fighting operations. Others reported that they drove until they found the most activity.

Lookouts were not discussed or set up at any point during the fire-fighting operations. Additionally, appropriate safety zones and feasible escape routes, taking into consideration the volume of personnel and resources arriving and working in one area, were not developed or discussed prior to initiating efforts to extinguish this fire. *Note: In the wildland fire environment, establishing and utilizing lookouts, communications, escape routes and safety zones (LCES) are critical to ensure the safety of wildland fire fighters. LCES should be implemented prior to initiating efforts to extinguish a fire and should be reevaluated during fire-fighting operations activities as the nature of and conditions of wildfires constantly change. All personnel involved in fire-fighting activities should be aware of the specific LCES components for every fire.*

When Brush 12 was still in the weeping lovegrass field (Field B), five fire fighters arrived in Brush 5 and Brush 53. Brush 53 began to attack the fire in the coastal grass field (Field A). Similar to the fire fighters in Brush 12, fire fighters in Brush 5 entered the coastal grass field (Field A) and then moved to the weeping lovegrass field (Field B) through the cut fence and started fire-fighting operations. Shortly after Brush 5 entered the weeping lovegrass field (Field B), Brush12 left the field to relocate with "Command" near the residential structure mentioned. Fire fighters in Brush 12 reported that they exited the field because they were unable to extinguish the fire and visibility was poor (less than 20 feet visibility) with erratic winds and occasional "fire tornados" or whirls. No communication occurred between fire fighters in Brush 12 or Brush 5 during this transition.

Fire fighters from Brush 5 were also unable to make progress extinguishing the fire in the weeping lovegrass field (Field B). After depleting their water supply, they exited the field, refilled with water from a tanker and joined fire fighters on Brush 53 in the coastal grass field (Field A). Fire fighters from the two brush trucks determined they could extinguish the fire in the coastal grass field (Field A) using a tactic of driving single file along the edge of the fire and applying water to the fire as it spotted out of a large stand of oak trees between the coastal grass field (Field A) and the weeping lovegrass field (Field B). As the brush trucks reached the edge of the spot fire, the fire fighters would regroup and repeat the same operation.

Two fire fighters in Brush 82 were also engaging in other fire-fighting operations north of the operations in the coastal grass field (Field A). It was reported that the fire fighters in Brush 82 did not communicate with personnel on any other brush trucks or tankers, or work together with other fire department's fire-fighting operations before or during the fire's extreme fire behavior and rapid rates of spread.

The victim was notified of the incident and responded in Brush 621. The victim (driver) and one other fire fighter arrived at the fire at approximately 1231 hours and began to extinguish spot fires at the flank of the fire near the fire's origin, away from other fire-fighting operations. After depleting their water and filling up from a nearby tanker, Brush 621 preceded south on CR 323 toward the coastal grass field (Field A) and the weeping lovegrass field (Field B).

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Upon arrival at the incident scene, the victim and the other fire fighter discussed the fire with one of the tanker operators. The victim and the passenger in Brush 621 saw Brush 5, Brush 52, and Brush 53 in the field. They entered the coastal grass field (Field A) to join the fire-fighting operations.

At approximately 1300 hours, the fire began to intensify. At this point, 10 fire fighters in five brush trucks (Brush 5, Brush 52, Brush 53, Brush 621 and Brush 82) were engaged in fire-fighting operations in the coastal grass field (Field A), and 10 fire fighters in five tankers were parked facing various directions on CR 323 adjacent to the entry to Field A. The IC and Brush 12 and Brush 13 were still located at the residential structure to provide fire protection. Also, a trooper from the Texas Highway Patrol had arrived on scene to monitor the operations. *Note: In Texas, state law dictates that any requests for mutual aid for assistance, such as from the Texas Forest Service, must be made through the Texas Highway Patrol.*

Fire fighters in Brush 5, Brush 52, Brush 53, and Brush 621 continued their fire-fighting operations. It was reported that the fire suddenly erupted, began to ignite and torch the oak trees and progress rapidly in a southeastern direction to the coastal grass field (Field A). At this point, the fire fighters in the brush trucks reported the flames to be up to 100 feet high in the oak trees. Realizing that they needed to exit the field, the fire fighters from the four brush trucks radioed to each other to evacuate the field and began to drive single file toward the gate on CR 323. It was reported the trucks drove across the field at approximately 30–40 mph toward the gate, which was approximately 250 yards away. Formal escape routes or appropriate safety zones had not been identified prior to engaging in fire-fighting operations. Fire fighters in Brush 82 also began to move toward the gate when the fire erupted. When Brush 82 caught up with the other four vehicles, the driver (victim) of Brush 621 allowed the fire fighters in Brush 82 to drive in front of his truck, between Brush 621and the other vehicles.

As the first fire fighters in Brush 5 exited the field through the gate and turned south on CR 323, a fire fighter from this brush truck told the fire fighters on the tankers to leave immediately. The drivers of the tankers began to exit in both directions on CR 323. It was reported that the fire reached CR 323 and the western juniper bushes lining the western edge of the road at approximately the same time as the brush trucks. Due to limited visibility, it was reported the drivers on the tankers were unaware of the fire coming directly toward them.

Fire fighters in Brush 52 and Brush 53 also exited the gate and proceeded south on CR 323. The fire fighters reported they had to navigate around other vehicles. They also reported the bushes around CR 323 were engulfed in flames and they had to drive through fire to escape. Fire fighters were still riding on the back of these trucks and were using the water from the fire hoses on the engine to protect themselves. As they were exiting, one of the drivers of a brush truck called the county fire dispatcher to request ambulances. This fire fighter reported that, although he did not know the status of any other fire fighters, considering the conditions of the fire, he was certain that there would be injuries.

Fire fighters in Brush 82 attempted to follow the other brush trucks and exit through the gate. Their exit route to CR 323 was blocked by the tankers trying to leave the scene. The driver of Brush 82 stopped his truck in the gate entrance with Brush 621 behind him. With the fire advancing quickly, the fire fighters from the two parked brush trucks proceeded to exit their vehicles and run toward the road.

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The fire fighter riding on the back of Brush 621 reported that, as he jumped off the truck, he told the victim, who was still sitting in the brush truck and appeared to be talking on the radio, that "I am bailing." This was the last time anyone had contact with the victim. It is not known which direction the victim ran to escape the fire and what his actions were after he exited his truck. (See Diagram #1)

As the three fire fighters from Brush 82 and Brush 621 attempted to outrun the fire on foot on CR 323, they were able to jump into or onto Tanker 620. Due to the volume of vehicles attempting to escape the fire, the poor visibility due to the smoke, as well as a variety of tanker mechanical issues resulting from the intense heat, fire fighters were driving their tankers off the road, frequently colliding with each other, blocking each other in, and, as a result, many had to escape the fire by backing out (using the edge of the road as a guide as it was not possible to see the road). Tanker 7 did not escape on the road, but rather drove into a field east of CR 323. Tanker 7, operated by Chief 7, with two other fire fighters, was in the field of coastal grass on the east side of CR323 when the fire erupted. Chief 7 drove Tanker 7 east into the field approximately 100 yards and parked. The three fire fighters each deployed a hoseline to protect the apparatus and themselves. They operated in this mode for approximately 5–10 minutes until the fire passed them.

All of the remaining fire fighters on the tankers and the three fire fighters from Brush 82 and Brush 621 were able to escape the fire; however, five other fire fighters suffered burns during their escape. Many of the fire fighters were not wearing any type of personal protective equipment (PPE). One brush truck was completely destroyed after it became stuck in a ditch; however, the fire fighters were able to escape and walk to safety before the apparatus burned. Three other tankers and one brush truck also incurred damage to their air brakes, lights, hoses, and/or other equipment due to the intensity of the fire.

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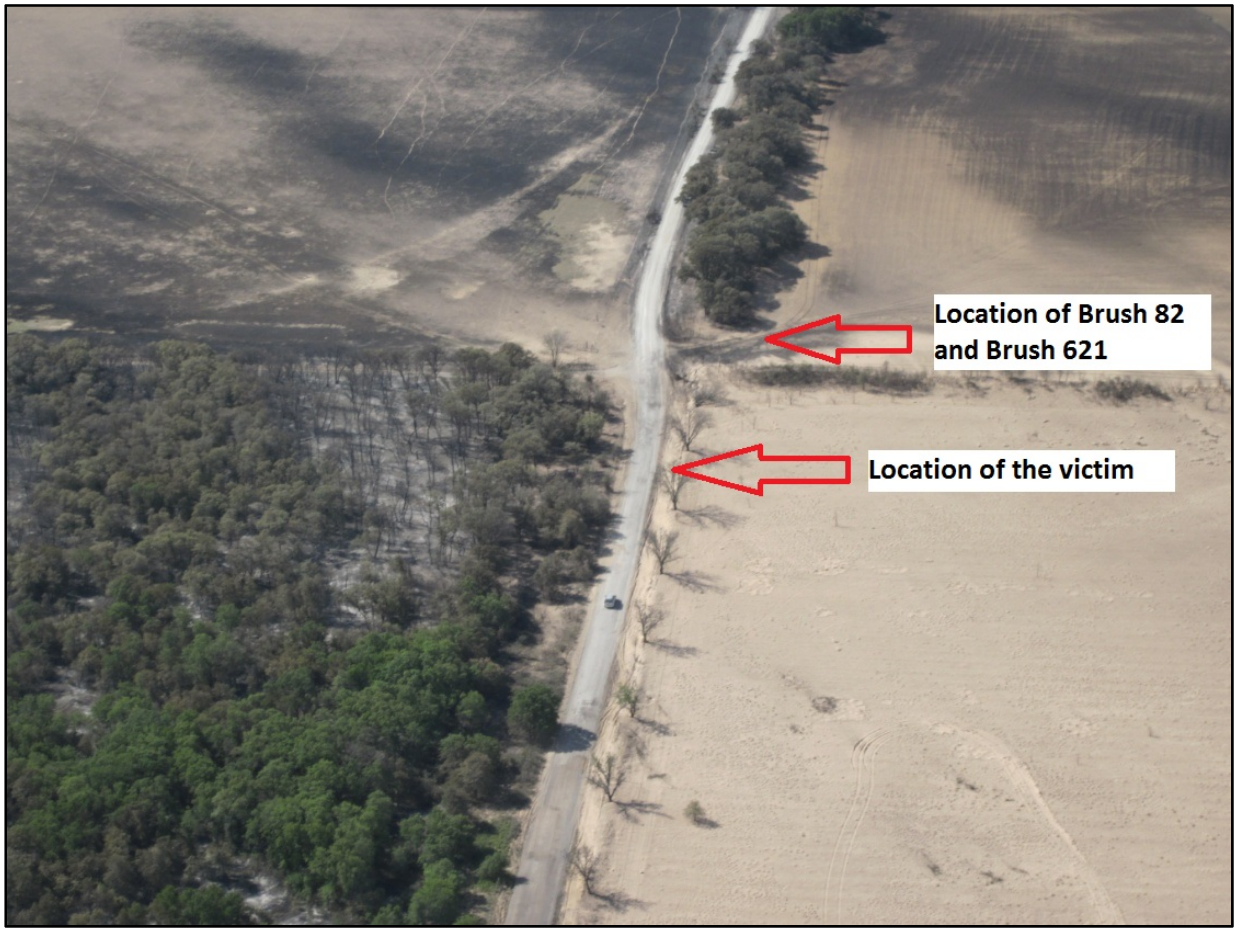


**Photo 1. Area where the fire fighter fatality occurred on CR323 looking toward the south. The field in the bottom right is the field that had the weeping lovegrass (Field B). The upper field (top right) consisted of coastal grass (Field A). The photo was taken from a Texas Fire Service reconnaissance aircraft.**
***(Photograph courtesy of the Texas Fire Service)***

Once the fire had passed over them, the fire fighters on Tanker 7 exited the field and proceeded approximately 30 yards north on CR 323 when they noticed an object in the ditch alongside CR 323.

Upon further investigation, Chief 7 and the fire fighters from Tanker 7 realized the object was a person lying in the west ditch with his bunker pants on fire. The time was approximately 1330 hours. The fire fighters extinguished the burning bunker pants. Chief 7 identified the victim, conducted a patient assessment, and, upon determining the victim was deceased, contacted Chief 6 by cell phone advising him that one of his fire fighters was deceased. Chief 6 was already en route to the fire; however, the fire had blocked him from entering CR 323, so he was forced to find an alternative route.

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Previous radio communication had indicated that other fire fighters may have been unaccounted for and, as a result, the fire fighters from Tanker 7 began to search for additional personnel. The fire fighters found Brush 82 and Brush 621 still running and parked at the gate entrance. They looked into both trucks but did not find any other personnel. The county commissioner then arrived at the scene and the fire fighters on Tanker 7 left the incident scene due to the heat and smoke still present in the area.

Chief 6 observed and marked the location of the victim, as well as any other equipment that could provide additional information about the incident. He then closed CR 323 and contacted the mayor, requesting a justice of the peace (county coroner) and funeral home personnel. The justice of the peace arrived at the scene approximately 30–45 minutes later. The accident investigation was conducted by the county sheriff's office, the Texas Highway Patrol, and the Texas State Fire Marshal's Office.

The victim was found approximately 100 feet from Brush 621 lying in the ditch west of CR 323. He had sustained severe burns on his head and upper body. The victim was wearing bunker pants, fire-fighting boots, a tee shirt, and a headset for radio communication. He had not donned any other PPE. His radio headset was found in the middle of CR 323, midway between the trucks and his body. The headset had been run over by a vehicle, so it was likely not found where it had fallen off the victim. The victim did not have access to a fire shelter as fire-fighting personnel involved in this incident reported that fire shelters were not standard issue or used while participating in wildland fire-fighting operations.

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

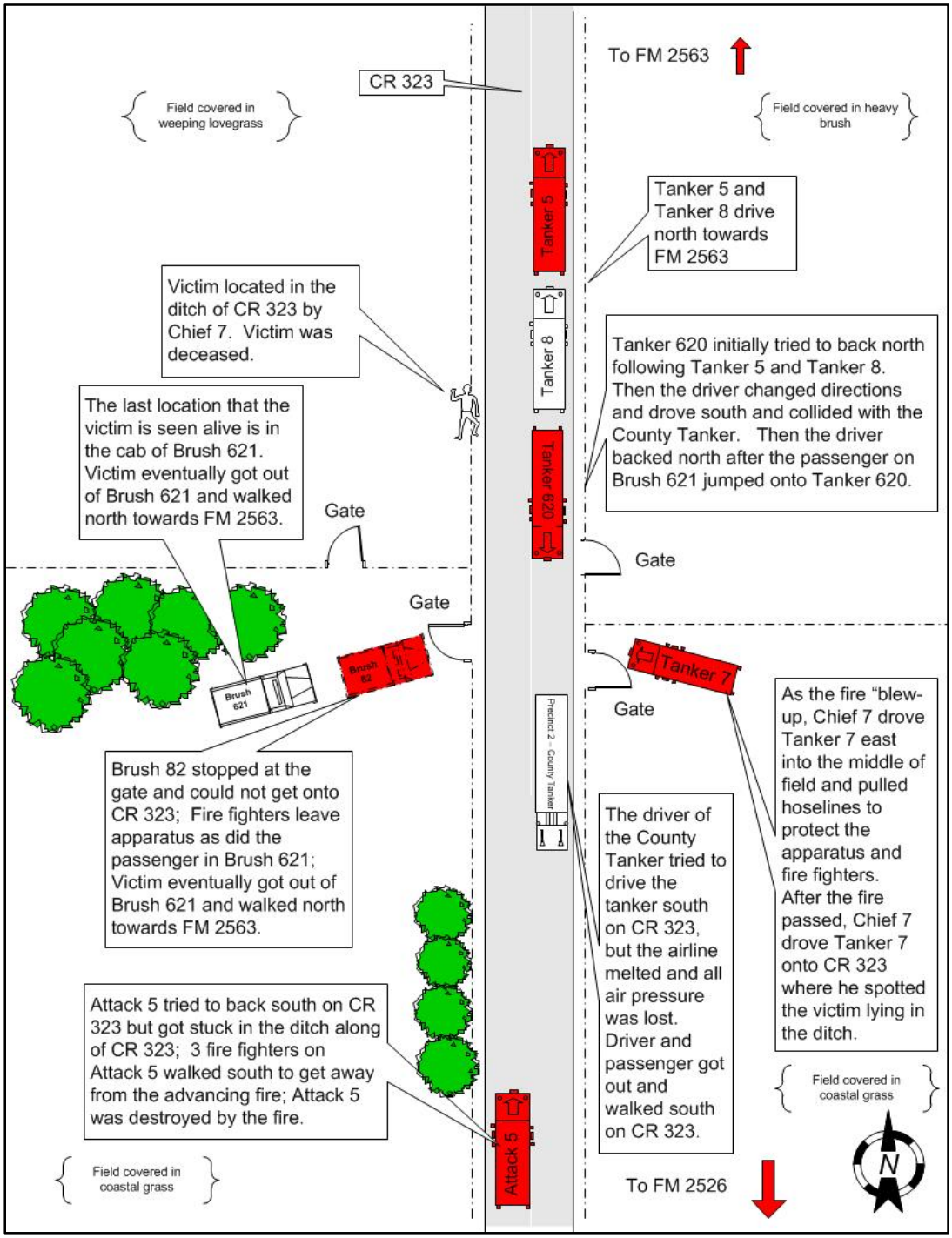


**Diagram 1: Location of apparatus and personnel when the fire erupted resulting in the death of the driver/operator of Brush 621**

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

## 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:

- *Ineffective incident management*
- *Ineffective personnel accountability system*
- *Lack of situational awareness*
- *Lack of common radio frequency*
- *A safety zone and escape route were not effectively communicated to all fire fighters*
- *Failure to use a fire shelter from the approaching fire*
- *Weather conditions.*

## Cause of Death

According to the autopsy report, the medical examiner listed the victim's cause of death due to blunt force trauma consistent with auto-pedestrian impact injuries.

## Recommendations

***Recommendation #1: An Incident Management System should be used to manage wildland urban interface incidents.***

Discussion: An incident management system is intended to provide a standard approach to the management of emergency incidents. The many different and complex situations encountered by fire fighters require a considerable amount of judgment in the application of an Incident Command System. The primary objective is always to manage the incident, not to fully implement and use an incident management system. The incident commander should be able to apply the incident command system in a manner that supports effective and efficient management of the incident. The use of an incident management system should not create additional challenges for the incident commander, but rather provide a systems approach for achieving a successful outcome of the incident.

Most incidents are considered routine and involve a small commitment of resources, while few incidents involve a large commitment of resources and are low-frequency/high-risk events. It is imperative that an incident management system accommodate all types and sizes of incidents and provide for a regular process of escalation from the arrival of the first-responding resources at a routine incident to the appropriate response for the largest and most complex incidents. An incident management system should be applied, even to routine incidents, to allow fire fighters and other first responders to be familiar with the system, prepared for escalation, and aware of the risks that exist at all incidents.

National Fire Protection Association (NFPA) 1500 *Standard on Fire Department Occupational Safety and Health Program*, 2007 Edition,[4] and NFPA 1561 *Standard on Emergency Services Incident*

*Management System*, 2008 Edition,[5] state that an incident management system (IMS) should be utilized at all emergency incidents. Most often, this system is commonly known as or referred to as an Incident Command System (ICS).

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."[5] 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 (ESO) responders and other persons involved in those activities."[5] Chapter 4.2 states, "The incident management system shall integrate risk management into the regular functions of incident command."[5]

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

The incident commander's sole function is to "command and control" the emergency incident. The incident commander should not to be involved in actual fire-fighting operations due to the incident commander being responsible for functions of command which are listed in the paragraph above.

At the time of this incident, the county was experiencing multiple structure fires and wildland urban interface incidents. The resource needs of the incident outweighed the initial deployment coupled with the rapid spread of the fire which created problems with incident management.

***Recommendation #2: The Incident Commander should use division/group supervisors to ensure for effective tactical level management***

Discussion: As illustrated by the fact that this incident was spread out over more than 3,000 acres, the need for effective span of control and the effective use of staffing and resources requires effective tactical level management. In this case, the incident commander could have used divisions and/or groups to manage the available resources committed to this incident.

A Division is the organizational level having responsibility for operations within a defined geographic area. A Group is an organizational level responsible for a specified functional assignment at an incident. The use of Divisions/Groups in the ICS organization provides a standard system to divide the incident scene into smaller subordinate management units or areas. Complex emergency situations often exceed the capability of one officer to effectively manage the entire operation. Divisions/Groups reduce the span-of-control to more manageable smaller-sized units. Divisions/Groups allow the

incident commander to communicate principally with these organizational levels, rather than multiple, individual company officers providing for command and incident scene organization.[6]

A span of control of 3 to 7 resources with 5 being the optimum is considered desirable in most cases. To maintain an effective span of control at each level of the command structure, the organization should be expanded whenever the need is identified. This can be accomplished by adding levels or reassigning responsibilities within existing levels or a combination of both. The incident commander also should consider activating additional levels within the command structure where activities become highly complex or are conducted over a large geographical area.

Generally, Division/Group responsibilities should be assigned early in the incident, typically to the first company assigned to a geographic area or function. This early establishment of Division/Group provides an effective incident management organization framework on which the operation can be built and expanded. The number of Divisions/Groups that can be effectively managed by the incident commander varies. Normal span-of-control is three to seven. In fast moving, complex operations, a span of control of no more than five Divisions/Groups is indicated. In slower moving less complex operations, the incident commander may effectively manage more Divisions/Groups. Division/Group guidelines provide an array of major functions which may be selectively implemented according to the needs of a particular situation. This places responsibility for the details and execution of each particular function on a Division/Group. When effective Divisions/Groups have been established, the incident commander can concentrate on overall strategy and resource assignment, allowing the Division/Group Supervisor to supervise their assigned units. The incident commander determines strategy and assigns tactical objectives and resources to the Divisions/Groups.

Each Division/Group Supervisor is responsible for the tactical deployment of the resources at their disposal, in order to complete the tactical objectives assigned by the incident commander. Division/Group Supervisors are also responsible for communicating needs and progress to the incident commander. Divisions/groups reduce the overall amount of radio communications. Most routine communications within a Division/Group should be conducted in a face-to-face manner between Company Officers and their Division/Group Supervisor. This process reduces unnecessary radio traffic and increases the ability to transmit critical radio communications. The safety of fire-fighting personnel represents the major reason for establishing Divisions/Groups. Each Division/Group Supervisor must maintain communication with assigned companies to control both their position and function. The Division/Group Supervisor must constantly monitor all hazardous situations and risks to personnel. The Division/Group Supervisor must take appropriate action to ensure that companies are operating in a safe and effective manner.[7]

***Recommendation #3: A personnel accountability system should be used to account for all fire fighters and first responders assigned to the incident***

Discussion: Personnel accountability on a fireground means identifying and tracking all personnel working at the incident. A fire department should develop its own system and standardize it for all incidents. National Fire Protection Association (NFPA) 1561 *Standard on Emergency Services Organizations Incident Management*, 2008 Edition, Paragraph 4.5.1, states, “The emergency service

organization (ESO) shall develop and routinely use a system to maintain accountability for all resources assigned to the incident with special emphasis on the accountability of personnel."[5]

The function of personnel accountability should be assigned to personnel who are responsible for maintaining the location and status of all assigned resources at an incident. This function is separate from those of the incident commander who is responsible for overall command and control of the incident. Due to the importance of responder safety, this function would be assigned to a personnel accountability officer. This function can be staffed by the chief's aide, staff assistant, or field incident technician, a chief officer, or other responder.

Many different methods are used for the accounting of resources:

- Tactical worksheet
- Command board
- Apparatus riding lists
- Electronic bar-coding systems
- Accountability tags or keys (e.g., PASSPORT System)
- T-card system

The intent is to track the fire fighters and first responders by function and location. The components of the personnel accountability system should be modular and expand based on the size and complexity of the incident.[5]

Accountability is much more than a hardware tracking system and must be addressed by all levels at the incident. The incident commander addresses the strategic level of accountability by tracking all crews and divisions/groups by location and function on a tactical worksheet. The incident commander must know who is in charge of each tactical level management unit, what crews are assigned to each division/group, where each division/group is located, and the assignment of each division/group. Division/group supervisors address the tactical level of accountability by tracking crews assigned to them. To maintain close supervision, division/group supervisors must know the location and function of assigned crews and be in the assigned area. Company officers must address the task level of accountability by knowing where each fire fighter is located and what each fire fighter is doing. Accountability is everyone's responsibility. All members operating on the incident must actively participate in the personnel accountability system. Each person involved in an incident whether at the strategic, tactical, or task level of an incident must make a strong personal commitment to follow all policies and procedures regarding accountability. [8]

A personnel accountability system must be able to be integrated into any existing incident command system plus this system must be used at every incident and drill so that it becomes routine. Fire departments that respond with one another due to automatic or mutual aid agreement must use the same compatible personnel accountability system. Personnel accountability is a simple and effective key component to keep fire fighters safe while operating at an emergency incident. [8]

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

From a wildland fire-fighting perspective, the personnel accountability system can function properly when fire fighters are spread out over a large area versus structural fire-fighting when fire fighters are operating in a single structure. One of the necessary components of accountability during wildland fire-fighting operations is to ensure for unity of command and effective span of control. Unity of command ensures that all fire fighters report to one person and maintain contact with their supervisor. Additionally, the supervisor should have a span of control of 3 to 7 resources with 5 being the optimum. To maintain this effective span of control, the organization should be expanded whenever the need is identified. This can be accomplished by adding levels or reassigning responsibilities within existing levels or a combination of both. The incident commander also should consider activating additional levels within the command structure where activities become highly complex or are conducted over a large geographical area.[5]

Some procedures to consider for personnel accountability during wildland fire-fighting operations:

- Wildland fire fighters shall work in teams of two or more while working on or near the fireline of an active fire unless they are in visual or voice contact with an officer.
- On initial attack fires, the incident commander shall:
  - Maintain the name and location of all personnel on the incident;
  - On extended attack fires, ensure to maintain the name and location of all personnel within their unit, division, or branch;
  - Document/record the status and location of personnel and unit information to the Staging Area Manager; The Staging Area Manager will maintain the status and location until the incident is controlled, a personnel accountability officer is assigned, or an incident management team is in place.[3]

Another critical element that is essential to the success of the personnel accountability system is effective fireground or incident scene communications. The fire department should have a communications standard operating procedure (SOP), written in clear, plain language, coupled with an effective training program.

***Recommendation #4: Fire departments should ensure that the communications system meets the requirements for daily and complex incidents***

Discussion: The communication system allows fire service personnel and other public safety organizations to communicate within and across agencies and jurisdictions. It is essential that the communication system be capable of interoperability, as incident response operations require continuous flow of critical information among jurisdictions, organizations, and agencies. Interoperability plans should include considerations of governance, standard operating procedures, radio equipment, hardware, technology, training, and use during daily emergency operations as well as large-scale or complex operations which can include commercial structure fires, mass-casualty incidents, hazardous materials incidents, wildland fires, special operations incidents, natural disasters, and other human-caused incidents.[6]

The communication system should include a dispatch, command, and tactical channels though for many organizations this may be only one or two channels. In some jurisdictions, several communities may share several radio channels for public safety operations while other localities may share radio channels within its government agencies (e.g. fire, law enforcement, EMS, and public works). A fire department needs to ensure that the needed radio channels are available when a large-scale or complex incident occurs. This can include the use of a common radio frequency which can be designated as a "mutual aid frequency" to ensure proper communications are available during a large-scale or complex incident such as a wildland urban interface fire which requires resources from mutual aid fire departments as well as assisting agencies and cooperating agencies. Standard operating procedures, radio equipment and other hardware, the ability to record and capture all radio channels transmissions, and dispatch and communication protocols must be in place to ensure that available radio channels are available when needed.[5]

A "dispatch channel" is a radio channel that provides communications between the communication center and the incident commander or single resource. A "command radio channel" is defined as a radio channel that provides communications between the incident commander and the division/group supervisors or branch director during an emergency incident. A "tactical channel" is a radio channel that provides communications between resources assigned to the incident and the incident commander. The use of a tactical channel or fireground channel separate from the dispatch channel is essential to ensure uninterrupted communications. Several fire fighter fatalities have been associated with excessive radio traffic with dispatching and fireground operations on the same channel. [5]

Another essential component of the communication system is the dispatcher or telecommunicator. SOPs should exist for telecommunicators (dispatchers) to provide support to emergency incident operations with elapsed time-on-scene notifications to the incident commander. Telecommunicators shall be trained to function effectively within the incident management system in accordance with NFPA 1061 *Standard for Professional Qualifications for Public Safety Telecommunicator*. Dispatchers must ensure that vital or necessary information is communicated to responders. In this scenario, the dispatch center should have communicated the daily *fire weather forecasts*. The daily *fire weather forecasts* can be readily available to all fire departments through the use of the internet/email. The local dispatch center can also alert fire fighters to the *Red Flag Warning* as they respond to an incident. [5]

The communication system is a vital component of fire fighter safety and effective fireground operations. There are multiple components to this process that need to be in place to ensure a successful outcome of each incident.

***Recommendation #5: Lookouts, communications, escape routes, and safety zone (LCES) should be established and used at each wildland incident***

Discussion: In the wildland fire environment establishing and utilizing Lookouts, Communications, Escape Routes, and Safety Zones (LCES) are critical to ensure the safety of wildland fire fighters. This includes selecting a lookout or lookouts, setting up a communication system, choosing escape routes, and selecting a safety zone(s). LCES is built on two guidelines: before safety is threatened, each

firefighter must know the LCES system will be used, and LCES must be continuously reevaluated as fire conditions change. Note: LCES works well in in other emergency responses such as hazardous materials mitigation, civil unrest, and flooding.

The LCES systems approach to fire line safety is an outgrowth of analysis of fatalities and near misses for over 20 year of active wildland fire-fighting operations. LCES simply focuses on the essential elements of the standard FIRE ORDERS (**See Appendix Two**). LECS should be automatic in wildland firefighting operations, and all firefighters should know the LCES interconnection. LCES functions sequentially - it's a self-triggering mechanism. Lookouts assess -and reassess - the fire environment and communicate threats to safety to affected members; fire fighters use escape routes to safety zones. All fire fighters should be alert to changes in the fire environment and have the authority to initiate communication. [9]

To take the process a step further, situational awareness enhances the LCES system by being aware of what is happening around you at an incident scene to understand how information, events, and your own actions will impact operational goals and incident objectives, both now and in the near future. [10] Situational Awareness becomes especially important in the firefighting operations and fire fighter domains where the information flow can be quite high and poor decisions can lead to serious consequences.[11]

Situational awareness is a combination of attitudes, previously learned knowledge and new information gained from the incident scene and environment that enables the incident commander, tactical level managers, and company officers to gather the information they need to make effective decisions that will keep their fire fighters and resources out of harm's way, reducing the likelihood of adverse or detrimental effects.[11]

The key is that the lookout(s) must be qualified individual(s) that follow the checklist provided in the NWCG "Incident Response Pocket Guide" (NWCG PMS #461):
• Experienced, competent, trusted;
• Enough lookouts at good vantage points;
• Knowledge of crew locations;
• Knowledge of escape and safety locations;
• Knowledge of trigger points;
• Equipped with a map, weather kit, watch, and Incident Action Plan.[3]

***Recommendation #6: Provide fire fighters with approved fire shelters and provide training on the proper deployment of the fire shelters***

Discussion: Fire shelters are crucial pieces of safety equipment allowing fire fighters to protect themselves should they be overrun by a fire with no option for escape. Fire shelters are effective life saving devices that primarily protect fire fighters by reflecting radiant heat and trapping breathable air.[12] According to the National Wildfire Coordinating Group's (NWCG) *Fireline Handbook*, fire

shelters should always be carried when on the fire line and be used after planned escape routes or safety zones become inadequate and entrapment is imminent.[12]

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, Paragraph 5.3.6 states: "Members who perform wildland fire-fighting shall be trained at least annually in the proper deployment of an approved fire shelter".[4] Not only should fire fighters always carry fire shelters, but all personnel should participate in hands-on training describing when, where, and how to use their shelter. Training should emphasize that although a fire shelter can save a fire fighter's life, carrying a fire shelter should never be considered an alternative to safe fire-fighting. Avoiding entrapment should always be a fire fighter's first priority and fire shelters are intended to be deployed only as a last resort.[12]

Though used as a last resort, fire shelters greatly enhance the chances of survivability in the event of being overrun by a wildland fire.

There is discussion in the fire service about sheltering in the cab of fire apparatus in the event of being overrun by a wildland fire. The United States Forest Service published a study in 1997 which looked at the issues of fire entrapment comparing conditions inside vehicles and fire shelters. [13] Due to the significant risk of the fire consuming the vehicle and the byproducts of combustion from components (e.g. plastic off-gassing) of the vehicle's interior, the risks may outweigh the potential benefits.[13]

***Recommendation #7: Fire fighters who engage in wildland fire-fighting should use personal protective equipment which meets NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting***

Discussion: Firefighters involved in wildland fire-fighting activities should be provided, at a minimum, the PPE as addressed in NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*, which include fire resistant shirt and pants, gloves, boots, helmet/hard hats, and fire shelters. The goal of this PPE is to protect fire fighters against adverse environmental effects during wildland fire-fighting operations and provide radiant heat protection for the wildland fire fighter using flame resistant clothing and equipment without causing excessive internal heat stress.[14]

While structural turnout gear is permitted for wildland fire-fighting, this PPE is designed to perform differently than the PPE used by wildland fire fighters. Due to the weight and composition of structural turnout gear, the high temperatures and low humidity typically associated with wildland fires, the duration of wildland incidents, and the amount of physical activity required for extinguishing wildland fires, structural PPE may actually increase heat stress and be a disadvantage for fire fighters engaged in wildland fire-fighting operations. Research studying the physiological effect of PPE during wildland fire-fighting activities has indicated that the majority of heat stress related to wildland fire-fighting was internally generated. As a result wildland fire fighter PPE is "designed to let heat out, not keep heat in."[15]

Of the five fire fighters who were injured at this incident, none of them were equipped with wildland fire specific PPE. Some personnel were wearing turnout gear; others were not wearing any fire-specific

PPE (jeans, tee shirt, etc.). All fire fighters who are expected to respond to wildland fires should be provided with and use NFPA approved protective clothing that is designed for the unique conditions found in wildland fire-fighting operations.

***Recommendation #8: Fire fighters who engage in wildland fire-fighting should be trained to meet the minimum training requirements as required by the National Wildfire Coordinating Group (NWCG) or NFPA 1051, Standard for Wildland Fire Fighter Professional Qualifications***

Discussion: Rural and volunteer fire fighters increasingly manage and provide fire-fighting operations for wildland fires, especially in the Wildland Urban Interface (WUI). As previously mentioned, few fire fighters interviewed during this incident reported having participated in any formalized wildland or WUI training.

The National Wildfire Coordinating Group (NWCG) provides leadership specific to the wildland fire community regarding training, standards, equipment, fire-fighting qualifications, and other fire functions specific to wildland fire-fighting. From a training standpoint, the *National Interagency Incident Management System Wildland Fire Qualification System Guide* describes the minimal qualifications and training recommended, and even required in some cases, when engaging in wildland fire operations.[16] NWCG recommends the minimum training for fire fighters (NWCG Fire Fighter Type II) involved with WUI incidents should be I-100, *Introduction to the Incident Command System*, S-130, *Fire Fighter Training*, L-180, *Human Factors on the Fireline*, and S-190, *Introduction to Wildland Fire Behavior*.[16] It is recommended that all rural and volunteer fire fighters, who engage grass and wildland fires, meet the NWCG minimal training requirements. These qualifications also meet the requirements of NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*, Wildland Fire Fighter I. [17]

Fire fighters, especially those trained in structural fire-fighting need to meet the requirements for wildland fire fighter training to ensure they have the necessary knowledge, skills, and competencies that ensure for their safety during wildland urban interface fires.

***Recommendation #9: Fire departments and fire service agencies should ensure that fire fighters fully comply with "The Standard Fire Orders" and are aware of the "18 Watchout Situations" and "Common Denominators of Fire Behavior on Tragedy Fires."***

Discussion: Fire fighter and public safety is the first priority of the wildland fire management program. To ensure wildland fire fighter safety, it is important to follow the standard FIRE ORDERS, recognize the "Watch out situations", and recognize the "common denominators of fire behavior on tragedy fires."[3] (**For the complete list of each, see Appendix Two**)

The original ten Standard Firefighting Orders were developed in 1957 by a task force commissioned by the USDA-Forest Service Chief Richard E. McArdle. The task force reviewed the records of 16 tragic fires that occurred from 1937 to 1956. The Standard Firefighting Orders were based in part on the successful "General Orders" used by the United States Armed Forces. The Standard Firefighting

Orders are organized in a deliberate and sequential way to be implemented systematically and applied to all fire situations.

Shortly after the Standard Firefighting Orders were incorporated into firefighter training, the 18 Situations That Shout Watch Out were developed. These 18 situations are more specific and cautionary than the Standard Fire Orders and described situations that expand the 10 points of the Fire Orders. If firefighters follow the Standard Firefighting Orders and are alerted to the 18 Watchout Situations, much of the risk of firefighting can be reduced.

In the mid-1970s, fire researcher Carl Wilson identified four common denominators of fire behavior that caused fatalities and near-misses on wildland fires. These four common denominators have been cited for decades in fire safety training, in the "Fireline Handbook" (PMS # 410–1), and in the "Incident Response Pocket Guide" (PMS # 461).

***Recommendation #10: States, municipalities, and authorities having jurisdiction should consider requiring mandatory wildland fire training for fire fighters.***

*Discussion:* Fire fighters encounter significant risks and hazards during emergency operations which can lead to an occupational injury or even death. Fire fighters must be provided with the necessary knowledge, skills, and abilities to ensure that they can perform their job tasks safely and effectively.

One of the most important risk management control measures used to prevent occupational injuries, illnesses, and fatalities is a viable training and certification program. Each fire fighter must be properly trained to complete the necessary job functions and tasks they are expected to perform during emergency operations. As each state is different in the mandatory requirements for training and certifying fire fighters, there should be a consistent model which requires that **all** fire fighters complete at least NFPA 1001, *Standard for Professional Qualifications for Fire Fighters*, Fire Fighter I.[3]

The state of Texas does not have minimal qualifications for structural firefighting for volunteer fire fighters. Most career fire departments in Texas do not have minimal requirements for wildland firefighting although 60% of their calls involve wildland firefighting operations. To ensure the safety of the fire fighters, all states should have mandatory requirements that **all** fire fighters meet the training requirements as defined by NFPA 1001, *Standard for Professional Qualifications for Fire Fighters*, Fire Fighter I and the National Wildfire Coordinating Group and NFPA 1051, *Standard on Wildland Fire Fighters Professional Qualifications*, Wildland Fire Fighter I.

# References

1. Weather Underground [2011]. http://www.wunderground.com/history/airport/KBKD/2011/4/15/DailyHistory.html?req_city=Eastland&req_state=TX&req_statename=Texas. Date accessed: September 13, 2011.

2. NOAA. [2011]. Glossary, http://www.weather.gov/glossary/index.php?word=Red%20Flag%20Warning. Date accessed: November 7, 2011. National Oceanic and Atmospheric Administration.

3. NWCG. [2004]. Fireline Handbook (National Wildfire Coordinating Group Handbook 3, PMS 410-1, NFES 0065). Boise, ID: National Wildfire Coordinating Group.

4. NFPA [2007]. NFPA 1500, standard on fire department occupational safety and health program. 2007 ed. Quincy, MA National Fire Protection Association.

5. NFPA [2008]. NFPA 1561, standard on emergency services organization incident management. 2008 ed. Quincy, MA National Fire Protection Association.

6. DHS [2007]. National Incident Management System. 2007 ed. Washington, DC: US Department of Homeland Security.

7. FIRESCOPE [2007]. Field operations guide, 2007 ed. Riverside, CA. FIRESCOPE. ICS 420-1.

8. Parks, B. [2008]. Fireground Accountability – A 'System' to Keep Fire Fighters Safe. FireRescue 1, http://www.firerescue1.com/firefighter-safety/articles/403750-Fireground-Accountability-A-System-to-Keep-Firefighters-Safe/, Date Accessed: November 2, 2011.

9. United States Department of Agriculture Forest Service, Fire and Aviation Management, "LECS – Lookouts, Communications, Escape Routes, and Safety Zones",http://www.fs.fed.us/fire/safety/lces/lces.html, Date Accessed: November 2, 2011.

10. NASF. [2003]. The changing role and needs of local, rural, and volunteer fire departments in the wildland urban interface. Washington, DC: National Association of State Foresters.

11. Naum, C. [2011]. Situational Awareness and Risk Assessment. http://thecompanyofficer.com/2010/02/12/situational-awareness-and-risk-assessment/. Date Accessed: November 2, 2011.

12. NWCG. [2003]. The New Generation Fire Shelter. Publication # NFES 2710. 2003 ed. Boise, ID: National Wildfire Coordinating Group.

13. United States Department of Agriculture Forest Service, "Surviving Fire Entrapments, Comparing Conditions Inside Vehicles and Fire Shelters, Publication 9751-2817-MTDC. September 1997. Washington, DC; United States Department of Agriculture Forest Service. http://www.wildfirelessons.net/documents/MTDC_Surv_Entr_Vehicles_Shelters_1997.pdf

14. NFPA [2011]. NFPA 1977, standard on protective clothing and equipment for wildland fire fighting. 2011 ed. Quincy, MA National Fire Protection Association.

15. Bone, B.G; Clark, D.F.; Smith, D.L.; Petruzzello, S.J. [1994]. Physiological responses to working in bunker gear: A comparative study. Fire Engineering: November 52–54.

16. National Wildfire Coordinating Group. [2011]. National interagency incident management system wildfire fire qualification system guide. Boise, ID: National Wildfire Coordinating Group.

17. NFPA [2007]. NFPA 1977, standard on protective clothing and equipment for wildland fire fighting. 2007 ed. Quincy, MA National Fire Protection Association.

## Investigator Information

This incident was investigated by Jay Tarley, Safety and Occupational Health Specialist and Murrey E. Loflin, Investigator, Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, NIOSH, Morgantown, WV, and Corey Campbell, Occupational Safety and Health Specialist, NIOSH Western States Office, Denver, CO. An expert technical review was provided by Dick Mangan, principal member of Blackbull Wildfire Services. A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division. This report was authored by Murrey E. Loflin and Corey Campbell.

## Additional Information

The Texas State Fire Marshal's Office conducted a separate investigation of this incident. Their investigation report will be available at http://www.tdi.state.tx.us/fire/fmloddinvesti.html.

## Disclaimer

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# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

## Appendix One
## Fire Behavior Forecast for April 15, 2011
## for the Operational Period of 0800–2000 hours

**FIRE BEHAVIOR FORECAST**

| | |
|---|---|
| **FORECAST NUMBER: #47** | **TYPE OF FIRE: Wildland** |
| **FIRE NAME: West Texas IA 2011** | **OPERATIONAL PERIOD: 04/15/2011 0800-2000** |
| **DATE ISSUED: 04/14/2011** | **TIME ISSUED: 1800** |
| **UNIT: Texas Forest Service - Abilene** | **SIGNED: /s/ Darrell Schulte**<br>**Typed/printed:** |

**INPUTS**

**WEATHER SUMMARY**

**Critical fire weather conditions today in the North Branch and central North West Branch.**
**West Texas:** Highs: 80's – 90's°, RH:5 – 10% , Winds N 10 – 15, gust to 20 mph
**North West Texas:** Highs: 70's – 80's°, RH: 5 - 15%, Winds: (PH) NW 25 – 30, gust to 45 – 50; Lubbock NNW 15 – 20 mph, gust 30 – 35 mph.
**North Texas:** High: 80's°, RH: 10 – 20 %, Winds: NW 20 – 25, gusts to 35 mph.
**Central and South Central Texas:** High: 80's°, RH: 10 – 30%, Winds: NW 15 mph, gusts 25 mph.
**South Texas:** High: 90's°, RH: 5 – 30% , Winds: (Upper Rio Grande)NNW 10 – 15mph, gusts 20; Lower Rio Grande N 15, gusts to 20 mph.

**OUTPUTS**

FIRE BEHAVIOR ***Expect the Unexpected!!***

*GENERAL:*

ROS's will range from 0.2 to 4+ MPH today across the Area at the higher wind speeds. Flame lengths will range from 2 – 26 feet.

**SPECIFIC:**

**The GS3 (Moderate grass/shrub) fuels can have ROS's of up to 2.2+ MPH with flame lengths up to 19 feet today especially in the Panhandle, North and South Texas areas.**
**Spotting distance of 1+ mile possible today.**
**With predicted gusts ROS's can exceed 4.4+ mph!!**

**In GR2 and GR3 ROS's can range from 1 ½ to 3.3 MPH. Flame lengths can range from 2 to 13 feet.**
**Spotting distances up to 0.9 mile possible today.**
**With gusts expect ROS's up to 4+ mph, with 14 ft flame lengths.**

**POI in the West, Northwest and South Branch is 100 percent today.**
**POI for, North, and Central Texas will be about 80 – 100%.**

**The attached Hauling Chart assumes fine fuel moistures that range from 2 to 4 percent, with a wind speed of 15, with gusts to 55 MPH. In these very dry fine fuels watch for wind shifts and terrain effects on the direction of spread, they can happen very quickly! Hatched areas are ROS with the forecast Gust wind speeds.**

**AIR OPERATIONS:**

**Visibility should be good today. Winds aloft will make flying difficult, and bumpy, if not impossible.**

**SAFETY**

Expect the Unexpected!!! Watch for rapid changes in ROS and Flame length with any change in the wind speed and direction! POI is 100% across most of West Texas, be careful!!

Updated: March 2002

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

## Appendix Two

### *" The Standard Fire Orders" "18 Watchout Situations" and "Common Denominators of Fire Behavior on Tragedy Fires."*

The **Standard FIRE ORDERS** are:

1. Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.
4. Identify escape routes and safety zones and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively.
7. Maintain prompt communications with your forces, your supervisor, and adjoining forces.
8. Give clear instructions and insure they are understood.
9. Maintain control of your forces at all times.
10. Fight fire aggressively, having provided for safety first.

The **18 Watchout Situations** are:

1. Fire not scouted and sized up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link with crewmembers/supervisors.
8. Constructing line without safe anchor point.
9. Building fireline downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and the fire.
12. Cannot see main fire, not in contact with anyone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather is getting hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across line.
17. Terrain and fuels make escape to safety zones difficult.
18. Taking a nap near the fire line.

# Volunteer Fire Fighter Dies and 5 Volunteer Fire Fighters are Injured during Wildland Urban Interface Fire—Texas

There are **four major common denominators** of fire behavior on fatal and near-fatal fires. Such fires often occur:

1. On relatively small fires or deceptively quiet areas of large fires.
2. In relatively light fuels, such as grass, herbs, and light brush.
3. When there is an unexpected shift in wind direction or wind speed.
4. When fire responds to topographic conditions and runs uphill.

Alignment of topography and wind during the burning period should always be considered a trigger point to re-evaluate strategy and tactics.