



## **Forest Ranger II Dies After Receiving Second- and Third-Degree Burns Operating a Crawler Tractor (Bulldozer) While Clearing Vegetation During a Wildland Fire - Arkansas**

### **SUMMARY**

On October 28, 1998, a 40-year-old male Forest Ranger II (the victim), died after receiving second- and third-degree burns on September 9, 1998, while he was operating a crawler tractor (bulldozer). The victim was clearing vegetation at a wildland fire site consisting of 285 acres of thick natural regeneration pine trees approximately 25 feet high when the incident occurred. The victim was operating a John Deere 450 bulldozer with a V-blade in front and a plow in the rear. The victim's bulldozer was third in line of the four machines. As the four bulldozers were clearing the line, staying approximately 60 to 70 yards apart, except for the lead bulldozer which was more than 200 yards ahead, the second bulldozer operator noticed the winds shifting and rapid fire movement coming toward the bulldozers. He advanced his bulldozer forward to a safe area while trying to communicate by radio to the other bulldozer operators to immediately leave the area. His radio communication did not succeed because of weak radio batteries which caused the radio to switch channels erratically. After adjusting his radio, he again attempted to notify the other machine operators in the area, but was unsuccessful due to the loud noise from the bulldozers. Finally, he successfully made

communication with air attack and told them to have the remaining bulldozer operators immediately leave the area due to changing winds. Within a few seconds, the fire grew in intensity. At that time, the victim put his bulldozer in reverse and traveled about 10 to 15 feet backward when the V-blade in front of the bulldozer became lodged on an eight-inch diameter tree. Since he could not move his bulldozer away from the advancing heat/fire, he exited the left side of the cab of the bulldozer and ran away from the direction of the intense heat and fire. The victim walked a short distance until he was seen by another Ranger who assisted him approximately one-quarter of a mile to the main road. First aid was administered and he was transported to the local hospital by an ambulance on the fire scene. The victim had received second- and third-degree burns over 60 percent of his body and was later transported to the burn unit at a children's hospital where he underwent surgeries and skin grafts. After 7 weeks of hospitalization, the victim died. NIOSH investigators conclude that, to prevent similar occurrences, the Forestry Commission and fire departments engaged in wildland fire fighting should:



*Figure 1. Bulldozer at Incident Scene*

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

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

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- *ensure all radio equipment is functional and durable, with the capacity for extended operation, and ensure frequency compatibility with contractors and aircraft operations*
  - *configure bulldozer operator radio systems to allow full reception of transmissions in a high-noise environment while operating machinery*
  - *provide wildland personal protective equipment (PPE) that is NFPA 1997 compliant, and monitor to ensure its use*
  - *conduct annual fire shelter refresher training for all personnel and ensure shelters are readily available for all bulldozer operators*
  - *implement the Incident Command System (ICS) for the management of all fires and establish an Incident Command Post (ICP) as needed to facilitate command and control, especially on complex fires involving multiple agencies*
  - *utilize National Weather Service (NWS) Fire WX Forecasters for all fire weather predictions and immediately share all information about significant fire behavior events with all personnel (e.g., long-range spotting, torching, spotting, and fire whirls).*
- On November 12 and 13, 1998, two Safety and Occupational Health Specialists from the Division of Safety Research, and an Operations Fire Specialist for the U.S. Forest Service investigated the incident. Interviews were conducted with the District Forester and members of the Arkansas Forestry Commission (AFC) ground crews. The incident site was visited and photographs of the fire scene and bulldozer were taken. A copy of the death certificate, dispatch records, training records and map of the fire scene were obtained. The Forestry Commission District involved in the incident serves an area of 3 million acres, and of those, 1.8 million acres consist of timber. The state does not require any training to become a Ranger with the Forestry Commission; however, all new Rangers are provided with training from the State Forestry Commission. This training includes, introduction to fire control, mobile equipment use, chain saw operation, equipment maintenance and inspection, and fire report completion. Additionally, the victim had a current interagency fire-job qualification (red-card) for "firefighter squad boss," and he had also completed the "pack-test." The victim had 3 years of experience.
- Eleven fire departments with 17 engines and two water trucks; 220 personnel, including volunteers, police, and timber company co-op workers; two air tankers and a spotter plane were involved in this fire; however, only the events involving the crew which included the victim are included in this report.

**INVESTIGATION**

On September 9, 1998, at 1315 hours, a wildland fire was reported to the AFC. A Country Ranger arrived at the fire scene within minutes after the fire was reported. At that time, he assumed the duties of IC. Between 1320 and 1330 hours, the initial fire attack crew arrived at the scene. The initial attack crew was comprised of three crawler tractors (bulldozers) and operators (including the victim), a County Forester, who assumed the Incident

**INTRODUCTION**

On October 28, 1998, a male 40-year-old Forest Ranger II (the victim), died after receiving second- and third-degree burns on September 9, 1998, while operating a crawler tractor (bulldozer) in a wildland fire which burned about 285 acres of thick natural regeneration pine trees approximately 25 feet high.

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Commander (IC) duties, and a timber company co-operator and his supervisor, who assumed the role of IC on the south portion of the fire ground involving timber on contractor land. The fire started at approximately 1300 hours when a homeowner was burning debris in the yard. The fire escaped control and spread to a nearby 3-year-old pine plantation. The weather conditions affecting the fire growth included relative humidity at 18 percent, ambient air temperature at 87° F, winds from the northeast at 8 to 15 m.p.h., and the Keech Byram Drought Index above 600. *Note: A drought index above 600 indicates a level of extreme drought conditions.* Also, wind speed and direction, under the influence of Hurricane Frances, were erratic rather than constant.

Before this fire, three other fires had been reported. The District Forester, functioning as air patrol, was observing the fire areas from the air at about 1300 hours. He observed the fire escalating and ordered the assistance of two tanker planes (tankers 21 and 124) and a spotter plane, which were dispatched between 1416 and 1430 hours. At approximately 1400 hours, other fire crews arrived on the fire scene. These crews included four additional bulldozers and operators and a County Forester who assisted the acting IC because his County Ranger was assigned to another fire in a neighboring area.

The IC was directing operations on Camp Road (see Figure 2) where volunteer fire departments had deployed their engines and personnel to water down the area and protect nearby homes, while the County Forester was directing bulldozer operations on the north fire line. The bulldozer operations consisted of a total of four bulldozers and a Forest Ranger (one of the bulldozer operators was a timber company co-operator). To control the spread of fire, the crew was using the direct attack strategy operating about 20 to 25 feet away from the fire, by clearing and plowing lines about 9 feet wide. The

timber company co-operator bulldozer was operating more than 200 yards ahead of the three AFC bulldozers. The victim was operating a John Deere 450 bulldozer with a V-blade in front and a plow in the rear. The three AFC bulldozers (lead bulldozer, a John Deere (JD) model 550; middle bulldozer, the victim's dozer, and end bulldozer, JD model 450) were instructed to follow each other in succession and to plow a line in a southwesterly direction adjacent to the north fire line between the Pump Station Road and Camp Road. At the same time, two AFC JD 350 bulldozers improved and patrolled the constructed fire line in the vicinity of the Pump Station Road. Sometime between 1416 and 1600 hours, Tanker 21 had dropped a load of fire retardant in the area adjacent to where the succession of three bulldozer operators would be working (see Figure 2). Additionally, Tankers 21 and 124 each would make another fire retardant drop during the fire. The AFC bulldozer operators started to plow the line around 1500 hours; however, advancing the plow line was slow due to breakovers (i.e., fire spreading across the fire control line), which the operators had to double back to control. All AFC personnel involved on the fire ground were wearing Nomex IIIA® fire shirts, helmets, goggles, gloves, and cotton jeans. [Note: It is unknown whether the victim was wearing gloves, as none were found on the fire scene and the victim had sustained third-degree burns on both hands].

As the AFC bulldozers were plowing the line and staying approximately 60 to 70 yards apart, the winds were gusting approximately 15 m.p.h. Generally the winds come from the northwest/southwest, but on the day of the incident, the winds were coming from the northeast. The smoke plume from the fire created a convection column that rose to between 6,000 and 8,000 feet above ground. The first fire fuel consisted of a pine plantation which was three or more years old. The trees included very dense natural regeneration trees about 25 feet high

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and mature saw timber pine. Additionally, the terrain, one of three factors affecting fire behavior in addition to weather and fuels, was flat.

As the lead AFC bulldozer operator was plowing, he noticed rapid fire movement coming in the direction of the three bulldozers. He advanced his bulldozer to a safe area while trying to communicate by radio to the other operators to seek cover. His radio communication did not succeed because his radio had jumped off the assigned frequency. It was reported that this is a recurring problem when the radio batteries become weak on the radio models used by the AFC. He reset his channel and attempted a second contact with the other bulldozer operators. The crew was not able to hear the call due to the loud background noise. He then made radio contact with air attack flying overhead, and air attack directed the remaining bulldozer operators to retreat.

Shortly after the lead bulldozer pulled off the main plow line to seek cover, the victim apparently realized the fire was going to overtake him, and he began to backup his bulldozer. He moved the bulldozer backward approximately 10 to 15 feet when the edge of the V-blade on the front of the bulldozer caught on an eight-inch diameter tree (see Figure 1). It appears the bulldozer may have stalled, and the victim exited the bulldozer through the left side of the cab. Since the bulldozer did not receive any significant burn damage (e.g., the plastic seat cover, the gauges and the hydraulic hoses were still intact), it is believed that the victim received radiant burns after exiting the bulldozer. After the victim was on the ground he started walking back toward the area where the fourth bulldozer was operating. The bulldozer operator saw the victim walking toward him with the legs of his pants burned away and with apparent burns to his legs, hands, and face. The operator helped the victim walk back to the Pump Station Road about ¼ mile away. In the interim an

ambulance had been notified and was waiting for the victim when he arrived. The victim was transported to a nearby hospital less than 3 minutes away. The victim was treated for second- and third-degree radiant burns over 60 percent of his body and hospitalized in critical condition. The victim was then transferred to the Children's Hospital Burn Unit in Little Rock, Arkansas where he lived for 7 weeks before dying from complications of the burns.

#### **CAUSE OF DEATH**

According to the certificate of death, the cause of death is listed as multi system organ failure due to large body surface area burns.

#### **RECOMMENDATIONS/DISCUSSION**

**Recommendation #1. Ensure all radio equipment is functional and durable, with the capacity for extended operation, and ensure frequency compatibility with contractors and aircraft operations. [2]**

Discussion: All AFC personnel had portable radios to communicate between each other and aircraft operations; however, AFC did not have the capability to communicate with everyone on the fire scene including, contract personnel and volunteer fire departments. The lead AFC bulldozer operator was using his radio to relay through the air observer that the Rangers and bulldozer operators should exit the area due to the shifting winds. Since he did not hear any response or air traffic, he visually inspected his radio and noticed his radio had "jumped" channels. It was reported that when the radio batteries become low, the radios have a tendency to "jump" channels without the operator's knowledge. Users of portable radios should ensure that all radios are fully charged and operational before use in the field, especially on the fire ground. If radios are unreliable, then the AFC should consider the following: 1) purchase of new or different radios, 2) mount mobile radios on

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the bulldozers, and 3) carry spare battery packs for replacement as needed.

**Recommendation #2. Configure bulldozer operator radio systems to allow full reception of transmissions in a high noise environment while operating machinery.**

Discussion: Bulldozer operators were equipped with hand-held radios which were chest-mounted. Oftentimes the ground crew has to make visual contact with the bulldozer operators to ensure they can hear what is being transmitted via the radio. Due to the high level of noise on the fire ground and from the bulldozers, headset-mounted radios inside the hard hats of personnel should effectively transmit required operations.

**Recommendation #3. Provide fire ground personnel with wildland personal protective equipment that is NFPA 1977 compliant, and monitor to ensure its use. [1]**

Discussion: AFC personnel were issued and wore hard hats, gloves, boots, goggles, Nomex IIIA® shirts and cotton jeans. If the victim had been wearing Nomex pants or coveralls, they might have greatly reduced the severity of burns received by 35 percent of his body surface area, thereby improving his chances of survival.

**Recommendation #4. Conduct annual fire shelter refresher training for all personnel and ensure it is readily available for all fire ground personnel including bulldozer and engine operators. [2,4]**

Discussion: As recommended, the entire crew was initially trained on the proper use and care of a fire shelter in April 1998. Members had to properly demonstrate their knowledge to the District Forester to successfully complete the training. “Your Fire

Shelter, Beyond the Basics” suggests, additional deployments should be practiced under a variety of conditions. This includes training in the field where different types of entrapments can occur. If training were conducted more frequently, including demonstration sessions, this might have influenced the victim to use the fire shelter once he exited the bulldozer. The fire shelter is designed to reflect 95 percent of the radiant heat. The opinion of the victim’s doctor stated that all burns were from radiant heat.

**Recommendation #5. Implement the Incident Command System (ICS) for the management of all fires, and establish an Incident Command Post (ICP) as needed to facilitate command and control, especially on complex fires involving multiple agencies. [2,3]**

When the Country Forester arrived, he took over the IC duties. The IC was directing operations with volunteer fire departments; however, another County Forester was directing bulldozer operations on the fire line. Additionally, the lead machine operator was communicating with air operations instead of the IC. All personnel should be trained on ICS and ICP to facilitate command and control on the fire ground, especially on complex fires involving multiple agencies. In this incident, numerous fire agencies and the timber company were involved in suppression actions without coordinated command and control.

**Recommendation #6. Utilize National Weather Service (NWS) Fire WX Forecasters for all fire weather predictions and immediately share all information about significant fire weather and fire behavior events with all personnel (e.g., long-range spotting, torching, spotting, and fire whirls). [2]**

Discussion: The AFC obtains the weather forecast from NOAA/NWC. This type of weather forecast



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does not provide site specific information on fire weather, such as erratic wind change. NWS Fire WX Forecasters should be utilized for all fire weather predictions, and should include requests for spot weather forecasts during periods of abnormal weather or high fire danger on wildland fires.

**REFERENCES**

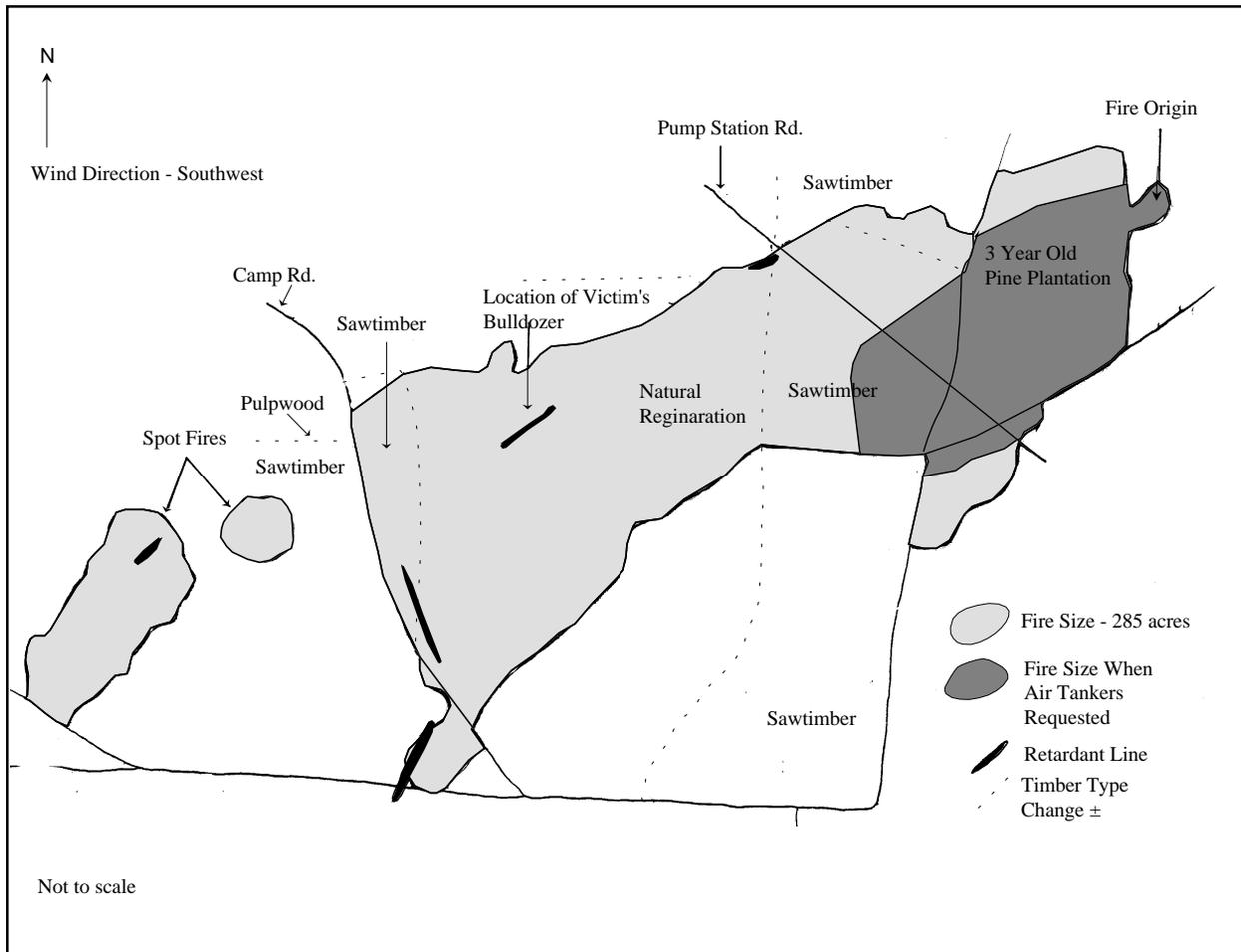
1. National Fire Protection Association. NFPA 1977, Standard on Protective Clothing and Equipment for Wildland Fire Fighting. National Fire Protection Association, Quincy, MA, 1998 Edition.
2. National Wildfire Coordinating Group (NWCG Handbook 3). Fireline Handbook, January 1998.
3. National Fire Protection Association. NFPA 1051, Standard for Wildland Fire Fighter Professional Qualifications. National Fire Protection Association, Quincy, MA, 1995 Edition.

4. National Wildfire Coordinating Group. Your Fire Shelter, Beyond the Basics. U.S. Government Printing Office: 1996-790-274/40083

**INVESTIGATOR INFORMATION**

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***Figure 2. Map of Wildland Fire Incident Site***