



## **Volunteer Fire Fighter Drowns During Dry-Suit Training Dive - North Carolina**

### **SUMMARY**

On January 15, 2000, a 37-year-old male volunteer fire fighter drowned during a dry-suit certification training dive. The victim was one of six divers which included one certified diving instructor (Professional Association Dive Instructor [PADI] Dive Master) and five students (three of the students were volunteer fire fighters). The victim was a member of the fire department's search and recovery dive team. On the day of the incident, the training was being conducted at a privately owned freshwater lake that is dedicated exclusively to recreational diving. The training consisted of one, 3-hour classroom training session (held on January 8, 2000), followed by three open-water dives conducted on January 15, 2000. The first dive was conducted in a controlled area near the shore. The second and third dives were logged open-water dives for dry-suit certification. On the third dive ascent, the group made a safety stop at a depth of 15 feet. After the instructor got the okay signal from all of the students, they continued their ascent to the surface. When the victim failed to appear at the surface, two of the divers descended to the bottom and began searching for him. They found the victim at a depth of approximately 22 feet.

They brought him to the surface where rescue breathing was initiated while moving him toward shore. Once on shore, paramedics transported the victim by ambulance to a local hospital where he was pronounced dead at 2238 hours. NIOSH investigators concluded that, to minimize the risk of similar occurrences, fire departments should

- ***ensure that divers maintain continuous visual, verbal, or physical contact with their dive partner***

### **INTRODUCTION**

On January 15, 2000, a 37-year-old male volunteer fire fighter (the victim) drowned during a dry-suit certification training dive. On the third training dive, the group ascended the tethered line, making a safety stop at a depth of 15 feet. After the instructor got the okay signal from all of the students, they continued their ascent to the surface. The victim failed to surface and was found at a depth of approximately 22 feet. He was pronounced dead 6 hours later. The National Institute for Occupational Safety and Health (NIOSH) was notified of this incident by the U. S. Fire Administration on January 18, 2000. On



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>

or call toll free **1-800-35-NIOSH**



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February 7, 2000, two Safety and Occupational Health Specialists from NIOSH investigated this incident. Meetings were conducted with investigators from the State Fire Marshal's office. Meetings and interviews were also conducted with the Dive Instructor of the class, the Chief, and fire fighters from the fire department involved in this incident. NIOSH investigators obtained from the fire department copies of training records, the victim's dive log, diving standard operating procedures, and witness statements. An incident report completed by the State Fire Marshal's office was also obtained. A site visit was conducted and the site was photographed. The victim's dive equipment was inspected and found to be in good working order.

The volunteer fire department involved in this incident consists of one fire station with a total of 19 volunteer fire fighters. The department serves a population of 7,000 in a geographic area of 20 square miles. The fire department's search and recovery dive team was established within the past year. The victim had 1 year of experience with the fire department and had completed basic fire fighter training. The victim was a certified PADI diver with 1 year of diving experience, and he was an original member of the fire department's search and recovery dive team. The victim had 18 logged dives over the 11-month period and had passed a required annual departmental physical.

#### **INVESTIGATION**

On January 15, 2000, dry-suit certification training was being conducted by a local commercial dive shop at a private freshwater lake. The lake is an old rock quarry that is approximately 100 acres in size with a maximum depth of 65 feet. Dedicated exclusively to recreational diving, the lake has a number of underwater sites that include sunken boats and training platforms. These dive sites are marked with surface buoys and are tethered by guidelines (3/16-inch nylon rope). The water clarity on the

day of the incident was 12 feet. The surface was calm and the water temperature was 51° F. The weather conditions were reported as sunny with an ambient air temperature of 48° F. The training consisted of a 3-hour classroom training session held on January 8, 2000, followed by three open-water dives that were conducted on January 15, 2000. The class began at 0800 hours with the first three hours consisting of setting up air bottles, checking equipment, and pre-planning of scheduled dives. Three dives were planned for that day (see Diagram 1). The instructor and five divers buddied up to form three teams of two divers each. The class began the first dive at 1100 hours in an area near shore at a depth of approximately 12 feet. This session allowed the students to do the following: (1) become familiar with their dry-suits and dry-suit buoyancy, (2) ensure that air could be relieved from their dry-suits to prevent over inflation, (3) adjust the weight on their weight belts, and (4) conduct pivot maneuvers. The victim needed to add approximately 10 pounds of additional weight to his weight belt, bringing the total weight to approximately 18 pounds, to compensate for the added buoyancy of his dry-suit. The first dive lasted approximately 30 minutes. The divers then took a 1-hour break on shore where they consumed water and soft drinks. They donned new air bottles prior to the second dive. (Air bottles were filled to an approximate air pressure of 3,000 psi before each dive.) The second dive lasted 25 to 30 minutes and was conducted in 20 to 25 feet of water. The second dive consisted of following the sloping bottom down, moving away from shore, and then traveling parallel to the rock wall leading out toward a buoy tethered to a sunken boat. The victim, for an unknown reason, became separated from the group at this point but was located at the surface by the instructor. The victim indicated to the instructor that everything was alright, and the two proceeded back down to join the group. The group followed the tethered guideline down to the boat (depth approximately 20 feet) where they conducted skills



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training maneuvers. The group ascended the line toward the surface where they made a 3-minute safety stop at a depth of 15 feet. The group then surfaced, went to shore, and took another 1-hour break before proceeding with the third dive. The third dive consisted of swimming on the surface to the same buoy where they had conducted their second dive. Once they reached the buoy they began their dive by descending the guideline to the bow of the boat. A second guideline is tethered from the bow of the boat (at approximately a depth of 20 feet) to a training platform 350 feet from the boat (at a depth of 28 feet) (see Diagram 2). Once the group reached the bow of the boat, they followed the second guideline toward the platform for another 100 feet (at a depth between 20 and 28 feet) before stopping. The divers then spent approximately 20 minutes performing various training tasks before proceeding side-by-side along the guideline in teams of two back toward the sunken boat. They ascended the guideline from the bow of the boat toward the buoy on the surface and completed a safety stop with the instructor at a depth of 15 feet. The divers were in a circle facing each other with the guideline in the center of the circle. After a 3-minute safety stop, the divers gave an okay signal to the instructor to continue their ascent to the surface. The victim was last seen slightly below and to one side of his partner at a depth of 8 feet and appeared to be ascending without difficulty. All of the divers made it to the surface simultaneously except for the victim. The instructor and students did not see any air bubbles breaking the surface. The instructor told two of the students (one a dive master and the other a certified search and recovery diver) to follow the guideline back down and retrace the dive path along the guideline. The instructor and one of the students then swam to shore to find a vantage point from where they could locate the missing diver by looking for his air bubbles breaking the water surface. Once they reached shore (approximately 40 feet from the buoy) they looked

for but did not see any air bubbles. The instructor told the student to go dial 911 at a phone located nearby. The two divers reached the bow of the sunken boat and found the victim's snorkel (approximately 8 feet from the boat) on the bottom near the guideline. (The victim had put his snorkel in his Buoyancy Compensator Device [BCD] because it had broken off earlier during the training exercise.) The two divers then began following the line leading from the bow of the boat toward the training platform. Approximately 12 feet from the bow of the boat, they found the victim in a sitting position on the lake bottom (at a depth of approximately 22 feet) with his mask still in place but without his regulator in his mouth. The two divers immediately put air in the victim's BCD and ascended to the surface. The entire descent and ascent took approximately 1½ minutes. Once the divers reached the surface with the victim, they established buoyancy for themselves and the victim, and then they cleared vomit from his mouth. They removed the victim's mask and noticed a small trickle of blood emitting from his nose. They began rescue breathing and started moving him to shore. The victim did not have a pulse, and once on shore the divers began administering cardiopulmonary resuscitation (CPR). The paramedics arrived just as they were beginning the second chest compression. The paramedics finished removing the victim's equipment and cut off his dry-suit. They defibrillated the victim and then loaded him into the ambulance. The entire sequence from the time the victim was found on the lake bottom until he was transported to the hospital was approximately 6½ minutes. The victim was transported to a local hospital where he was pronounced dead 6 hours later at 2238 hours.

#### **CAUSE OF DEATH**

The death certificate lists the cause of death as severe metabolic acidosis as the result of near drowning.



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**RECOMMENDATIONS AND DISCUSSION**

**Recommendation:** *Fire departments should ensure that divers maintain continuous visual, verbal, or physical contact with their dive partner.*<sup>1,2</sup>

Discussion: Effective underwater communication refers to the capability to communicate between divers and from a diver to the surface. The divers present at this incident were able to communicate by utilizing recognized dive signals such as a “thumbs-up” to indicate they were okay. Fire departments should follow OSHA safety standard 29 CFR 1910.424(c)(2) by ensuring that a diver be lined from the surface or accompanied by another diver in the water who is in continuous visual contact during the diving operations. The victim was a volunteer fire fighter and was not covered by OSHA regulations. However, following OSHA standards would provide additional protection for fire fighters who face unique environments and hazards associated with technical rescue operations. Effective

communication and continuous visual contact are two ways in which divers can convey any equipment or medical problems they may be experiencing. One of the divers observed the victim and the victim’s dive partner at a depth of 8 feet, and neither appeared to be having any difficulty ascending to the surface.

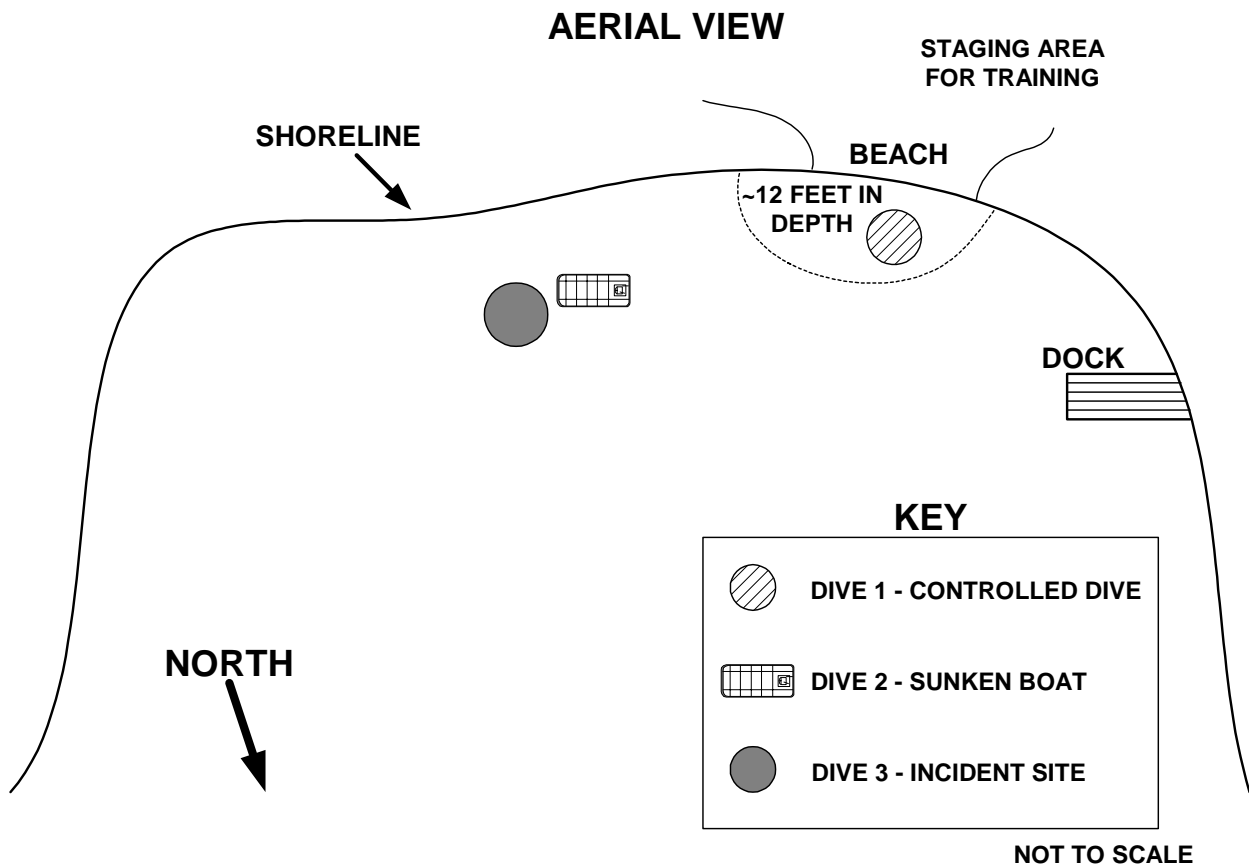
**REFERENCES**

1. National Fire Protection Association [1999]. NFPA 1670, standard on operations and training for technical rescue incidents. Quincy, MA: National Fire Protection Association.
2. 29 Code of Federal Regulations 1910 Subpart T, Commercial Diving Operations. 1910.424, SCUBA diving.

**INVESTIGATOR INFORMATION**

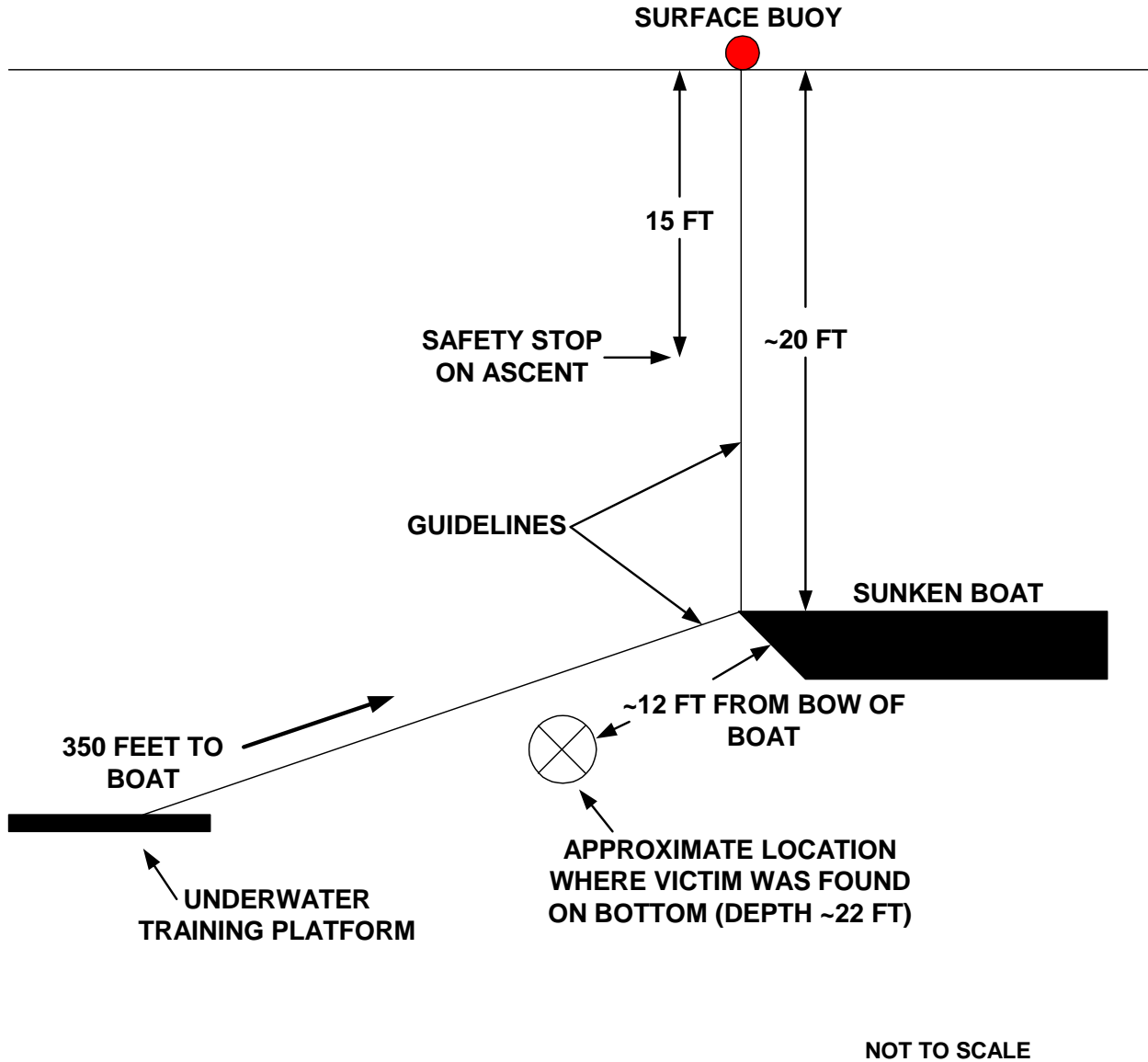
This incident was investigated by Frank Washenitz and Mark McFall, Safety and Occupational Health Specialists, Division of Safety Research, NIOSH.

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*Diagram 1. Site Photo*

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*Diagram 2. Profile of Incident Site*