MASSACHUSETTS DPH/DLI/NIOSH
FACE MA-92-04
DATE: May 01, 1992

TO: Director, Massachusetts Department of Public Health, Occupational Health Surveillance Program

FROM: Massachusetts Fatal Accident Circumstances and Epidemiology Project (MA FACE) Field Investigator

SUBJECT: Off-Duty Municipal Firefighter/EMT Drowns in Massachusetts River

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SUMMARY

A 30 year old male off-duty municipal firefighter/EMT performing independent scuba diving work for an area electricity production company accidentally drowned when his body became entrapped in a submerged river water gate. The water gate was one of two points where river water enters a submerged pipeline/shaft system to provide turbine power for the electricity generation process. The company had been attempting for several days to completely close the water gate for maintenance purposes without success. The victim had contracted with the company to clear an underwater obstruction from one of the water gates hoping the gate would then freely and entirely close. Having performed this service on at least one previous occasion and while attempting to clear the obstruction, his leg(s) became entrapped in the partially opened water gate. With his air supply rapidly running out, several unsuccessful attempts were made from above to extricate the victim. By the time certified and equipped divers arrived on-site to further the rescue attempt, the victim had been without air for approximately 30-40 minutes. Once extricated, the victim was revived, yet he died several hours later at the regional hospital. The Massachusetts FACE Investigator concluded that, in order to prevent future similar occurrences, divers and entities needing such services should:

* determine, assess, and discuss beforehand, the actual and/or potential hazards associated with the performance of underwater projects. Diving equipment should be checked and double checked and plans made in advance of rescue operations that may be needed in association with such identified or unidentified hazards

* implement and enforce strict compliance with policies that ensure fail-safe communications with individuals engaged in underwater operations

* implement and enforce strict compliance with policies that mandate diving in teams of no less than two certified persons familiar in underwater rescue operations

* implement and enforce strict compliance with policies that mandate one or more certified persons familiar in underwater rescue operations be located immediately above the jobsite water level with appropriate equipment to mount immediate rescue operations, if necessary

INTRODUCTION

The Massachusetts FACE Investigator was notified by the Massachusetts Department of Labor and Industries on December 06, 1991 that an afternoon community newspaper included a story detailing the drowning death of an off-duty municipal firefighter/EMT on December 03, 1991. The MA FACE Investigator immediately initiated an investigation into the incident. The victim had subcontracted with an area company to provide underwater scuba diving services in 12-15 feet of river water. When he attempted to dislodge a submerged water gate obstruction, he became entrapped, ran out of air, and subsequently drowned. On December 15, 1991, the MA FACE Investigator interviewed the municipal fire department chief, municipal fire department captain, and reviewed the incident scene. On January 02, 1992 the rescuing diver was also interviewed. Multiple reports and statements, numerous photographs, death certificate and autopsy findings were obtained during the investigation.

The victim was performing independent off-duty work at the time of the incident. The victim's official employer was a municipal firefighting/rescue department in existence for 100+ years and employed 35 persons of various ranks in typical firefighting/rescue capacities. While the department did not employ a designated safety officer, it did utilize and follow detailed written safety rules and procedures. The victim was one of several certified fire department divers who utilized his expertise in his profession on the job, for personal gain, and for

recreation.

INVESTIGATION

One of two water gates, 4 feet by 8 feet in diameter and 12-15 feet below the river surface, each as part of a conveyance system supplying municipal river water to a private electricity generation facility in Massachusetts, was obstructed from fully closing which hindered internal maintenance operations for several days. On the morning of December 03, 1991 the victim met at the jobsite with two company representatives to discuss the problem. The victim had performed similar work in this area before. The plan called for an underwater dive to dislodge an obstruction that prevented the problematic water gate from fully closing. Agreeing to repeatedly tug on his lifeline in the event of trouble, the victim entered the frigid water at approximately 8:30 a.m. in a wet suit and diving gear which included an oxygen tank containing 45 minutes of air and a flashlight. He also brought with him a 2 inch by 6 inch by 4 foot lumber remnant which was to be used to block the opening and minimize the leak in the event that the gate could not be freed.

After the victim had been below the 34 degree river surface for approximately 10 minutes, one of two company representatives tugged on the lifeline which was attached to the victim's waist. The victim then returned several tugs of his own. Unsure if the return tugs meant trouble, both company representatives made several attempts to pull the victim from the water but were unable to do so. They immediately contacted the municipal fire department on a radio the victim had provided. Fire department response occurred within minutes. Knowing their co-worker and friend was conducting a dive at this location, the first two fire department responders, a captain and a firefighter, made several additional attempts to extricate the victim to no avail. In an act of desperation, the victim's lifeline was then attached to the bumper of an awaiting ambulance on two separate occasions. The attempt to extricate the victim in this manner yielded a lifeline that broke approximately 12 inches from the victim's waist. During this course of rescue, a neighboring community rescue squad was summoned. At approximately 9:15 a.m., the victim's visible exhalation bubbles on the river surface stopped. At 9:20 a.m., the fire department chief and the victim's brother, who also was a fire department employee, both responded to the scene and made dives to free the victim. The brother had to abort his attempt due to equipment failure. The fire chief's first effort was aborted due to unexpected turbulence. On his second attempt at

approximately 9:25 a.m., he was able to locate the victim in the murky water but was unable to free him. At 9:35 a.m., a company representative recommended opening the other water gate to relieve some of the pressure that may have been causing the victim's entrapment.

At 9:45 a.m, 1 hour and 15 minutes after the victim entered the river and some 30 minutes after his air ran out, the neighboring community rescue squad diver had arrived at the scene and made his rescue attempt. He was able to free the victim with a simple turn of the lower left leg which indeed had been caught between the water gate base and its' concrete resting pad. Once brought to the surface, CPR was immediately administered by multiple certified rescue personnel. Approximately 1 hour and 15 minutes following rescue, the victim was revived in the emergency department of the local hospital. Subsequently, he was transferred to another medical center where he died at 5:35 p.m. of the same day.

The rescuing diver described that the body was in a floating manner with arms outstretched towards the river surface and only the lower left leg caught at the water gate base. Autopsy findings showed intense red lividity of both legs from the mid thighs to the feet. This appears to be consistent with trauma suffered from pulling up on the body when both legs were pinned horizontal to the river bed between the base of the water gate and its concrete resting pad.

There were no eyewitness accounts of the actual entrapment, however information gathered throughout the investigation suggests two possible scenarios of the incident:

a. Given the turbulence described by the fire department chief following his first rescue attempt, the victim may have become entrapped due to excessive water pressure created by the volume of water rushing through the small opening at the base of the water gate. Relieving the water pressure by opening the secondary water gate then may have partially freed the body allowing easier extrication.

b. The victim may have attempted to kick the obstruction from the opening, thus pinning his legs in a manner such that he was unable to free himself or to be freed by those pulling upwards on his body.

CAUSE OF DEATH

The Medical Examiner listed the cause of death as asphyxia due to drowning.

RECOMMENDATIONS/DISCUSSION

* Recommendation #1: Divers and entities in need of diving services should determine, assess, and discuss beforehand actual and/or potential hazards associated with the performance of underwater projects. Diving equipment should be checked and double checked and plans made for rescue operations that may be needed in association with such identified or unidentified hazards.

Discussion: Had policies or procedures similar to those offered in OSHA Standard 29 CFR 1910.410 been implemented at the time of this incident, a company representative or company designee in charge may have employed measures affecting the safety and health of the victim. Prior to commencing any hazardous or potentially hazardous project, divers or entities in need of diving services should closely examine and discuss the nature of the job to identify factors that could result in illness, injury, or death similar to those outlined in OSHA Standards 29 CFR 1910.420 and 29 CFR 1910.421 for commercial diving. Without prior open discussion, dangerous factors that may be well known to one party, may not necessarily be known to the other. The planning phase should additionally address specific emergency response and rescue measures in the event of an unforseen incident. In this case, pre-project discussions or meetings may have revealed the hazards that resulted in the victim's entrapment. In addition, prior discussions may have more readily identified the means of relieving water gate pressure in the event of entrapment which in this case, had not been considered nor initiated until it was to late. Finally, OSHA Standard 29 CFR 1910.424 details requirements for a diver-carried reserve breathing gas supply. Considering that the victim apparently felt he had more than enough air to complete the task, a reserve supply may have provided the means to survive his ordeal.

* Recommendation #2: Divers and entities in need of diving services should implement and enforce strict compliance with policies that ensure fail-safe communications with individuals engaged in underwater operations.

Discussion: A constant means of maintaining fail-safe communications with individuals engaged in dangerous operations while not in sight of potential emergency responders should be developed and implemented similar to that outlined in OSHA Standard 29 CFR 1910.422. This incident did not effectively provide such a means. Agreeing to tug repeatedly on his lifeline

in the event of trouble did not clearly establish the victim's need for assistance. Since the company representatives were the first to tug on the victim's lifeline, there is cause to believe that the victim was entrapped early on in his dive and may have been unable to repeatedly tug on his lifeline to inform them he was in trouble. The market place offers manufactured diver's face masks that provide for constant verbal communication with other diver's and/or individuals above the water surface. There are also emergency flotation devices that can be secured to a diver's body or belt that in the event of an emergency can be instantaneously inflated and sent to the surface as a notice of trouble. While lifelines and lanyards were meant to provide a valuable source of personal protection, the ability to verbally communicate with potential emergency responders could only enhance life sustaining or life saving procedures.

* Recommendation #3: Divers and entities in need of diving services should implement and enforce strict compliance with policies that mandate diving in teams of no less than two certified persons familiar in underwater rescue operations.

Discussion: While it is common place for individuals to dive alone with a lifeline tended at the surface, the risks associated with solo diving remain. OSHA Standard 29 CFR 1910.424 for commercial diving outlines requirements for EITHER a lifeline to be tended at the surface OR the diver be accompanied by another diver in the water in continuous visual contact during the diving operation. Additionally, the same standard requires a diver to be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces. Had ANY COMBINATION of these measures been required or been voluntarily followed during this dive, the result may have been different. Since the lifeline fell short of its intended goal in this incident, strong consideration should be given to implementation of a " buddy system " regardless of rules or regulations.

* Recommendation 4: Divers and entities in need of diving services should implement and enforce strict compliance with policies that mandate one or more certified persons familiar in underwater rescue operations be located immediately above the jobsite water level with appropriate equipment to mount immediate rescue operations, if necessary.

Discussion: OSHA Standard 29 CFR 1910.424 requires that a standby

diver be equipped and available while a diver is in the water. While instantaneous response by company representatives may not have made a difference in this incident, it remains imperative that a minimum of at least one fully equipped certified diver familiar with rescue operations be on immediate standby if needed.

REFERENCES

Office of the Federal Register: Code of Federal Regulations, Labor, Title 29, Parts 1910.410 (July 01, 1991)
1910.420 (July 01, 1991)
1910.421 (July 01, 1991)
1910.422 (July 01, 1991)
1910.424 (July 01, 1991)

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