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NIOSH
Fire Fighter Fatality Investigation
and Prevention Program

Death in the line of duty...

A summary of a NIOSH fire fighter fatality investigation *December 17, 2007*

Career Captain Dies from Complications of a Drowning Incident due to a Combination of Exhaustion, Hypothermia and Carbon Monoxide Poisoning During Surf Rescue Training – Washington

SUMMARY

On March 22, 2006, a 40-year-old male career Captain (victim) died from complications of a drowning incident that occurred two days prior. The victim was in a training class with another student to become certified on a personal watercraft/waverunner (PWC) to conduct surf rescue operations for his jurisdiction. While the victim participated in training evolutions as a passenger on the back of the PWC, he fell off and reboarded numerous times while the engine was running. After a wave knocked both trainees from the PWC, the victim reported that he was too tired to re-board and seemed confused. The instructor attempted to drag the Captain into shore using an 18-inch tow strap attached to the rear of the PWC, but this was very difficult due to the surf conditions and the engine's water propulsion hitting the victim's upper body. After numerous attempts to hang on, the Captain became lost in the surf. A few minutes later, the instructor found the Captain and swam him to shore. The victim was retrieved from the surf and advanced life-saving efforts were initiated until the ambulance arrived on the scene and transported him to a local hospital. He was airlifted to a regional medical center where he died two days later from the injuries received during the incident. NIOSH investigators consider the drowning episode to have been triggered by a combination of exhaustion, hypothermia [rectal temperature less than 95.7º Fahrenheit (F)], and carbon monoxide poisoning (carboxyhemoglobin level estimated to be 20%). To minimize the risk of similar occurrences, fire departments, police departments, and/or agencies with surf rescue teams should:

- ***ensure that PWC are never boarded by an operator or a passenger while the engine is running***
- ***enhance current standard operating procedures to include requirements for rescue boards on all PWC during emergency responses and training***
- ***enhance current standard operating procedures to include requirements for issued personal protective equipment (PPE)***
- ***enhance current standard operating procedures for training operations to duplicate the same level of response as an actual emergency***
- ***provide an emergency medical services unit at all training sessions***

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- ***consider conducting a job analysis of surf rescue to determine its fitness and strength requirements***

Additionally, manufacturers should:

- ***assess the significance of carbon monoxide exposures and carbon monoxide poisoning among operators of PWC during simulated rescue operations.***

INTRODUCTION

On March 22, 2006, a 40-year-old male career Captain (victim) died from complications sustained after a drowning incident. On March 23, 2006, the U.S. Fire Administration (USFA) notified the National Institute for Occupational Safety and Health (NIOSH) of the fatality. On June 11-14, 2006, a Safety and Occupational Health Specialist from the NIOSH Fire Fighter Fatality Investigation and Prevention Program investigated the incident. Meetings were held with the U.S. Coast Guard, police department officials responsible for the training, fire department officials, and the city attorney. Interviews were conducted with the fire and police department officers directly involved in the incident. Interviews were also conducted with representatives of the County's Sheriff Office, the State Medical Examiner's Office, and the dry suit manufacturer who established the training protocol for area surf rescue teams. The NIOSH investigator reviewed the fire department's report, the police department's report, the county sheriff's report, the police department's standard operating procedures (SOPs), the instructor's and trainees' training records, the dispatch log for the incident, and the ambulance, emergency department, and hospital records of this incident. The PWC was visually inspected and photographed.

Surf Rescue Team and Response Protocol

The Surf Rescue Team is operated by the local police department and staffed by its police and local career fire department members. The team is dispatched to any water event such as a capsized boat, a downed aircraft, or a swimmer in trouble. The department serves a population of approximately 6,000 residents in a geographic area of about 60 square miles.

Training

The State of Washington does not require a license or specialized training for surf rescue members. However, the police department requires the following for Operators and Instructors, respectively.
Operators:

- minimum swim qualification,
- rescue swimmer certifications,
- CPR and first aid certifications, and
- recommendation by the Surf Rescue Team leader.

Instructors:

- be an "Operator" for more than six months,

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- logged over 50 hours on the PWC,
- attend the National Marine Rescue Academy for PWC course or equivalent.

Personal Watercraft (PWC)

The PWC used by the instructor was a 2000, class A inboard boat with jet propulsion. It was 124 inches in length and weighed 605 pounds. It was a 2-stroke gasoline engine with 718cc displacement. The exhaust fumes exited near the water line at the rear of the craft (Photo 1). The PWC had an 18 inch towing strap looped off the back seat (Photo 2).

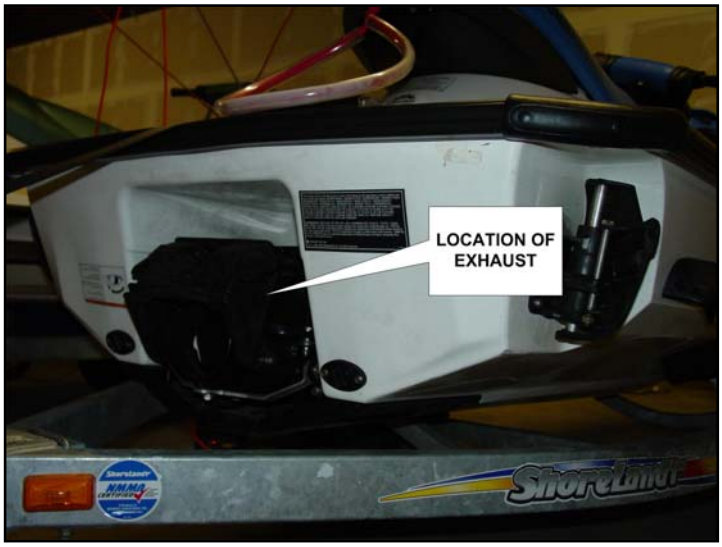

Photo 1. Location of Exhaust

Personal Protective Equipment

The victim was wearing a full body dry-suit with a poly-propolyene jump suit underneath, a polyolefin and Lycra® combination hood, a helmet, a strobe, a mask, a snorkel, a personal flotation device, and a pair of thin non-insulated gloves that he reportedly purchased to improve dexterity (Photo 3). The dry-suit provided a protective and abrasion resistant shell while the undergarment provided thermal protection. These garments were part of a system that provides substantial protection against the elements as long as it is not compromised. The hood and gloves that the victim was wearing were not waterproof and would have provided minimal thermal protection in this windy environment on the ocean, and possibly none once they became wet.

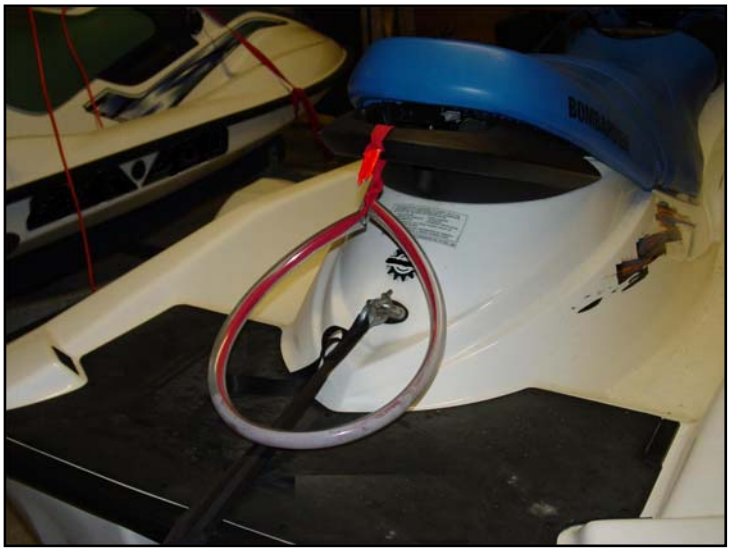

Photo 2. Towing Strap

Weather/Sea Conditions

The conditions were clear and sunny with the temperature averaging 62° F. The water temperature was approximately 47° F with winds averaging about 15 miles per hour and a wind chill of approximately 32° F.[1]

INVESTIGATION

On March 20, 2006, a 40-year-old male

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career Captain (victim) participated in a training session on surf rescue operations using a PWC in the ocean. The scheduled four hour session involved an instructor and two fire fighters (the victim and another fire fighter). The goal was to demonstrate proficiency at operating a PWC in surf conditions. Several weeks prior to this event, the instructor and these two fire fighters practiced in a nearby fresh water lake which was considered a less rigorous and less hazardous environment.

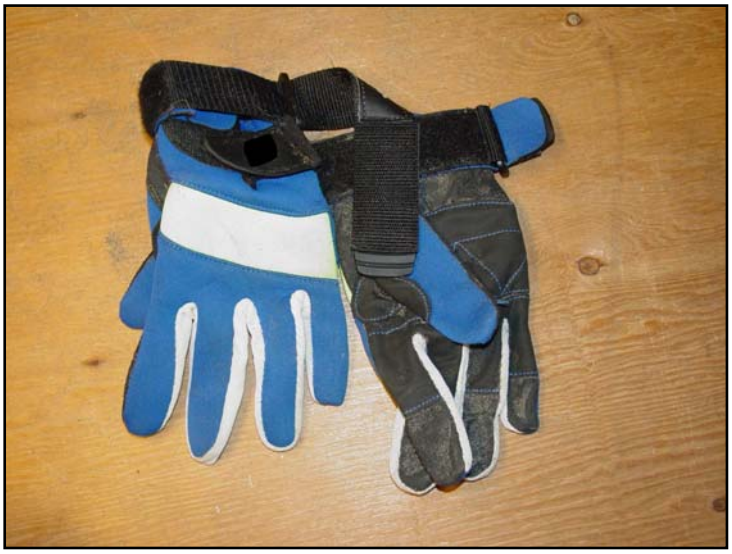

Photo 3. Gloves worn by victim during incident

The trainees spent the first two hours of the session conducting maneuverability drills with their individual PWC through the breakers as the instructor oversaw the drills while operating his PWC. After this, they rested on the beach for about 30 minutes, drank some water, but did not consume any food. The second half of the session was devoted to each trainee operating a PWC with a passenger (the other trainee) aboard which is a more difficult task. The victim was the first to drive the PWC with the other trainee as a passenger. The victim drove through the surf until approximately ¼ mile offshore and then completed several drills without incident (e.g. neither the driver nor the passenger fell off the PWC).

At approximately 1400 hours, the two trainees returned to shore to switch positions in thigh-deep water. When they returned to the open surf, the other fire fighter was driving and the victim was the passenger. As the driver was negotiating the rough surf, the victim fell off the PWC several times. Given the rough surf conditions, re-boarding the PWC as a passenger was an extremely difficult task. *Note: Boarding a PWC from the water is difficult, even in calm (e.g. non-surf) conditions. To board a PWC as a passenger from the water, is even more difficult. Once the driver is seated, the passenger approaches the back of the PWC and pulls the craft down while lifting his/her body out of the water. This is typically done with the passenger's hands on both of the side floor boards. In one fluid motion, the passenger raises his/her knees to the side floor boards as his/her hands leave the side floor boards to grab the seat handle. The passenger then quickly pull him/herself up onto the seat. During this procedure, both the driver and passenger must be perfectly balanced so the PWC doesn't tip over. Once the passenger is aboard, the driver must counter-balance the passenger's weight, and be prepared to start the craft and accelerate the moment the passenger is seated. It is also important to note that the exhaust exits underneath the PWC at the rear floor boards. Passengers preparing to re-board from the water could be exposed to exhaust fumes if the craft is running.*

Each time the victim fell off the PWC and into the cold water, he seemed to take longer and have more trouble re-boarding. The victim had just successfully re-boarded when a wave knocked both trainees off the PWC. The instructor was within yards of the trainees when they capsized and immediately went to render assistance on his PWC. The instructor yelled to both trainees to check their conditions. The driver gave a hand signal to communicate he was alright. The victim reported that he was too tired to re-board. The instructor threw the victim a buoyancy ring to clip around himself, but the victim could not manipulate the connection and began flailing his arms.

The instructor immediately realized the gravity of the situation and decided to tow the victim the ¼-mile to shore. He checked on the driver and saw him swimming to shore after being separated from the PWC. The instructor attempted to tow the victim back to shore using an 18-inch tow strap attached to the back seat of his PWC. The victim hooked his elbow into a loop on the tow strap and tried to keep his head above the water. During this towing process, the victim's face was very close (inches) from the rear floor boards where the engine exhaust exits the PWC.

Due to his exhausted state and the force of the jet propulsion hitting his upper body, the victim had difficulty holding onto the strap. The instructor had to circle around several times to reattach the victim to the strap. Approximately 100 yards from shore the victim became detached from the strap for the last time, remained face down, and was lost in the surf for a few minutes. The instructor found him and swam him into shallow water where he was assisted by the Safety Officer who was positioned on the shore.

RESUSCITATION and TREATMENT

Once on shore at 1515 hours, an ambulance was requested by the Safety Officer and the victim was unresponsive with seawater in his mouth. He had a pulse but no spontaneous respirations. Two rescue breaths were given, followed by mouth to mouth rescue breathing, but the victim slipped into cardiac arrest. Cycles of chest compressions and ventilations were provided according to the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. No automated external defibrillators (AED) were available on-scene. Ambulance personnel arrived six minutes later (1521 hours), and initiated advanced life support which included intubation (breathing tube placed into the victim's airway), and starting two intravenous lines through which medications were administered. At 1524 hours the ambulance departed for the local emergency department. Approximately 9 minutes en-route, the victim regained a heart rhythm which was able to maintain a blood pressure of 97/50 mm Hg. The ambulance arrived at the emergency department at 1555 hours (See Appendix for timeline).

In the emergency department the victim was unresponsive, with a heart rate of 115 beats per minute, a blood pressure of 107/30 mm Hg, and no spontaneous respirations. His rectal temperature was 95.7° F after being treated and warmed in the ambulance for 31 minutes. His first arterial blood gas

was taken at 1605 hours which showed extreme acidosis (pH=6.6, pO2=138, pCO2=62, and a bicarbonate of 6) consistent with a respiratory arrest. Other blood work was collected at 1610 hours and 1850 hours. A chest X-ray showed increased densities in his right lower lobe and right middle lobe (consistent with aspiration pneumonia and/or early adult respiratory distress syndrome). He was placed on a ventilator (breathing machine), given broad spectrum antibiotics for a possible pneumonia, and admitted to the intensive care unit with a diagnosis of "near-drowning."

In the intensive care unit the victim's lungs were not able to adequately oxygenate his blood, despite being on 100% oxygen through the ventilator. In addition, his blood pressure was beginning to fall, needing intravenous medication. Due to the victim's deteriorating clinical condition, he was transferred via air ambulance to a regional medical center. He was treated at that center for about 1 day, but he never regained consciousness. His cardiopulmonary status continued to deteriorate and he died at 0019 hours on March 22, 2006.

AUTOPSY

An autopsy was performed by the Associate Medical Examiner in the County Medical Examiner's office. Significant findings included:

- 5 foot 10 inches body weighing 232 pounds (body mass index of 33.3 which is considered obese.[2])
- Normal heart with minimal atherosclerosis in the coronary arteries
- No evidence of a pulmonary embolus
- Microscopic finding of ischemic necrosis [cell death due to lack of oxygen] in three critical areas of the brain (cerebrum, cerebellum, hippocampus)
- Negative blood screen for opiates, cocaine, amphetamines, PCP, marijuana, methadone, propoxyphene, benzodiazepines, barbiturates, and tricyclic antidepressants
- Carboxyhemoglobin (COHb) level of 10% (normal < 1%).[3] This test was run on about 1 milliliter of whole blood collected in a 5 milliliter purple top tube on 3/20/06. We do not know the precise time this blood sample was taken or the storage conditions (refrigerated or frozen) from 3/20/06 until 3/27/06 when it arrived in the County Medical Examiner's office. Upon arrival in the County Medical Examiner's office it was kept refrigerated until the initial testing (drug screen mentioned above) was completed on 3/27/06 and then transferred to a storage freezer. On 5/1/06, the Associate Medical Examiner requested COHb testing, so the sample was thawed and analyzed for COHb using a CO-oximeter.

The Associate Medical Examiner considered the cause of death to be "hypoxic ischemic encephalopathy [brain damage due to lack of oxygen] and adult respiratory distress syndrome due to drowning."

DISCUSSION

NIOSH investigators believe three factors contributed to this drowning incident: exhaustion, hypothermia, and carbon monoxide poisoning.

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EXHAUSTION. Attempting to board a PWC in the open surf as a driver is a strenuous task. Attempting to re-board a PWC in the open surf as a passenger is even more difficult, especially if the passenger is wearing cold water survival gear. Passenger re-boarding requires an incredible amount of strength, balance, and coordination with the driver. The victim had been involved in this physically demanding certification training for about three hours, the last 30 minutes as a passenger with numerous re-boarding episodes. The victim appeared fatigued, exhausted, and stated he was "too tired to re-board." The surf rescue team requires numerous Operator and Instructor qualifications (see above Training section), but none address the applicant's physical fitness to perform the essential tasks of surf rescue. Although the victim was obese (BMI of 33.3), obesity, by itself, does not predict an applicant's fitness (strength and aerobic capacity).

HYPOTHERMIA. In the emergency department the victim had a rectal temperature of 95.7° F [35.4° Celsius (C)]. Rectal temperature is a good measure of core body temperature. This reading was taken approximately 31 minutes after being treated, and warmed, in the ambulance. Therefore, his core body temperature was probably below 95.7° F when he entered the ambulance. Hypothermia is defined as the fall in core body temperature below 95° F. It can be classified as mild (>93.2° F), moderate (86° F -93.2° F), and severe (<86° F), although the temperature criteria for each classification varies somewhat by author. [4-8] The clinical effects of mild hypothermia include symptoms of cold, exhaustion, numbness and signs of shivering, decreased hand coordination, and mild impairment of judgement/responsivess. [6,7] With the exception of shivering, the fire fighter had all of these signs and symptoms while trying to re-board the PWC.

Prior to this incident the Fire department issued the trainees a neoprene body suit including gloves to provide protection from the cold water. The gloves issued by the fire department were three millimeters thick which reduced hand and finger dexterity. To overcome this dexterity problem, the victim used other gloves he had purchased that provided limited thermal protection. After falling from the craft into the cold water, the victim's hands would have become very cold. His cold hands probably impaired his ability to board the PWC, hold on to his training partner, clip himself onto the buoyancy ring, and hold onto the PWC's towing strap. In addition, the victim's face was also exposed to the cold water without insulation. These two sources, hands and face, immersed in cold water were likely responsible for the victim's mild hypothermia.

Shortly after being pulled from the water, the victim suffered a cardiac arrest. Although severe hypothermia is known to cause cardiac arrest, the victim's probable mild hypothermia, by itself, likely did not directly cause his cardiac arrest. [6,7]

CARBON MONOXIDE POISONING. Carbon monoxide (CO) is a colorless gas produced when fuels such as gasoline are burned. The PWC's engine exhausted in the rear of the craft near the water line. When attempting to reboard the craft and during efforts to drag him into shore, the victim's head would have been in the direct path of the exhaust. As mentioned previously, attempting to

board a PWC in the open surf is an extremely demanding task, especially while wearing cold water survival gear. This would produce a fast and deep breathing, factors that would increase his CO exposure.[9]

When inhaled, CO crosses the alveolar (lung) membrane and binds to hemoglobin forming COHb. The COHb alters the shape of the hemoglobin molecule which reduces the availability of oxygen to other tissues causing hypoxia. CO also disrupts the intercellular use of oxygen (oxydative phosphorylation) by binding to intracellular enzymes (cytochrome c oxidase).[10] The brain and the heart are the organs most vulnerable to hypoxia. Symptoms/signs associated with CO poisoning include headache, dizziness, weakness, nausea, confusion, fast heart rate and shortness of breath.[9] According to the training instructor, the victim acted in a confused or disoriented manner during the later efforts to reboard the PWC.

COHb levels in the blood are used to assess CO exposure and CO poisoning. As a marker of CO poisoning, it should be noted that COHb levels do not correlate well with clinical findings, and that profound unconsciousness has been reported with levels less than 20%.[11,12] Another potential source of CO exposure includes the victim's habit of smoking up to five cigars a day. COHb levels among primary cigar smokers (those who never inhaled cigarettes) are generally less than 5%, while secondary cigar smokers (cigarette smokers switching to cigars) have reported COHb levels as high as 13%, presumably due to the inhalation of the cigar smoke.[3,13-15] It is not known if the victim inhaled his cigar smoke, nor when his last cigar was smoked. It is known that once the training started (about 1000 hours), the victim did not complain of any symptoms or show any signs of CO poisoning.

The possibility of CO poisoning was not considered during efforts to resuscitate the victim. However, the Associate Medical Examiner was aware of drowning deaths associated with CO poisoning involving recreational boats.[16-18] On May 1, 2006 he requested the State Toxicology Laboratory test the Captain's COHb level. The COHb was elevated (10%), but not at a level considered dangerous. However, the Captain's resuscitation efforts included intubation and administration of 100% oxygen; measures that speed the elimination of COHb.[10,19] He was intubated and given 100% oxygen for approximately 47 minutes prior to blood being drawn at the local hospital (1610 hours according to the local hospital's laboratory report). Assuming the blood that was tested for COHb was from this blood collection, his corrected COHb would have been approximately 20%.[10] If, however, the blood that was tested for COHB was actually from his last blood draw at the local hospital (1850 hours), his COHb level would have been significantly higher (e.g. >60%). Unfortunately, the tube containing the victim's blood from the initial hospitalization only had the date, not the time that the blood was drawn. Other factors that can lower COHb levels include inadequate or prolonged storage of blood samples.[20-22] As mentioned earlier, storage conditions of the blood sample were not available after it was drawn on 3/20/06 until when it arrived in the County Medical Examiner's office on March 27, 2006.

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RECOMMENDATIONS/DISCUSSIONS

Recommendation #1: Fire departments, police departments, and/or agencies with surf rescue teams should ensure that PWC are never boarded by an operator or a passenger while the engine is running.

The police department's SOPs include the manufacturer's operating instructions for the PWC. With a properly attached "kill switch" the engine is automatically shut off when the operator falls off of the PWC. The instructions state that the craft should not be started until the driver and passenger are properly seated.[23] In this incident, the victim was riding as a passenger and fell off of the craft numerous times. The PWC was running each time while the victim attempted to board it.

Recommendation #2: Fire departments, police departments, and/or agencies with surf rescue teams should enhance current standard operating procedures to include requirements for rescue boards on all PWC during emergency responses and training.

Discussion: The department conducting the training had a PWC equipped with a rescue board which is attached to the back of the PWC to assist with transporting a victim or swimmer (Photo 4). The PWC that had this piece of safety equipment was not used during this training session. It could have assisted in transporting the victim to shore safely. The rescue board reduces the physical effort of holding onto the craft and the drag from being towed through the water. It also elevates the rescuee's head and acts as a shield from the exhaust.

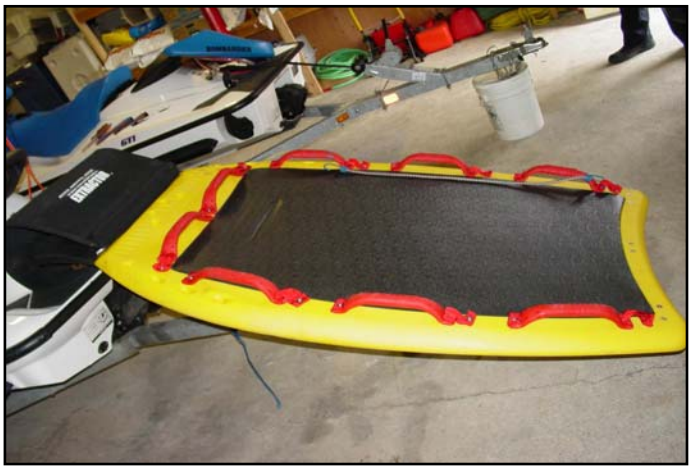

Photo 4. Rescue Board

Recommendation #3: Fire departments, police departments, and/or agencies with surf rescue teams should enhance current standard operating procedures to include requirements for issued personal protective equipment (PPE).

Discussion: Providing and using safety equipment that is compliant with all applicable standards will not necessarily guarantee fire fighter safety; however, injuries and fatalities can be minimized if protective clothing and equipment are used properly.[24]

In this incident the fire fighters who were taking the training were wearing gloves that were not issued to them. The gloves that were issued to them were made from neoprene that was 3mm thick to provide protection from the cold (Photo 5). The gloves that the fire fighters were wearing to increase

dexterity, provided limited thermal protection. Also, the hood that was issued to the surf rescue team provided little thermal protection once it became wet. After falling from the craft and being exposed to the cold water, the victim's ability to board, operate, and hold on to a partner while attempting the exercises could have been restricted. Reduced thermal protection could have also affected the victim's ability to attach a personal flotation device or hold on to the towing strap. A clear and effective policy addressing the use of issued PPE and protective clothing is the cornerstone to ensure that fire fighters will understand the importance of using this vital equipment on a routine basis, even in training.

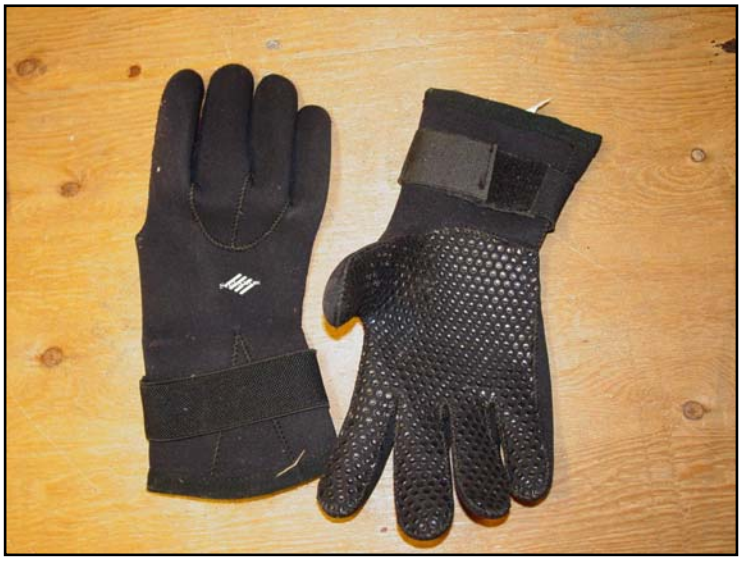

Photo 5. Gloves issued to surf rescue members

Recommendation #4: Fire departments, police departments, and/or agencies with surf rescue teams should enhance current standard operating procedures for training operations to duplicate the same level of response as an actual emergency.

Discussion: The department's SOPs indicate that any call of a swimmer in trouble, a capsized boat, a downed aircraft, etc., requires the Surf Rescue Team to activate.[23] A procedure included in this deployment is to notify the U.S. Coast Guard and request that they respond with a helicopter and a boat. The SOPs also state that a two person configuration on the PWC consisting of an operator and a rescue swimmer is preferred for rescue operations. It states that it allows for the operator to concentrate on his PWC and the rescue swimmer to focus on locating, stabilizing, and recovering the victim.[23]

The environment does not change between training and actual rescue operations. They are both potentially dangerous and should be conducted with the same safety procedures. Surf rescue training could possibly be coordinated with the U.S. Coast Guard's training to ensure that the same resources are available if needed. If not, then the U.S. Coast Guard could be notified that the training is being conducted in case an emergency situation should arise. Training evolutions in a hazardous environment should include adequate instructors and/or safety personnel to function if an incident should occur. In this incident, the instructor was alone on his PWC without a rescue board and was faced with two possible victims. The training took place approximately ¼-mile from shore. The instructor did not have any form of communication to the one safety person on shore.

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Recommendation #5: Fire departments, police departments, and/or agencies with surf rescue teams should provide an emergency medical services (EMS) unit at all training sessions.

Discussion: A transport-capable EMS unit should be considered at all incidents and fireground training. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*,[24] and NFPA 1561, *Standard on Emergency Services Incident Management System*,[25] require that a transport-capable EMS unit be standing by at special operations. The department's SOPs state that an ambulance should be dispatched to all water rescue incidents. In this incident, no EMS units or personnel were on the scene during the training.

Recommendation #6: Fire departments, police departments, and/or agencies with surf rescue teams should consider conducting a job analysis of surf rescue to determine its fitness and strength requirements.

Discussion: As mentioned previously, attempting to re-board a PWC in the open surf as a driver, and especially as a passenger, is physically strenuous. Although the surf rescue team requires numerous Operator and Instructor qualifications (see above Training section), none address the applicant's physical ability to perform surf rescue. Currently the fire department ensures that fire fighters can perform the essential job tasks of structural fire fighting by following the recommendations in NFPA 1582 and 1500.[24, 26] However, it is unclear if these tests are adequate for surf rescue given the additional strength and coordination needed for this assignment. Therefore, the fire department should consider a job analysis of surf rescue to determine its fitness and strength requirements. Then, as required by NFPA 1500, the fire department can perform these updated annual fitness assessments to ensure the applicants and current personnel are physically capable of performing the task in a safe manner.

Recommendation #7: Manufacturers should assess the significance of carbon monoxide exposures and carbon monoxide poisoning among operators of PWC during simulated rescue operations.

Discussion: With a corrected COHb level of 20%, the victim had significant CO exposure and CO poisoning. We cannot determine whether CO poisoning, by itself, was responsible for the drowning, however it was a contributing factor.

From 1990 to 2004, there were approximately 540 CO poisonings associated with exhaust from gasoline powered marine engines on recreational boats; 250 poisonings occurred on non-houseboats (other types of recreational boats).[27, 28] NIOSH has conducted two studies documenting CO exposures with PWC use. Both studies were conducted while the PWC were stationary. The first study measured CO exposures at center rear of the deck and found levels of 500 ppm using detector tubes and levels ranging from 126 to 2,600 for evacuated containers.[29] The second study measured CO levels 8 and 10 feet behind the PWC and reported mean CO levels of 2 and 3 parts per million

(ppm) with peaks of 15-17 ppm.[30] The NIOSH recommended exposure limit for occupational exposures to CO gas in air is 35 ppm for a full shift time-weighted average exposure, and a ceiling limit of 200 ppm, which should never be exceeded.[31] Additional study is needed to determine CO levels at various PWC locations for the driver, passengers, and during use of the towing strap and the rescue board under various environmental conditions.

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Career Captain Dies from Complications of a Drowning Incident due to a Combination of Exhaustion, Hypothermia and Carbon Monoxide Poisoning During Surf Rescue Training – Washington

Appendix: Timeline.

3/20/06

1000 hours: **Instructor and two trainees arrive at beach**

1030 - 1230 hours: **Individual maneuvers through surf**

1300 -1500 hours: Tandem maneuvers through surf

1515 hours: **Victim pulled onto beach**

Ambulance requested from dispatch

Mouth to mouth resuscitation began

Pulse stopped and chest compressions added

1521 hours: **Ambulance arrived on-scene**

1522 hours: **Victim intubated and bagged with 100% oxygen**

1523 hours: **Intravenous lines started**

Advanced life support medications administered

1524 hours: **Ambulance departs beach enroute to the local hospital's emergency department (ED)**

1533 hours: **Victim regains a pulse and blood pressure of 97/50 mm Hg**

1555 hours: **Ambulance arrives at the hospital ED**

1558 hours: **ED Initial Evaluation: Unresponsive, no spontaneous respirations. Rectal Temperature of 95.7° F, Pulse 115, BP 107/30,**

Placed on ventilator

2300 hours: **Victim transferred via air ambulance to regional Medical Center**

Career Captain Dies from Complications of a Drowning Incident due to a Combination of Exhaustion, Hypothermia and Carbon Monoxide Poisoning During Surf Rescue Training – Washington

3/22/06

0019 hours: Victim dies and resuscitation efforts are discontinued

3/23/06

0900 hours: Autopsy performed by County's Medical Examiner's Office

3/27/06

No time: State Toxicology Laboratory receives blood and serum sample from the local hospital (original admission from 3/20/06)

3/31/06 State Toxicology Lab completed serum drug screen

5/01/06 County Medical Examiner's officer requests the State Toxicology Lab analyze the blood sample for carboxyhemoglobin.

5/8/06 Supplemental Toxicology Lab report printed

5/12/06 Associate Medical Examiner completed and signs the autopsy report

INVESTIGATOR INFORMATION

This incident was investigated by Jay Tarley a Safety and Occupational Health Specialist, Division of Safety Research, NIOSH and Thomas Hales, MD, MPH. Dr Hales provided medical consultation and co-authored the report.