2016
12

Death in the line of duty...

National Institute for Occupational Safety and Health NIOSH

A report from the NIOSH Fire Fighter Fatality Investigation and Prevention Program October 25, 2019

Career Fire Fighter Critically Injured During Surf Rescue Training Dies Two Days Later—Hawaii

Executive Summary

On June 16, 2016, a 63-year-old male career fire fighter died two days after being critically injured during a surf rescue training exercise. The fire fighter, acting as the swimmer, was riding prone on the yellow rescue sled being towed by a rescue watercraft operated by another fire fighter (see cover photo). After cresting a large wave, the operator of the watercraft noticed that the swimmer had fallen off and discovered him floating face down in the surf. The operator jumped off of the watercraft, swam to the swimmer and got his head out of the water. The operator swam the unconscious swimmer back to the watercraft and placed him on the rescue sled. He boarded the watercraft and started towing the sled towards shore, however the swimmer fell off again. The operator jumped off the watercraft a second time to come to the aid of swimmer. This time the safety lanyard for the engine kill switch on the watercraft broke and the watercraft continued moving away. An off-duty fire fighter happened to be surfing nearby and noticed the empty watercraft motoring away and saw a fire fighter's yellow rescue helmet in the surf water. He surfed a wave over to the watercraft, boarded it, and drove to the two fire fighters in the white water. The operator and the off duty fire fighter got the swimmer onto the sled, continued on to the shore where they immediately initiated CPR. The fire fighters from their company who had remained on the beach drove to the site where the swimmer had been brought to shore and assisted with resuscitation efforts. Rescue arrived on the scene and the swimmer was transported to a local hospital where he died 2 days later.

The fire fighter was a passenger laying prone on the yellow sled attached to the watercraft. He was severely injured and later died after his head struck the rear of the rescue water craft (RWC) while cresting over a large wave during a training session. (*Cover Photo Courtesy of Fire Department*)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Contributing Factors

- Fire fighter riding prone on rescue sled while cresting large wave
- High risk surf conditions
- Accountability and communications, water rescue crew operating in surf while out of visual contact with shore-based personnel
- Water rescue crew operating alone in a dangerous high risk surf condition
- Failed safety kill switch lanyard

Key Recommendations

- *Fire departments and organizations who operate rescue water craft (RWC) should consider having the swimmer ride seated on the RWC vs riding kneeling or prone on the rescue sled.*
- *Fire departments should ensure that the incident commander conducts a risk-versus-gain analysis prior to committing to special operations in high risk surf conditions and continues the assessment throughout the operations.*
- *Fire departments should ensure that accountability and communications of all water assets are maintained even when crews operate out of site from land based crews.*
- *Fire departments should consider sending two rescue water rescue craft that operate in pairs in high risk surf conditions and always during training.*
- *Fire departments should ensure that a safety officer trained in the special operations discipline is appointed at all special operation water rescue incidents and training events.*
- *Fire Departments should ensure that safety kill switch lanyards are replaced/repaired in accordance with a preventative maintenance program.*

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

2016
12

Death in the line of duty...

National Institute for Occupational Safety and Health NIOSH

A report from the NIOSH Fire Fighter Fatality Investigation and Prevention Program October 25, 2019

Career Fire Fighter Critically Injured During Surf Rescue Training Dies Two Days Later—Hawaii

Introduction

On June 16, 2016, a 63-year-old male career fire fighter died after being critically injured during a surf rescue training exercise. On June 17, 2016, the U.S. Fire Administration notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research, Fire Fighter Fatality Investigation and Prevention Program of the incident. On June 30, 2016, the fire department contacted NIOSH to discuss the possibility of NIOSH investigating the incident. On July 24-31, 2016 an investigator with the NIOSH Fire Fighter Fatality Investigation and Prevention Program traveled to Hawaii to conduct an investigation. The NIOSH investigator met with the fire chief and executive officers and staff of the fire department. The investigator also met with personnel from the State of Hawaii Occupational Safety and Health office (HIOSH). During the investigation, witness statements were reviewed and interviews were conducted with the fire fighters and fire officers involved in the incident. The investigator also met with the representatives of the state department of Labor and Industrial Relations, Hawaii Occupational Safety and Health Division and officers from the International Association of Fire Fighters local union. The NIOSH investigator inspected the personal protective equipment used by the victim and the watercraft involved in the training incident and reviewed fire department standard operating procedures, training records from the department, and audio radio transmissions.

Fire Department

The fire department involved in this incident is a career department consisting of 1,150 members that provide fire and rescue protection as well as surf rescue. There are 43 fire stations located strategically throughout the city and county that serve a population of approximately 1.1 million in a geographic area of approximately 620 square miles. These fire stations house 43 fire engines, 16 aerial ladder trucks, 2 heavy rescue trucks with boats and SCUBA dive team members, 2 hazardous materials trucks, 2 helicoptors, and 6 tankers. The department operates 11 rescue water craft (RWC) for surf rescue. These are mounted on trailers and housed at 11 fire stations located throughout the island with 370 fire fighters trained to operate them. There are 22 battalion chiefs, 4 assistant chiefs, 1 deputy fire chief and a fire chief. The fire department has a safety division which consists of the Battalion Chief, Occupational Safety and Health Office, 2 Fire Captains, 1 Safety Specialist, and a civilian.

The training site was a popular surfing area located 600-700 feet out from the shoreline and approximately 3,293 feet down the beach and out of the line-of-sight site from the engine and ladder company staging area and RWC launch area (see training, launch and staging site Photos 1-5).

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

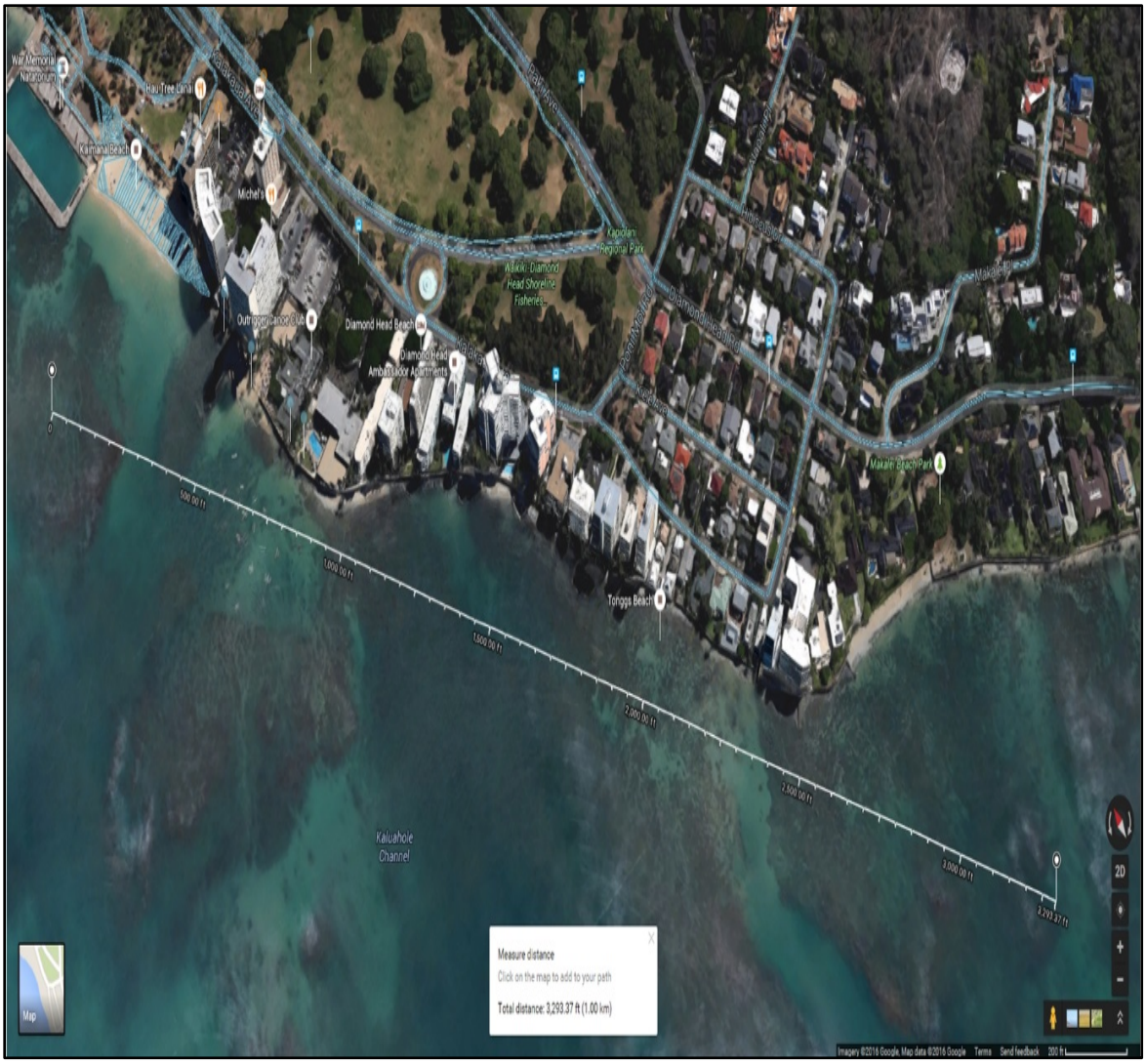

Photo 1. Line indicates just offshore of RWC launch area on the left and surf area where the victim fell off the sled on the right. Total distance traveled from launch area to incident area was approximately 3,293 feet or 1003 meters.
(Photo courtesy of Google Earth and modified by Fire Department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

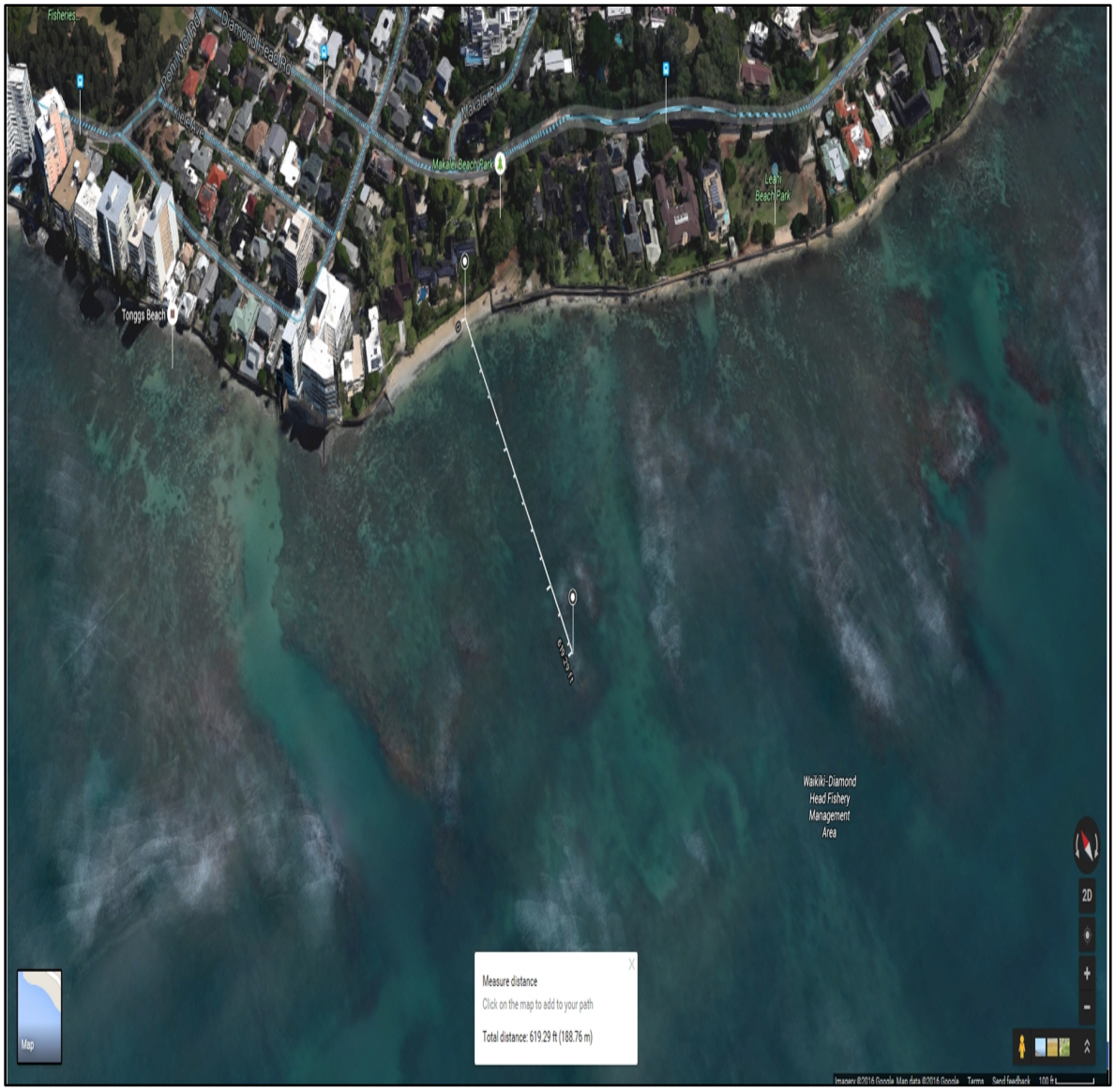

Photo 2. Direct distance from incident area to shore is approximately 619 feet or 188 meters. This is the approximate path that the victim was brought to shore where emergency medical care was provided by Engine 7 and Ladder 7.
(Photo courtesy of Google Earth and modified by Fire Department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photo 3. The red circled areas are the offshore breaks and training area where the incident occurred. The green area between the circles is a channel of deeper water to the shore. These deeper water channels can aid navigation (going out past the breakers and then back into shore areas) by having less breaking wave action.
(Photo courtesy of Google Earth and modified by Fire Department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photo 4. E-7, L-7 staging area and RWC launch site.
(Photo courtesy of Fire Department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photo 5. E-7, L-7 staging area and RWC launch site.
(Photo courtesy of Fire Department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Training and Experience

The State of Hawaii does not have requirements for fire fighter training, however the department in this incident is accredited by the Commission on Fire Accreditation International (CFAI). The department has a comprehensive fire academy and does have minimum training requirements. They consist of International Fire Service Accreditation Congress (IFSAC) certification for Fire Fighter 1 and 2, Hazardous Materials Awareness level and Hazardous Materials Operations level. Additional academy training includes Emergency Medical Technician-Basic and Water Rescue training (48 hour class).

The fire fighter (victim) in this incident had more than 21 years of experience as a professional fire fighter with this department. He had completed the department's required training including the following documented training:

- Fire Fighter I
- Fire Fighter II
- Emergency Medical Technician (B) National Registry
- Rescue water craft/surf rescue training

The department in this incident has an extensive SOP covering surface water rescue including the training, operation and use of the rescue water craft. Additionally, the department requires all instructors for the RWC program to undergo extensive operator training and complete a water physical agility course that consists of:

- A 1,000 yard run followed by a 1,000 yard swim to be completed in less than 25 minutes
- A 400 yard paddelboard in less than four minutes
- A 100 yard run followed by a 100 yard swim and 100 yard run in less than three minutes
- An 80 hour rescue water craft instructor course
- The department's water safety program (must possess a current certification card)
- The department's operator training program for towing familiarization (one time only)

Fire department personnel who operate the rescue water craft in emergency response incidents complete:

- An initial 56 hour rescue water craft field operators program training course
- A minimum of 10 hours quarterly training for rescue water craft proficiency

History of the department and water rescue.

The department in this incident has a mission statement that states they shall "provide for a safer community through prevention, preparedness and effective emergency response." Department personnel respond to various types of hazardous environments which include emergencies that occur in the ocean up to 3 miles off-shore. The island is surrounded by 277 miles of shoreline and the department is often dispatched for persons that are missing or that require assistance in the ocean. They include surfers, kayakers, boaters, swimmers and paddle boarders. During the mid-1990's the department implemented motorized watercraft as an additional resource to be used during search and rescues. The department has 11 rescue water craft (RWC) staged at various fire station locations around the island.

Equipment and Personnel

Units that initially responded to the training site:

- E-7 (Engine 7) with 4 personnel including an officer
- L-7 (Ladder 7) with 3 personnel including an officer

Water Rescue Craft and PPE. The 3 passenger RWC was manufactured in 5/2014 and was constructed of fiberglass reinforced plastic powered by a 4 cylinder, 1812 cubic centimeter, 180 horsepower inboard jet drive with 137 hours logged on the dash display. The watercraft weighed 822 pounds and was 140 inches in length. The model number was FB1800-NB. The victim and the operator were both wearing a water rescue life vest and helmet and the operator had a wrist lanyard kill switch that failed to stop the water craft due to a separation of the lanyard (see Photos 6-13).

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photo 6. Rescue Water Craft (RWC involved in this incident) with rescue sled attached and oriented in the use position.
(Photo courtesy of fire department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

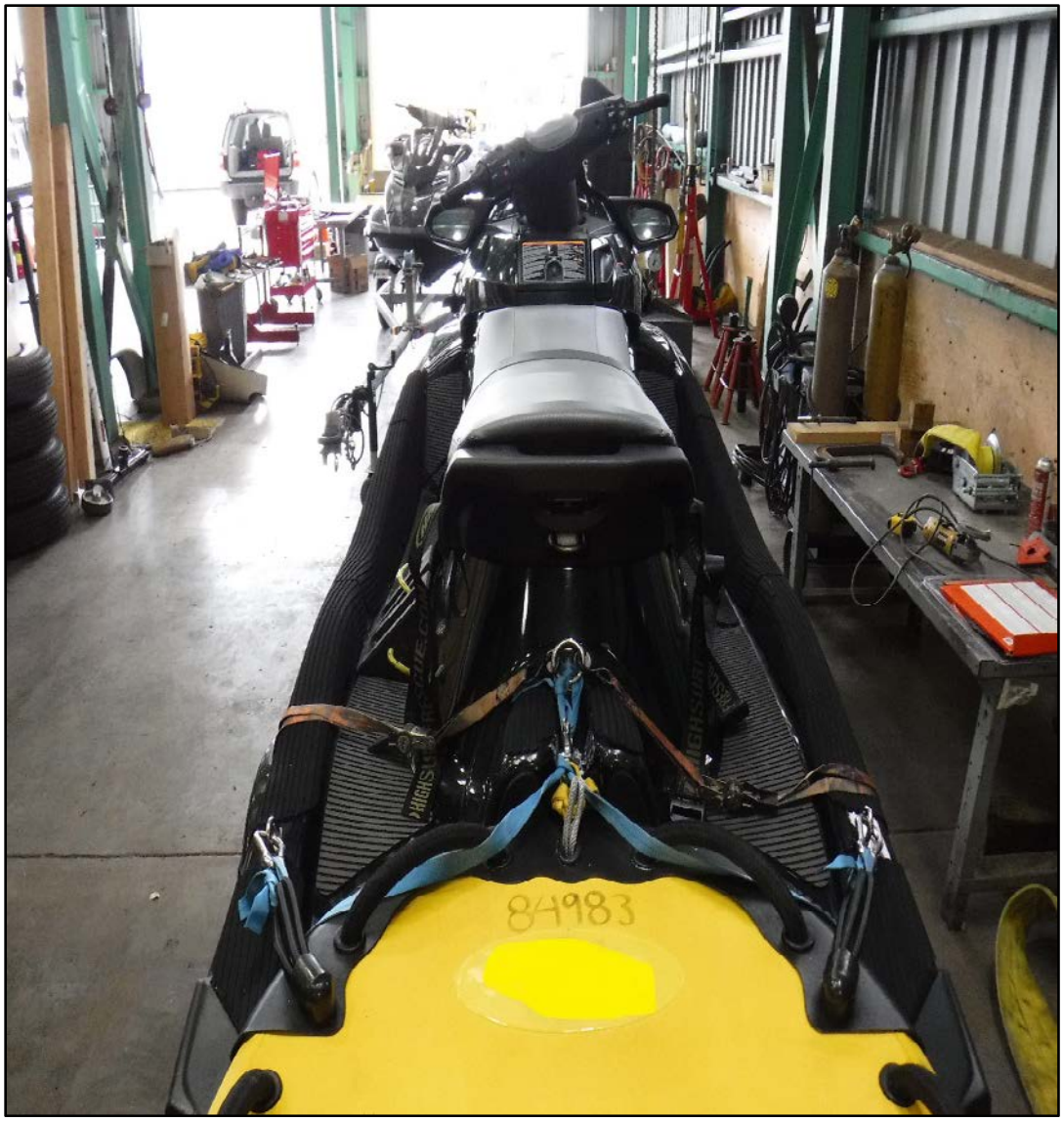

Photo 7. RWC shown with modified connection for the rescue sled attachment. The bow of the rescue sled is attached and riding on the rear of the RWC. The manufacturer of the water craft does not make the rescue sled or the transom attachment.
(Photo courtesy of the fire department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photo 8. Sled orientation to rear grab bar where the victim likely struck his head. This distance is measured at approximately 14 inches with the rescue sled in the dowward orientation and decreases to 8.5 inches as seen in photo 9. Riding prone on the rescue sled has many disadvantages for the swimmer with the main disadvantage of the swimmer being thrown forward or forward inverted (the slang term for this is being scorpioned), and striking the rear of the RWC.
(Photo courtesy of fire department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photo 9a. Yellow tape and square showing the distance between the area of the rescue sled where a passengers head would likely be when the rear of the sled is in the upward most position. The distance is approximately 8.5 inches. The distance to the RWC rear seat grab bar changes approximately 6 inches with the rise and fall of the rear of the rescue sled. (Photo courtesy of fire department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Photos 9b and 10. The connection at the rear of the RWC and the front of the sled prevented side to side but not the up and down motion of the rear. The amount of up and down movement for the rear of the rescue sled was 18 inches. Photo 10 on right measures distance of rear of the rescue sled to a level running position and Photo 9b on left shows the level of rise is approximately 18 inches from a level running position.
(Photos courtesy of the fire department)

Photo 11. Victim's helmet. Photo courtesy of fire department.

Photo 12. Victim's life vest. Photo courtesy of fire department.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

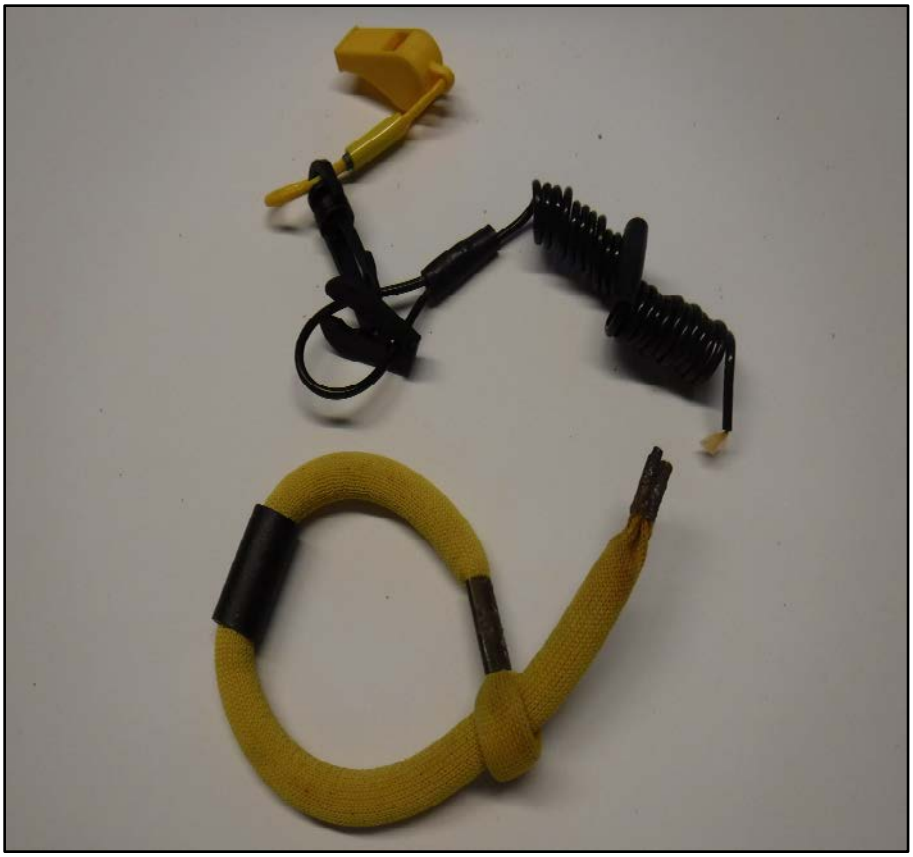

Photo 13. Most personal watercraft are equipped with a safety lanyard that either kills the engine or throttles the watercraft to neutral so operators who may have fallen off can re-board without the watercraft driving away. This watercraft had a safety lanyard that failed due to hidden corrosion underneath the outside covering. This photo shows the corroded area where the lanyard break occurred. The second time the RWC driver jumped in to help the fire fighter who fell off the sled, the RWC kept motoring away from them because the lanyard key stayed in the safety switch and the wristlet stayed on the operators wrist.
(Photo courtesy of the fire department)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Timeline

This timeline is provided to set out, to the extent possible, the sequence of events according to recorded radio transmissions. Times are approximate and were obtained from review of department reports, records, witness interviews, and other available information. Some of the times have been rounded to the nearest minute. This timeline is not intended, nor should it be used, as a formal record of events.

Incident and Fire ground Conditions	Time	Response & Fire ground Operations
Shift change June 14, 2016.	0800	Engine 7 and Ladder 7 crews report to work.
Morning shift meeting.	0830	Quarterly rescue water craft training discussed to take place from 0930-1400.
		Engine 7 captain provided training objectives which included beach launching, retrieving and area familiarization by water for various surf entry, exit zones and channels.
Engine 7 captain notified Battalion Chief of Training scheduled for the day for Engine 7 and Ladder 7.	0830	Battalion Chief acknowledged and advised Captain to monitor the surf conditions because a surf swell was expected to build throughout the day.
Engine 7 arrived at the training site and notified local lifeguard that they would be conducting training that day in the area.	1000	While waiting for Ladder 7, Engine 7 personnel performed a risk assessment and noted wave heights 2-4 feet in that area.
Ladder 7 arrived at training site.	1015-1030	Both crews started the training with launch procedures. Two fire fighters, 1 from Ladder 7 [noted in report as RWC operator] and 1 from Engine 7 [noted in report as swimmer] volunteered for the first evolution.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Incident and Fire ground Conditions	Time	Response & Fire ground Operations
RWC with operator and swimmer riding prone on the sled proceed 200 yards off shore.	**1033**	RWC operator conducts a radio check with the Engine Captain while still within sight of launch site, radio check was received as loud and clear, Engine Captain instructed RWC operator to check in every 15 minutes.
RWC operator acknowledged radio transmission and headed towards open ocean and then turned towards the training area in a surf zone.	**1033**	Training area surf zone is not within site of the launch area.
The RWC and sled had already crested over two waves described as white wash and the operator had looked back after both waves and ensured the swimmer was still on the sled.	**1033-1043**	The watercraft crested a 3rd large wave (not broken). The RWC operator looked back and saw the swimmer face down in the water and he jumped off the and swam to the swimmer approximately 5 feet away.
When the operator jumped off the RWC, the kill switch lanyard operated as designed and shut off power to the RWC.		RWC operator rolled him face up and was able to pull the unconscious swimmer onto the rescue sled, climbed back on the RWC, started it and tried to motor to shore.
The RWC operator's mic is keyed a number of times then a transmission from RWC operator that they needed help.	**1044-1046**	RWC operator called command and told them he had an injured fire fighter (victim), he had him on board and was heading in. E-7 personnel heard the radio message and tried to get the RWC's location no success. E-7 personnel notified life guard stand that they needed assistance with an injured fire fighter and requested lifeguard RWC (Rescue 1). Lifeguard contacted their Rescue 1 to respond.
The RWC operator was heading directly back to shore in white water when the unconscious victim fell off the sled again. The operator jumped off the sled and swam to the victim.	**Approx-1046-1059**	This time when the operator jumped off the RWC, the kill switch lanyard broke and the retainer key stayed in the ignition lock and failed to kill the engine. The RWC motored away from both fire fighters.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Incident and Fire ground Conditions	Time	Response & Fire ground Operations
An off duty fire fighter was surfing nearby, saw the RWC motoring with no one on it and recognized it as a fire department RWC. He surfed a wave over to the RWC, abandoned his surf board, climbed on the RWC and motored over to fire fighters in the water.	**Approx.-1046-1059**	RWC operator was with the victim and gave rescue breathing and chest compressions while holding his head above water. Both fire fighters were floating in the water alone at this point with no RWC.
The off duty fire fighter drove the RWC over to the two fire fighters.	**Approx-1046-1059**	The off duty fire fighter, RWC operator were able to secure the victim to the sled and they drove the RWC to the shore.
The off duty fire fighter and the RWC operator pulled the victim on to the beach and began CPR and mouth to mouth rescue breathing, Ocean rescue lifeguard RWC arrived on the scene and assisted with CPR.	**Approx-1046-1059**	Ladder 7 had left the launch site looking for the RWC. The drove up to a high rise and went to the 10th floor where they spotted the RWC on the beach and notified other units.
Ladder 7, Engine 7 and Ocean Rescue lifeguard personnel all provide BLS shore side and package the victim and moved to the roadside to meet and ambulance.	**1059**	
EMS unit arrives at the roadside location where the crews were working on the victim.	**1112**	Advanced Life Support (ALS) is started on the victim and he was transported to a local hospital
June 16, 2016		2 days later the victim died from his injuries.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Weather and Surf Conditions

According to the department, at the time of the incident the temperature was approximately 82 degrees Fahrenheit with a relative humidity of 63%. Visibility was clear at 10 miles and the average wind speed was 15 miles per hour from the east with gusts up to 29 miles per hour.

There was a high surf advisory on the day of the incident with surf conditions of 5 to 8-foot faces. Faces is a surfing term that describes the front of the wave (see Diagram 1). The department reported that the National Oceanic and Atmospheric Administration (NOAA) indicated that on the day of the incident at 2 p.m., the surf was reported to be 6 to 10-foot faces and winds 23 to 34 miles per hour.

The department also reported that a witness who was surfing at the specific surfing area where the incident took place reported wave heights at 8 feet with occassional waves in the 8-10 foot range.

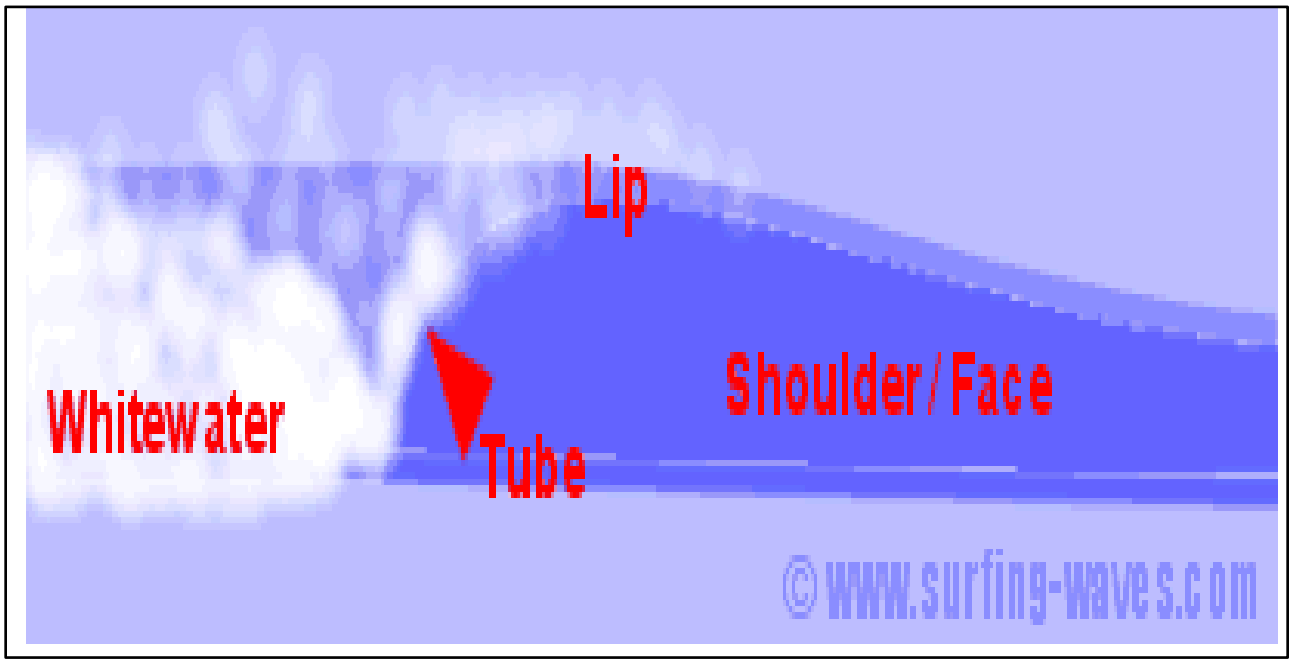

Diagram 1. Wave and surf terms. Courtesy of surfing-waves.com

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Investigation

On June 16, 2016, a 63-year-old male career fire fighter died after being critically injured during surf rescue training 2 days prior.

On 0830 hours on June 14, 2016, Engine 7 and Ladder 7 personnel attended the morning shift meeting to discuss a planned quarterly rescue water craft (RWC) training that was scheduled to take place that day from 0930-1400 (*Note: The Rescue Water Craft and attached rescue sled are referred to in this report as RWC*). The captain from Engine 7 provided the training objectives which included specific practical training on launching and recovering the RWC and water/surf operations with the RWC that included towing the rescue sled with the RWC driver and passenger and familiarization of the specific watercraft operating areas. The purpose of the familiarization was to identify areas where the RWC could operate such as channels in the surf area and entry and exit zones to get in and out of break zones and back and forth to shore areas.

The training session goals were to provide recurring training and familiarization with RWC launch procedures, and increase familiarization with the surfing spots that consist of looking for entry and exit points through the surf line and hazards. This quarterly training requires a minimum of 10 hours of practical skill training per quarter.

The Engine 7 Captain notified the Battalion Chief of the training that day for both Engine 7 and Ladder 7, the estmated length of the training and the location of the staging and launch area for Engine and Ladder 7 and the RWC. The Battalion Chief acknowledged and advised the Captain to monitor surf conditions because the surf swell was expected to build throughout the day.

The site where Engine 7 and Ladder 7 staged and launched the RWC was identified as one of the primary launch sites within the companies' district. It provides a launch site protected from large waves and also provides easy access to launch the RWC through the sand into the water (see Photo 5). After Engine 7 arrived, they notified the local lifeguard in the stand that they would be conducting RWC training that day. *Note: The lifeguard service is a professional career municipal service providing lifeguard service in many (but not all) beach areas for swimmers. The life guard service also has a RWC.*

While waiting for Ladder 7 to arrive at the launch site, Engine 7 personnel performed a risk accessment and reported wave heights in the immediate area at 2 to 4 feet (see Diagram 1). The department reported that the increased wave heights that day provided an opportunity for personnel to observe surf breaks that are not apparent until larger wave heights are present.

Ladder 7 arrived at the launch site and the training began with launching of the RWC and two personnel. Two fire fighters volunteered for the first training mission, 1 from Ladder 7 as RWC operator and 1 from Ladder 7 as swimmer.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

They launched the RWC and motored out from shore approximately 200 yards. The RWC operator conducted a radio check with Command (E-7 Captain) and Command answered loud and clear and also told RWC to check in every 15 minutes. The RWC with the operator seated on the ski and with the swimmer riding prone on the sled, headed in a northerly direction parallel to the shore approximately 1000 meters to the training area (see Photo 1).

After traveling to the training area where the surf break was occuring, they entered the area and started to operate in the heavy surf. This area was approximately 188 meters offshore in a surf zone (see Photos 2, 3).

The RWC crested over a couple of large waves, then after cresting one of the waves, the operator noticed that the swimmer had fallen off. This is the likely point where the swimmer struck his head on the rear of the RWC and sustained blunt force injury of head and neck. The operator turned the RWC around and motored over toward the swimmer and discovered him face down floating in the surf water. The operator jumped off of the watercraft, got the swimmer's head out of the water and placed him back aboard the sled. The operator boarded the RWC and headed towards shore. The RWC operator called over the radio to Command and advised that he had an injured fire fighter and that he was able to place the swimmer (victim) on the sled and he was heading in. Command called the RWC back on the radio trying to identify their location. They did not receive a radio response (*Note: The portable radio that the RWC operator was using was sealed in a water proof plastic pack, however an ear piece modification had been added so the user could hear the radio in the noisy operating conditions. The FD Safety office discovered during a post incident inspection that the ear piece wire had severed and the plastic seal modification had failed and water had penetrated and came in contact with the portable radio*).

Approximately half way in to the shore the victim fell off again and the operator jumped off and swam to him a second time. The RWC operator was able to keep the now unconsious victim's head out of the water, however, the kill switch lanyard on the watercraft had broken when the operator jumped off and the engine did not shut down. The RWC motored off with no one on it.

Back at the launch site Engine 7 made multiple attempts to radio the RWC with no success. One of the E-7 members walked over to the lifeguard stand and notified them that they had an injured fire fighter on their RWC and to request the lifeguard service send their lifeguard RWC (Rescue 1) to help. One of the radio transmissions from the fire department's RWC noted "Suicides Surf Break" (a well known surf site) and personnel from Ladder 7 heard the broken transmission and headed to the site by land.

The RWC operator kept the victim's head above the water and began in-water resusitation. These events took place in deep water almost 200 meters from shore. The operator could not stand up on the ocean floor to gain an advantage for lifting or positioning the swimmer. Additionally, the remote mic for operator's portable radio had stopped working and his whistle was not on the end of the safety lanyard on his wrist. The operator now had very little ability to signal distress.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

An off duty fire fighter happened to be surfing nearby, noticed the empty RWC motoring riderless and saw a fire fighter's yellow rescue helmet in the surf water. He surfed a wave and paddeled over to the rescue watercraft, boarded it and motored back to the two fire fighters in the white water (white water is a term used to describe the wash of very turbulent water just after the wave has crashed and before the next wave hits, see example in Photo 14). Since the kill switch key was still connected in the switch, the engine was still running and the off duty fire fighter was able to operate it.

The RWC operator and off-duty fire fighter got the victim onto the sled and all three fire fighters made their way to shore. The three got to the beach and CPR was begun. The lifeguard service Rescue 1 (RWC) arrived at the beach and assisted with resusitation.

The Engine 7 and Ladder 7 fire fighters drove to their location and also assisted with resusitation efforts. Ladder 7's automated external defibrillator (AED) was placed on the victim with multiple "no shock advised". Full C-spine protocols were administered and the victim was moved from the beach to a shore wall with CPR continuing throughout. An advanced life support (ALS) rescue unit arrived on the scene and the victim was transported to the hospital. He was successfully resusitated on the way to the hospital where he was admitted, however he died 2 days later.

Photo 14. Whitewater example, note the surfer in center of the photo. (Photograph courtesy of awanderingwombat.com, downloaded from bing images.com)

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

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 led to the fatality:

- Fire fighter riding prone on rescue sled while cresting large wave
- High risk surf conditions
- Accountability and communications, water rescue crew operating in surf while out of visual contact with shore-based personel
- Water rescue crew operating alone in a dangerous high risk surf condition
- Failed safety kill switch lanyard

Cause of Death

According to the chief medical examiner's report, the fire fighter acting as swimmer died from blunt force injury of head and neck with cervical vertebrae fractures and spinal cord injury. Blood gases for CO were unremarkable at 2%.

Recommendations

Recommendation #1: Fire departments and organizations who operate rescue water craft should consider having the swimmer ride seated on the RWC vs kneeling or prone on the rescue sled.

Discussion: Riding the rescue sled has many disadvantages for the swimmer with the main disadvantage of the swimmer being thrown forward or forward inverted (the slang term for this is being scorpioned), and striking the rear of the RWC. The passenger riding prone cannot see the conditions that the operator sitting on the RWC can see and therefore cannot brace for impact as the RWC crests over a wave. This poses a risk for being thrown forward and striking the rear of the RWC as occurred in this incident. Most rescue water craft are can easily carry both the operator and 1 or 2 passengers while towing the rescue sled to the scene. Once on the scene the swimmer can get off of the RWC and ride on the sled while securing a victim to the sled until a safe area out of the surf zone in deeper water or the shore is reached.

An additional benefit of the swimmer not riding the rescue sled out to the scene is a reduction in exposure time to exhaust fumes from the rescue water craft [NIOSH 2012]. In 2006, exposure to carbon monoxide from a personal watercraft contributed to the drowning death of a fire fighter during surf rescue training [NIOSH 2006].

In this incident the RWC was in a heavy surf zone and the operator crested a wave. After cresting over the top, the RWC, the rescue sled maneuvered in such a way that the victim was thrown forward and struck his head on the rear of the RWC breaking his neck and falling off into the water.

Recommendation #2: Fire departments should ensure that the incident commander, safety officer or lead instructor conducts a risk-versus-gain analysis prior to committing to operations involving a high surf condition.

Discussion: High surf rescue using rescue water craft is a high risk-low frequency event for most organizations. The term high surf is relative and has different meaning among surfers on the east and west coasts of the United States and certainly may have a different meaning in Hawaii. There are other factors that add to the dangers of water rescue beyond wave height and all of those factors have to be considered when sizing up a water rescue event, whether for training or actual rescue response. The difference is that in a training event there is discretionary time to make a decision based on the high-risk, low frequency analysis. In an emergency event there is little or no discretionary time for decision making.

A risk analysis often occurs at three levels, the strategic level, the tactical level and the task level. A risk analysis at the strategic level involves evaluating the risk and deciding if the organization is willing to accept the risk. An example would be a special operations group for water rescue being performed by the fire department. The department can take a number of actions after a comprehensive evaluation of the risk and the organizations ability to solve or remediate the risk. The department may decide to:

- not accept the risk and not perform the activity,
- share the risk with other organizations (mutual aid or other public safety organizations),
- accept the risk wholly and have a special operations group responsible for the program.

There are many fire departments across the country that have special operations groups for water rescue and SCUBA diving. There are few departments globally that perform surf rescue with rescue water craft on the size and scale required for the locality of this incident. If a department decides at the strategic level to accept the risk or share the risk, there has to be a total commitment to provide the resources and training and continued program support. If this commitment level changes due to financial or other reasons, a strategic level risk analysis should be repeated.

At the strategic and tactical level, the incident commander must perform a risk analysis to determine what hazards are present, what the risks to personnel are, how the risks can be eliminated or reduced, and the benefits to be gained [Kipp JD, Loflin ME 1996]. The difference between an emergency incident and a training event should be factored into the risk analysis. The incident commander or lead instructor should consider all of the factors and in a training event. Using the discretionary time available for the case of training events gives the IC or lead instructor an advantage that can add to fire fighter safety.

At the task level, the group leaders or rescue team leaders need to perform a risk analysis of the operation that they are directly involved in. If as in this incident, they are out of sight of the command post and/or the conditions may be too dangerous or exceed the capabilities of the team, the team leader needs to be capable of recognizing the risk and calling off or relocating the operation to a less risky location, or waiting for additional resources.

The following language from NFPA 1561 provides guidance for risk management on the fire ground and emergency scene and is applicable for water rescues and special operations as well. NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety*, 2014 Edition, Chapter 5.3.19 states, "The following risk management principles shall be utilized by the incident commander: [NFPA 2014a]

1. Activities that present a significant risk to the safety of responders shall be limited to situations that have the potential to save endangered lives.

2. Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of responders, and actions shall be taken to reduce or avoid these risks.

3. No risk to the safety of responders shall be acceptable where there is no possibility to save lives or property.

Recommendation #3: Fire departments should consider sending two rescue water rescue craft that operate in pairs in high risk surf conditions and always during training.

Fire departments and other agencies that provide water rescue services should consider sending two rescue water craft (assets) that can operate in pairs in high risk conditions. These agencies should always have two rescue water craft assets in training evolutions. The risks to the rescuers is similar in both training and actual rescue events, however the incident commander and training officer always has time on his or her side in a training evolution. This time can be used to wait for a thorough risk/benefit assessment of the conditions, number of assets, proper staffing with consideration of personnel capabilities, experience and the Knowledge, Skills and Abilities (KSA's) to be gained.

The water rescue safety officer should also ensure that a minimum of two water rescue craft are operational as the areas of surf rescue operations are frequently not accessible to other land based assets or rescue boats. Rescue water craft used in surf rescue require highly trained and skilled operators as well as swimmers that accompany them. The rescue water craft are likely the only craft that can assist one another in a dangerous surf zone. The personnel riding on these craft may not be able to communicate if they get knocked over or off of the craft. The second rescue water craft cannot only assist the first craft but may be able to communicate the situation to command. Essentially, this second craft can assist the first craft on the rescue or be a water-borne Rapid Intervention Team (RIT). The safety officer should also help identify other possible RIT assets such as pre-staging additional Rescue Water Craft (RWC) and air assets from their or other agencies.

Based upon the size and complexity of an incident, the Incident Commander should delegate responsibilities that include safety for the technical discipline being performed and also assign a safety officer for the incident scene. The incident command system can be expanded to include functions

necessary to effectively command and control an incident. Though the Incident Commander is still responsible for the safety and welfare of all members and first responders on-scene, this responsibility is delegated to the Incident Safety Officer [NFPA 2014a]. Upon confirmation, the water rescue safety officer should obtain the following information:

- Meet with the Incident Commander, command staff and water rescue team leader and discuss the needs and advise on the risk vs. benefit analysis at the strategic level and the tactical level. Does the benefit of the operation justify the risks to the personnel to achieve it?
- Overall situation status and resource status, resource capabilities
- Strategy and incident action plan (rescue plan)
- Known hazards and concerns (weather, surf height, degree of difficulty, water and environmental complications)
- Status of water rescue crews, crew leaders, crew capabilities, crew competencies, air assets, equipment, and personnel accountability
- Ensuring the water rescue crews are following the plan and accurate event monitoring and recording are taking place
- Back-up water rescue team assets
- ALS standby for medical care for rescuers
- Establishment of the rehabilitation group
- Confirmation of established radio communication channels (command channel, tactical channels)

The water rescue safety officer should don the personal protective equipment appropriate for the potential hazards that he/she will be exposed to (e.g., auto-inflating or standard personal floatation device (PFD) or float coat for colder weather). Also, the water rescue safety officer should be identified by a vest or helmet.

The water rescue safety officer should meet with the Technical Rescue Group Leader, Incident Safety Officer, and Incident Commander and develop a communication plan and coordinate their activities. The Incident Safety Officer is responsible for overall safety of the incident scene and reports to the incident commander. The water rescue safety officer reports to the Technical Rescue Group Leader, however coordination and communication between the safety officers can be advantageous on large complex missions.

NFPA 1521 *Standard for Fire Department Safety Officer Professional Qualifications* defines the role of the Incident Safety Officer (ISO) at an incident scene and identifies duties such as recon of the incident scene and reporting pertinent information back to the Incident Commander; ensuring the department's accountability system is in place and operational; monitoring radio transmissions and

identifying barriers to effective communications; and ensuring established safety zones and other designated hazard areas are communicated to all members on scene [NFPA 2015].

The presence of an Incident Safety Officer or technical rescue group Safety Officer does not diminish the responsibility of individual rescuers and group leaders (e.g., boat teams) for their own safety and the safety of others. The dedicated Incident Safety Officer and water rescue safety officer add a higher level of training, attention, and expertise to help the Incident Commander. The Incident Safety Officer and water rescue safety officer must have particular expertise in analyzing safety hazards and must know the particular uses and limitations of protective equipment. For example, while the technical rescue group safety officer may be focused on the safety of the water craft rescuers, the incident safety officer can help ensure the safety of the land support fire fighters and other agencies that may be on scene [Dodson 2007; Dunn 2000; NIOSH 2009].

The water rescue safety officer has a different area of responsibility than the Incident Safety Officer. He/she has the specific knowledge, skills, qualifications, and experience to oversee the safety of the members of the technical rescue group and the mission they are performing. Experience in the technical rescue discipline being performed is an extremely valuable resource. They must have that level of experience to recognize realistic mission goals, team and resource capabilities, team member capabilities, and team member limitations and have the discipline and authority to add, change, modify, intervene or stop an unsafe operation. This is especially important in technical rescue high surf training operations (where time is on their side to wait for additional rescue water craft to arrive and provide a RIT resource). The Incident Safety Officer working together with a trained and experienced water rescue safety officer can provide a fire department with a higher level of expertise to perform the necessary incident scene functions and assist the Incident Commander with incident scene safety.

Recommendation #4: Special operations water rescue teams should have a Safety Officer on scene who is trained in the discipline before commencing rescue water craft operations.

Discussion: NFPA 1670, S*tandard on Operations and Training for Technical Search and Rescue Incidents*, Chapter 4.5.2, states that "at technical search and rescue training exercises and in actual operations, the incident commander shall assign a safety officer with the specific knowledge and responsibility for the identification, evaluation, and where possible, correction of hazardous conditions and unsafe practices [NFPA 2014b]. The assigned safety officer should meet the requirements specified in NFPA 1521 *Standard for Fire Department Safety Officer* [NFPA 2015]. It is especially important to have that specialized and local knowledge when confronted with geographical conditions that are not found in many other locations (e.g. regular and extremely large surf conditions and frequent emergency incident call demands for rescue).

Safety officers assigned to special operations incidents, such as technical rescue water rescue incidents, need expertise in the specific technical rescue field to effectively evaluate surf hazards and provide direction with respect to the safety of all personnel [NFPA 2013]. A qualified fireground safety officer might not possess the necessary expertise in water rescue craft operations and, therefore, might not recognize or understand capabilities of the team members, severity of the surf conditions, limitations and hazards to rescue workers, the need for specialized equipment appropriate for water rescue

operations problems with equipment, or performance issues of personnel (e.g., undertrained for the mission at hand). NFPA 1521 notes, “in cases where the designated incident safety officer does not possess the technician-level training, appointing a technician-level trained assistant or technical specialist with the necessary training will help satisfy the safety needs of the technician-level members.” As stated earlier, this incident occurred in a locality that experiences surf conditions seldom experienced by other water rescue agencies in the United States. It is extremely important to have a qualified water rescue safety officer with experience in the expected conditions.

The water rescue safety officer has the critical advisory role to the Incident Safety Officer (ISO) and the incident commander on the risk vs. benefit on the strategic and tactical levels. A safety officer properly trained in the technical rescue field being performed can also help prevent a swimmer from attempting a skill beyond their level of training. The incident safety officer should be integrated into the incident command structure [NFPA 2015].

A safety officer, specifically trained and qualified water rescue can evaluate, monitor, and advise the incident commander on the incident action/rescue plan. He/she can help with primary decisions regarding rescue/recovery, weather, surf, resources team capabilities, outside resources, water conditions, rescue plan activities such as approach paths, escape paths, water depth, water rescue plan complications, and operations to determine whether they fall within the criteria as defined by the fire department’s risk management plan. He/she should also ensure pre-incident safety checks as well as monitor the health and well-being of the rescuer’s pre-incident and post-incident.

NFPA 1561 *Standard on Emergency Services Incident Management System and Command Safety* states in Paragraph 5.3.1 that "the Incident Commander shall have overall authority for management of the incident"[NFPA 2014a]. NFPA 1561 Paragraph 5.3.2 states, "The Incident Commander shall ensure that adequate safety measures are in place" [NFPA 2014a]. However, technical rescue incidents require that the incident commander have a safety officer who is trained in the discipline e.g. SCUBA, Water Rescue, Confined Space Rescue, High Angle Rescue, Hazmat, and Trench Rescue) and dedicated to the specific operation.

A safety officer for a technical rescue water rescue incident should also be located where the operation is taking place. They can help to evaluate and monitor the water conditions, the incident action plan, the operation, evaluate resource status, ensure accountability and pre-incident safety and equipment checks, continuously evaluate member abilities and capabilities, and ensure that all operational function positions are staffed and qualified backup rescue personnel are in place to aid in the event of complications.

Recommendation #5: Fire departments should ensure that a stationary command post is established and effectively communicate with the team members on training as well as actual special operations incidents.

Discussion: Fire departments should train their command officers to establish a stationary command post and effectively communicate with the team members on training incidents as well as actual

special operations water rescue incidents. Often, the conditions that create the high risk events are present in training evolutions (e.g. dangerous heavy surf, far from shore).

While it may be easy for some command officers to effectively command a rescue event from a mobile position (on foot away from a command post) when everything is going well, when critical communications occur or significant events occur it is possible to miss those communications with all of the incident and environmental noise and confusion that can occur.

Much like Command responsibilities at small residential fire incidents or other smaller events, some officers may be more comfortable with operating outside or away from a formal stationary command post because they may have a very good comfort level developed from past experience. However, this comfort level can easily be challenged when faced with unexpected conditions such as a Mayday or an overturned rescue water craft, an empty RWC floating in the surf zone, missing water rescue members. or an emergency radio transmission that may not be heard by the incident commander.

A critical function of command is to allow for clear communications with his/her divisions, dispatch and other agencies. Many times, a mobile commander may not hear an emergency communication due to many outside influences or factors. If the incident commander is mobile and a emergency or Mayday transmission is made by radio on a different channel, the incident commander may miss the transmission and a delay in taking action could occur.

In addition to a stationary command post, effective communication can assist the incident commander to formulate a rescue plan by using RIT and/or building a rescue group comprised of multiple RIT crews and a rescue group leader. In many instances an already established RIT can be put into action and managed by the incident commander. However in some cases, the responsibilities may be divided and a rescue group established and given direction by a division commander.

Many things need to be coordinated once a Mayday has occurred. If the Incident Commander is trying to perform all of these functions away from a formal command post setting (by themselves), they can be quickly over tasked and may overlook critical needs. Building a command team at a formal command post can help an incident commander develop and organize the strategy and tactics that will match the incident. A command team that is properly set up can provide direction, assign responsibilities and have the advantage of clear communications.

An incident action plan and command of an emergency incident scene is best performed by a command team at a stationary command post with functions written down. In the rare event such as a Mayday, a check list may help to trigger response functions. We have included an example Mayday check sheet for fire incidents that can be modified for special operations in the appendix.

Muscle memory/repetitive skill training is just as important for an incident commander as it is for fire fighters “knowing their SCBA.” This ability to command emergency incidents is learned not only through didactic training but skill development with hands on training. Consistently establishing a formal command on smaller incidents or training incidents is a good method to build command

training skillsets (including special operations incidents). This can benefit the experienced incident commander, however it is a critical skill building process for newer officers or those "acting" in these roles.

Everyone on the emergency incident scene benefits from repetitive skill training including command officers.

Recommendation #6: Fire Departments should ensure that safety kill switch lanyards and other critical components of the RWC exposed to salt water are replaced/repaired in accordance with a preventative maintenance program.

Discussion: Many RWC are equipped with a safety lanyard that either kills the engine or throttles the watercraft to neutral so the operator fell off, he/she could swim back and re-board without the watercraft driving away. This watercraft had a wrist mounted safety lanyard that failed due to hidden corrosion underneath the outside covering. Photo 13 (page 15) shows the corroded area where the lanyard separation occurred. In this incident, the second time the RWC driver jumped in to help the fire fighter who fell off the sled, the RWC kept motoring away from them because the lanyard key stayed in the lock and the wristlet stayed on the operator's wrist.

As part of an overall preventative maintenance and safety pre-check, critical components exposed to salt water including but not limited to the safety kill switch and wrist lanyard, should be inspected and replaced on an established schedule. Old lanyards or other safety devices that are replaced should be destroyed or made inoperable so they can't be mistakenly used or placed back in service.

Recommendation #7: Incident commanders should ensure accountability and maintain situational awareness on special operations water rescue events and incidents.

Discussion: Although there is no evidence that the following recommendation would have prevented this fatality, it is being provided as a reminder of best safety practice for the fire service. All officers and fire fighters operating at technical rescues (i.e. special operations, water rescue, SCUBA, swift water events) should maintain accountability and situational awareness. The nature of the technical rescue demands disciplined accountability and a continuous risk assessment throughout the incident.

Fire departments need to ensure and maintain accountability for all responding and operational personnel at the task, tactical and strategic levels.

An accountability system can be as simple as a team using the buddy system (task level) on a single unit minor emergency medical response to a formal command (tactical and strategic level) accountability function established such as a technical rescue or large fire response.

A personnel accountability system can help to reduce exposure to hazardous areas and also potentially hazardous areas. A personnel accountability system is a system that readily identifies both the location and function of all members operating at an incident scene [NFPA 2014a]. The accountability system should be inclusive of all sizes and types of emergency incidents.

The philosophy of the personnel accountability system starts with the same principles of an incident management system – company unity and unity of command. Unity can be fulfilled initially and maintained throughout the incident by documenting the situation status and resource status on a tactical worksheet. An integral part of the accountability system is to make sure the fire fighters who are assigned and operating in the hazard zone are accounted for, starting with the initial operations and throughout the entire incident. Also, a system should be in place to periodically check to make sure that all members operating in the hazard zone are accounted for.

One of the most important functions of command safety is for the incident commander to initiate a personnel accountability system that includes the functional and geographical assignments at the beginning of operations until the termination of the incident. NFPA 1561, Standard on Emergency Services Incident Management System and Command Safety states in Paragraph 8.12.4, "The incident commander and members who are assigned a supervisory responsibility that involves three or more companies or crews under their command shall have an additional member(s) (e.g., staff aide) assigned to facilitate the tracking and accountability of the assigned companies or crews" [NFPA 2014a].

Officers, fire fighters/rescuers should report changing or unsafe conditions to the Incident Commander or Safety Officer. It is important to train fire fighters and officers to maintain their accountability and situational awareness especially regarding performance under changing, unexpected or high surf conditions. The training should include a description of what accountability and situational awareness are and how it is accomplished in specific technical rescue operations.

The book *Essentials of Fire Fighting and Fire Department Operations* [IFSTA 2013] defines situational awareness as an awareness of the immediate surroundings. On all fire and emergency incidents, emergency personnel should be trained to be constantly alert for changing and unsafe conditions. Even though a safety officer may have been designated for the incident, it is the obligation of all personnel to remain alert to their immediate surroundings. They must maintain their situational awareness and be alert for unsafe or previously unseen conditions, e.g., changing surf or weather conditions.

Situational awareness can be described as a heightened consciousness of what is currently developing or occurring. The opposite of situational awareness is tunnel vision where the personnel become so focused on operational assignments or their comfort with past training sessions that they fail to sense changes in their environment.

The International Association of Fire Chiefs (IAFC), Safety, Health and Survival section developed the "Rules of Engagement for Structural Fire Fighting". Although the rules were developed for structural fire fighting, they are applicable to special operations water rescue incidents.

The incident scene can create a significant risk to fire fighters and other emergency responders, and it is the responsibility of the incident commander and command organization officers to minimize emergency responder exposure to unsafe conditions and stop unsafe practices [IAFC 2013].

The rules of engagement can assist the Incident Commander, company officers, fire fighters and emergency responders who are at the highest level of risk in assessing their situational awareness.

The rules integrate the fire fighter into the risk assessment decision making process. These members should be the ultimate decision maker as to whether it's safe to proceed with assigned objectives. Where it is not safe to proceed the rules allow a process for that decision to be made while still maintaining command unity and discipline. The following are excerpts from the IAFC rules of engagement:

Rules of Engagement for Fire Fighter Survival:

- Size-up your tactical area of operation (to cause the company officer and fire fighters to pause for a moment and look over their area of operation and evaluate their individual risk exposure and determine a safe approach to completing their tactical objectives).
- Maintain continuous awareness of your situation, location and emergency scene conditions
- Constantly monitor communications for critical radio reports.
- You are required to report unsafe conditions or practices that can harm you. Stop, evaluate, decide (prevent exposure to unsafe conditions or practices that can harm them and allowing any member to raise an alert about a safety concern without penalty and mandating the supervisor address the question to ensure safe operations).
- You are required to abandon your position and retreat before deteriorating conditions can harm you (be aware and cause an early exit to a safe area when they are exposed to deteriorating conditions, unacceptable risk and a life-threatening situation).
- Declare a mayday as soon as you think you *(or another fire fighter)* are in danger (ensure the fire fighter is comfortable with declaring a mayday as soon as they think they are in trouble) [IAFC 2013].

The Incident Commander's rules of engagement for fire fighter safety:

- Rapidly conduct or obtain a size-up of the incident (determine the safest approach to tactical operations as part of the risk assessment plan and action development plan before fire fighters are placed at substantial risk).
- Conduct an initial risk assessment (and utilize a safety officer and all command staff to continue to perform a continuing risk assessment) and implement a safe action plan (cause an incident commander to develop a safe action plan by conducting a size-up, assess the survival profile and completing a risk assessment before fire fighters are placed in high risk positions on the emergency scene).
- If you do not have the resources to safely support and protect fire fighters, seriously consider a defensive strategy (prevents the commitment of fire fighters to high risk tactical objectives that cannot be accomplished safely due to inadequate resources on the scene).
- Maintain frequent two-way communications and keep interior crews informed of changing conditions.
- Obtain frequent progress reports and revise the action plan.

Ensuring the accountability of every fire fighter, their location and status causes the incident commander and command organizational officers to maintain a constant and accurate accountability of the locations and status of all fire fighters within a small geographic area of accuracy within the hazard zone and aware of who is presently in or out of the zone [IAFC 2013].

References

Dodson D [2007]. Fire department incident safety officer. 2nd ed. New York: Thomson Delmar Learning.

Dunn V [2000]. Command and control of fires and emergencies. Saddle Brook, NJ: Fire Engineering Book and Videos.

IFSTA [2013]. Essentials of fire fighting, 5th ed. Stillwater, OK: Fire Protection Publications, International Fire Service Training Association.

IAFC [2013]. Rules of engagement for structural firefighting. Fairfax VA: International Association of Fire Chiefs, Safety, Health and Survival Section http://www.iafcsafety.org/downloads/Rules_of_Engagement_short_v10_2.12.pdf

Kipp JD, Loflin ME [1996]. Emergency incident risk management. New York: Van Nostrand Reinhold.

NFPA [2013]. NFPA 1500, Standard on a fire department occupational safety and health program. 2013 ed. Quincy, MA: National Fire Protection Association.

NFPA [2014a]. NFPA 1561 standard on emergency services incident management system and command safety. Quincy, MA: National Fire Protection Association.

NFPA [2014b]. NFPA 1670 standard on operations and training for technical search and rescue incidents. Quincy, MA: National Fire Protection Association.

NFPA [2015]. NFPA 1521 standard for fire department safety officer and professional qualifications. Quincy, MA: National Fire Protection Association.

NIOSH [2006]. 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, By Tarley, J. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, F2008-32, https://www.cdc.gov/niosh/fire/pdfs/face200614.pdf

NIOSH [2009]. Career fire fighter dies while diving for a civilian drowning victim—Rhode Island. By Miles S.T., Tarley J, Morgantown, WV: U.S. Department of Health and Human Services, Centers for

Disease Control and Prevention, National Institute for Occupational Safety and Health, F2008-32, https://www.cdc.gov/niosh/fire/pdfs/face200832.pdf.

NIOSH [2012]. Evaluation of Carbon Monoxide Exposures During Rescue Operations Using Personal Watercraft – Florida By Robert E. McCleery, Alberto Garcia, Cincinnati Ohio, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Health Hazard Evaluation Report 2008-0014-3151, https://www.cdc.gov/niosh/hhe/reports/pdfs/2008-0014-3151.pdf.

NIOSH [2016]. Career Probationary Fire Fighter Runs Out of Air and Dies in Commercial Structure Fire—Michigan. By Miles S.T., Bowyer M. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, FACE Report F2013-14 https://www.cdc.gov/niosh/fire/pdfs/face201314.pdf.

Investigator Information

This incident was investigated by Stephen Miles, Investigator/Safety and Occupational Health Specialist with the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Surveillance and Field Investigations Branch, Division of Safety Research, located in Morgantown, WV.

An expert technical review was provided by Chief Steven Orusa, Fire Chief for the Fishers Fire and Emergency Services, Fishers, Indiana. Chief Orusa is also the author of *Dive Rescue Specialist, Operational Training for Public Safety Divers*. He has served over 33 years in law enforcement and fire service positions. He is past director of the International Association of Dive Rescue Specialists Response Team and has served on public safety and military dive operations worldwide.

A technical review was also provided by the National Fire Protection Association, Public Fire Protection Division. This report was authored by Stephen Miles.

Disclaimer

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH). In addition, citations to websites external to NIOSH do not constitute NIOSH endorsement of the sponsoring organizations or their programs or products. Furthermore, NIOSH is not responsible for the content of these websites. All web addresses referenced in this document were accessible as of the publication date.

Career Fire Fighter Critically Injured and Dies Two Days Later After Falling off Water Rescue Craft During Training—Hawaii

Appendix 1

COMMAND WORKSHEET FOR "MAY-DAY"

□ Gather
- Location _____
- Unit_____
- Name_____
- Air Supply_____
- Resources Needed_____

□ Are other crew members or crews involved?

□ Deploy RIT to area reported or last known work area

□ Announce URGENT radio traffic only

□ Have Dispatch:

Initiate the May-Day Protocol

□ Send one additional alarm
□ Send tech rescue vehicle
□ Send one more ambulance than the number of missing or trapped Fire Fighters
□ Duty Officer (duty officer will callback other chief officers to support operation)
□ Contact special rescue teams if requested
□ Monitor all radio channels

□ Change the Incident Action Plan to high priority rescue effort

□ Tell fire fighter(s) calling May-Day, crew members' nearby and the RIT team to stay on the fire ground channel. The I/C will become the Rescue Branch Director
□ Announce the name_____of the new I/C and tell everyone else to move to channel_____

□ New IC

□ Assure that everyone changes to the new fire ground channel and conduct a PAR – withdraw only if NECESSARY – DO NOT abandon fire fighting positions
□ Move up or Reinforce fire fighting efforts to support the Rescue Branch
□ Backup RIT for deployed RIT
□ Coordinate a staging area with Rescue Branch for equipment and 2nd alarm companies
□ Next Chief Officer on scene will take COMMAND
□ Assign a Safety Officer

□ Monitor Structural Stability of Building

□ Consider the Pro's and Con's on ventilation, forcible entry and fire stream placement on the rescue
□ Consider writing off parts of the building or pushing or drawing the fire into uninvolved areas to support rescue
□ Consider a secondary means of egress for the rescue operation – *while considering how opening the building may negatively affect rescue efforts*

□ Rescue Support

□ Rescue Branch Director will have a support person log times of personnel entering and exiting rescue area
□ Stage equipment near the entry/exit point
□ Stage EMS and ambulances near the entry/exit point
□ Stage crews to support the RIT/Rescue operation near the entry/exit point
□ Provide lighting at the entry/exit point

□ Changes on the Fireground

□ Conduct a PAR after the rescue operation is completed
□ Conduct a PAR if an emergency retreat is ordered due to structural stability or fire condition issues

□ Assign PIO

□ Chief Officer
□ Set-up Media Area
□ Control information releases

Exemplar fire-ground Mayday check-off sheet. Departments can modify for special operations.