Swiftwater Safety and Rescue: A Matter of Survival

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STATEMENT OF NEED

All communities with identified moving water hazards should pre-plan incidents, develop standard operating procedures, and then train and equip their personnel to safely and effectively respond to rescue and recovery incidents in and around moving water.

LEARNING OBJECTIVES

After completing this activity, the participant should be able to:

1. identify distress and drowning victims in a moving water environment.
2. describe the methods used to meet NFPA 1670 Standard for Technical Rescue, specifically pre-planning, community-wide threat assessment, training, and acquiring the resources to support a moving water rescue or recovery operation.
3. discuss effective rescues of victims in a moving water environment.

INTRODUCTION

An average of 200 Americans drown each year in flash flooding. It is the top weather-related killer ahead of earthquakes, tornadoes, and hurricanes. The most common causes of drowning in swiftwater are cars crossing flooded roadways and being swept away and children playing near flooded creeks. An average of three professional rescuers drown each year while attempting rescue.

LEARNING OBJECTIVE: IDENTIFYING DISTRESS AND DROWNING VICTIMS IN A MOVING WATER ENVIRONMENT

Mechanisms and Physiology of Drowning

The drowning process includes a series of progressive and destructive stages:

- Struggle
- Aspiration of water in the stomach and upper airway
- Laryngospasm
During the drowning process, the conscious victim may only struggle at the surface of the water for 20-60 seconds. During this struggle, the drowning victim cannot call out for help and cannot wave for help. The process is generally as follows:

- Hypoxia is caused by lack of oxygen to the brain and other vital organs and tissues.
- Laryngospasm will relax and victim will involuntarily gasp, resulting in the aspiration of water into his or her lungs.
- Since the victim is unconscious at the surface or submerged below the surface of the water with his or her face immersed in the water, the victim is not breathing (respiratory arrest).
- As a result of the lack of oxygen to the brain and heart, the victim’s condition deteriorates into cardiac arrest.

**Types of Drowning**

- **Wet Drowning**—Following hypoxia and unconsciousness, the laryngospasm relaxes and water enters and compromises the lungs.
- **Dry Drowning**—Suffocation in the water while the laryngospasm is intact, preventing water from entering and compromising the lungs.
- **Laryngeal Drowning**—Vomitus is aspirated into the airway, resulting in a laryngeal spasm. Often results from swimming after eating.
- **Torso Reflex**—The individual reflexively gasps as a result of cold water contact on the face and/or chest. During this sudden gasp, the individual can aspirate water into the airway, resulting in a laryngospasm.
- **Silent (Passive) Drowning**—A drowning incident without any surface struggling because the victim is rendered unconscious, incapacitated, or dead due to a physical or medical situation (i.e., sudden cardiac arrest, shallow water blackout, head injury, stroke, drug overdose, etc.).
- **Saltwater vs. Freshwater Drowning**—There is no significant difference in the resuscitation protocols for saltwater versus freshwater drownings. However, the probability of a successful resuscitation is diminished if saltwater, polluted water, or a high-concentration of chlorinated water is aspirated into and therefore compromises the lungs.
- **Mammalian Diving Reflex**—As a result of the sudden immersion or submersion into cold water, the body’s metabolism is decreased, therefore decreasing the need for oxygen to sustain life. The colder the water and the younger the individual, the greater the chance of surviving a prolonged submersion in the water.
LEARNING OBJECTIVE:
THE METHODS USED TO MEET THE REQUIREMENTS OF NFPA 1670 STANDARD FOR TECHNICAL RESCUE

- NFPA 1670—Standard on Operations and Training for Technical Search and Rescue Incidents
  - This standard deals specifically with identifying and establishing levels of functional capability for conducting technical rescue operations safely and effectively.
  - The standard includes swiftwater rescue operations. The purpose of this standard is to minimize threats to rescuers while conducting operations at technical search and rescue (SAR) incidents.

These standards are intended to assist the authority having jurisdiction (AHJ) to:
1. assess the technical rescue hazard within its specific response area.
2. identify the level of operational capability needed.
3. establish operational criteria.

As a responder to technical rescue incidents, the AHJ needs to determine the level of response the authority is compelled to provide. The AHJ must then plan for it, train for it, and allocate the necessary resources to manage the appropriate response at that level.

According to NFPA 1670, the AHJ shall establish levels of operational capability needed to conduct operations at technical SAR incidents safely and effectively, based on hazard identification, risk assessment, training level of personnel, and availability of internal and external resources. This standard advocates the establishment of written standard operating procedures (SOPs) consistent with one of these operational levels:

- **Awareness level**—represents the minimum capability of organizations that provide response to technical SAR incidents.
- **Operations level**—represents the capability of organizations to respond to technical SAR incidents and to identify hazards, use equipment, and apply limited techniques specified in this standard to support and participate in technical SAR incidents.
- **Technician level**—represents the capability of organizations to respond to technical SAR incidents and to identify hazards, use equipment, and apply advanced techniques specified in this standard necessary to coordinate, perform, and supervise technical SAR incidents.
NFPA 1670 also defines the operational level protocols for various disciplines. Specifically, this standard requires the following for swiftwater rescue:

- **Operations level:**
  - Recognizing the unique hazards associated with swiftwater rescue operations
  - Identifying these water hazards and being able to read the river
  - Operating surface support and shore-based rescue equipment used in swiftwater rescue operations
  - Procuring the necessary equipment to perform swiftwater rescue operations

- **Technician level:**
  - Self-rescue and survival unique to the moving water environment
  - The reach, throw, row and go rescue technique unique to swiftwater rescue
  - The use of watercraft and specialty equipment unique to swiftwater rescue

AHJ conducts a threat assessment within its community and jurisdiction to assess the needs of the community and prepare its teams to the appropriate level of operational capability.

NFPA 1670 does not require the AHJ to immediately purchase a lot of expensive equipment or assemble technician level teams. There is nothing wrong with the authority training personnel and operating at the awareness or operations level, as long as the AHJ arranges for the response of external resources if it does not plan to handle the SAR incident. Emphasis on awareness issues ensures that critical elements of the scene will be managed appropriately by all personnel, not just the technical rescue team. Safety issues are addressed, resource needs are identified, and the technical team can do the work instead of managing the scene.

Therefore, the AHJ must conduct a threat assessment within its community and jurisdiction to assess the needs of the community and prepare its teams to the appropriate level of operational capability.

**Preparation and Training of First Responders**

- **First responders**—trained and equipped in order to effectively and safely respond to an emergency in and around moving water.
- **Level of training and type of rescue equipment**—based on the local community needs as determined through the community threat assessment.
The term *target hazard* is commonly used within the fire and rescue sector to denote a structure or occupancy that has been determined to have a greater than average life hazard or a structure that presents a greater degree of complexity for structural firefighting and/or EMS operations. Designated target hazards receive a high priority in the pre-incident management process and often a higher level of first-alarm response assignment. The designation of a structure or occupancy as a target hazard should be determined after a thorough inspection of the structure. It is then the duty and responsibility of the fire and rescue agency to pre-plan the emergency response and firefighting tactics and strategies that can be anticipated to occur at this particular structure or occupancy.

The concept of identifying target hazards and the development of pre-plans to manage the incident should be expanded to include not only physical structures and occupancies but also rivers, lakes, streams, culverts, and other areas prone to flooding.

Once the threat assessment has been conducted within the community and the potential for flooding is identified, it is then the responsibility of the fire and rescue agency to:

- develop pre-incident management plans for every potential site.
- develop standard operating procedures (SOPs) or standard operating guidelines (SOGs) to appropriately and effectively implement these plans.
- train its personnel to respond appropriately.
- provide its personnel with appropriate personal protective equipment (PPE) and rescue equipment to effectively and safely respond to these potential incidents.

Some large public safety and rescue agencies have the capability, due to their personnel and equipment resources, to develop technical or specialized rescue teams. In such cases, the formation, training, and equipping of a swiftwater rescue team can be easily accomplished.

However, smaller departments do not have the equipment or personnel resources to train and select a specialized team. Therefore, generalized awareness training must be provided for all personnel and operations and technician level training provided for as many personnel as possible.

Regardless of the size of the department, swiftwater rescue awareness training should be provided to all personnel. This training should include the following:

- Procedures for implementing the assessment phase of the incident
• Procedures for size-up of existing and potential conditions
• Procedures for identifying the resources necessary to conduct safe and effective swiftwater rescue operations
• Procedures for implementing the emergency response system for swiftwater rescue incidents
• Procedures for implementing site control and scene management
• Procedures for recognition of general hazards associated swiftwater rescue incidents and the procedures necessary to mitigate these hazards within the general rescue area
• Procedures to determine rescue versus body recovery operations

Fire and rescue personnel trained at the awareness level should also be trained in procedures to identify the approximate location of a victim once the victim has submerged below the surface. Awareness and operations level personnel should be capable of performing shore-based rescues and for supporting technician level personnel by manning tether lines, setting up equipment, taking incident command, etc. However, to function in this capacity, first responders must be appropriately equipped with basic rescue and personal protective equipment and must be trained in their proper use.

At the technician level, personnel would have the responsibility for organizing and implementing the type of rescue necessary depending upon:
• the physical and emotional condition of the victim.
• the equipment resources available.
• the location of the victim.
• the personnel resources available.

Technician level functions at swiftwater rescue incidents must include the development and implementation of:
• procedures for self-rescue unique to incidents involving moving water.
• procedures for reach, throw, row, and go technique rescues unique to incidents involving moving water.
• procedures for the use of watercraft, specialty craft, and specialty equipment unique to incidents involving moving water.

**LEARNING OBJECTIVE: EFFECTIVE RESCUES OF VICTIMS IN A MOVING WATER ENVIRONMENT**

**EQUIPMENT**

In order to accomplish this level of rescue, technician level personnel must be adequately equipped to protect themselves from the elements and to effectively and safely perform the rescue and/or recovery operation. PPE should include the following:
• Wetsuit or dry suit
• Wetsuit booties or dry suit boots
• Gloves
• Personal flotation device (PFD)
• Helmet

In addition, safety equipment should also be considered to include the following:
• Whistle (pea-less and plastic)
• Knife
• Swim fins
• Strobe light and/or flashlight
• Helmet visor
• Goggles
• Rescue throw bag

There are numerous types, brands, and styles of PFDs. However, personnel operating at the Technician level should be outfitted with a specially-designed Type V PFD specifically designed for swiftwater rescue operations. These specially designed PFDs come with a rescue tether strap with a quick-release cam buckle mechanism that allows the rescuer to be tethered as well as allows the rescuer to release his or her tether when needed.

All personnel operating at the awareness and operations levels should be provided with appropriate PFDs to protect them from the elements and any unintentional entries into the water. They can also be trained in the use of and have available certain shore-based rescue equipment including rescue throw bags, heaving lines, or other specialty equipment designed to be extended or deployed from shore.

The following is a description of personal protective and basic rescue equipment suitable for use by awareness and operations level rescue personnel for performing shore-based rescues.

**Personal Flotation Devices**

Five types of PFDs are approved by the U.S. Coast Guard:
• **Type I and Type II**—not suitable for use by rescue personnel as wearable devices as they are cumbersome and reduce mobility by the wearer.
  – Excellent for use by the victim before rescue personnel attempt to remove him or her from the hazard.
• **Type III**—variety of designs and intended purposes, most suitable for use by rescue personnel.
• **Type IV**—throwable device that may be appropriate for use to throw to a victim in the water.
• **Type V**—special-use PFD, such as the type described above for use by swiftwater rescue technician personnel.

**Rescue Throw Bags**

- Minimum of 70 feet of 5/16-inch or 3/8-inch line stuffed inside a bag.
- Rescuer holds one end of the line and throws the bag to the victim.
- Line deploys out of the bag when the bag is thrown.
- Difficult for victim to effectively hold on to the device due to his or her physical condition (i.e., injury or hypothermia) and/or emotional condition.

**Inflated Fire Hose**

An end cap is attached to one end of one or several hose sections while an end cap with an air chuck valve tapped into it is attached to the other end. The hose is inflated to approximately 30-100 psi using an SCBA bottle. This makes an excellent buoyant device for rescue personnel and the victim. The hose can also be wrapped around a 14-foot roof ladder, which makes an excellent flotation platform. In an emergency, the hose can be inflated with a CO₂ fire extinguisher with the ends of the hose folded and tied off with webbing.

**Line Deploying Guns/Rockets**

Line deploying guns are excellent to deploy lines across the river for swiftwater rescue operations. If concurrent rescue methods are attempted, the line gun provides one means by which to coordinate efforts allowing for one team to tether to the other team to assist in progress toward the victim.

The following is a description of equipment suitable for use by technician level rescue personnel for live-bait or GO rescues:

**Wetsuits**

Wetsuits are typically constructed of neoprene, which provides limited thermal protection for activities in cold water. Suits are usually lined with a nylon fabric for strength and to allow for ease in donning and removing. Some newer suits are also constructed of spandex, in addition to the neoprene, which gives the suit more stretch. Wetsuits help to preserve body heat by trapping the water that has been warmed by body heat so it cannot escape and take the heat with it. Wetsuits must fit snugly to work efficiently.

**Dry Suits**

A dry suit provides a protective barrier to the wearer while immersed in water and protects the whole body, with the exception of the head, hands, and pos-
Sibly the feet, unless the suit is equipped with integral boots. The difference between a dry suit and a wetsuit is that dry suits are designed to prevent water seepage in order to keep the wearer dry. Depending upon the temperature of the water, thermal insulation such as fleece may need to be worn.

**Water Rescue Helmets**

Rescue personnel assigned to swimming and/or boat-rescue operations should wear, as part of their standard PPE, a helmet specifically designed for water rescue. Helmets should be self-draining and must fit the rescuer securely and protect the rescuer should he or she be temporarily submerged.

**Swim Fins**

Swim fins are ideal for swimming rescue operations and provide additional propulsion for the rescuer. Fins used for swiftwater rescue operations typically have a smaller blade than fins used by SCUBA divers.

**Water Rescue Ropes and Bags**

The length of rope required depends on the location and situation, but a floating line specifically designed for use in the water and stuffed inside a standard rope bag should be available to attach to rescue personnel as a shore-based tether line. Once the rescuer contacts the victim, rescuers on shore can pull or pendulum the victim and rescuer back to shore using the tether line. When tethering rescue personnel in a moving water environment, the rescuer should be equipped with a quick-release tether system that allows the rescuer to disengage from the tether line if necessary. A variety of rope products are available. But, for swiftwater rescue operations, 7/16-inch waterline should be used.

**Rescue Buoy**

Whenever possible, the rescuer should try to keep some type of buoyant device between him- or herself and the victim. The device should also assist the rescuer in maintaining a firm grasp on the victim while he or she is being pulled to shore.

**Rescue Slings**

A commercial 48-inch sewn sling can be used to fasten a “fast-sling” around the victim to provide a good hand-hold for the rescuer. A make-shift sling can be prepared by tying the two ends together of a 48-60-inch piece of 1-inch webbing. As the rescuer advances toward the victim, he or she slips the sling over the victim’s shoulders before attempting to swim him or her through rapids.
**Basket Stretcher With Flotation Collar**
Most rescue agencies have basket stretchers within their rescue equipment inventory. A backboard should be placed and secured inside the basket stretcher, and a flotation collar should be attached to the upper half of the basket. This allows the foot of the basket to be sunk below the victim, and the victim can then be slid into the basket stretcher. When the victim needs to be removed from the basket, the backboard is removed with the patient secured to the backboard.

**Rescue Boat**
Inflatable boats that can be paddled using canoe paddles or kayak paddles make excellent platforms for rescue in moving water. Some inflatable boats require a standard SCBA bottle to inflate the boat in under a minute.

**Boogey Board or Rescue Sleds**
Boogey boards are excellent rescue devices to provide buoyancy to both the rescuer and victim. The boogey board can also be used by the rescuer to propel him- or herself down stream by swimming from one eddy to the next while trying to get to the victim.

**Training Requirements and Conduct of Training Drills**
A number of swiftwater rescue training programs are conducted throughout the United States for public safety and rescue organizations and their personnel. Training should also be conducted as part of a department’s ongoing inservice continuing education program.

Rescue personnel need to be able to size-up a scene and determine the equipment and personnel resources required to respond safely and effectively to rescue or recovery operations in moving water. Equipment must be in good operating condition and always at the ready. SOPs or SOGs must be in place and personnel must be familiar with the pre-established pre-plans in order to respond safely and effectively to the incident.

Rescue personnel must have a comprehensive knowledge of the personnel and equipment resources available within their department and community, and the incident commander must make a rapid determination as to whether the resources are immediately available to respond to the incident. If personnel and equipment resources are not immediately available, then additional resources must be obtained rapidly through mutual aid or other resources.

Just as firefighters practice donning personal protective equipment and SCBA equipment for fighting structure fires, swiftwater rescue personnel must also be competent at donning PPE, such as dry suits and PFDs. Furthermore, they must be competent in their self-rescue skills and survival skills.
At the minimum, swiftwater rescue personnel should be competent in basic rescue and survival skills to include the following:

- Donning a PFD on land and entering the water from an elevation
- Swimming and propulsion on both the front and back while wearing a PFD
- Reaching, wading, and extension rescues from shore as well as from shallow water
- Basic swimming rescues for active and passive victims from the front and rear
- Throwing rescues from shore using rescue throw bags and/or heaving lines
- Personal survival skills and defense maneuvers
- Management of aquatic spinal injuries in a moving water environment

Moreover, if specialized equipment has been purchased and is available, personnel must be competently trained in the use and maintenance of this equipment.

**WATER HAZARDS**

In addition to rescue procedures and skills, a great deal of emphasis must be placed on self-rescue and survival procedures in cold water and when near, in, or around other hazards.

**COLD WATER**

Cold water will rob the body of heat 25-30 times faster than in air. Once a person is immersed in cold water, his or her arms and legs become numb and ineffective in a very short period of time. Therefore, unless properly protected in a wetsuit or dry suit, the ability of a victim to assist in his or her own rescue is extremely limited and will rapidly degenerate. The inherent design of any immersion suit, wetsuit, or dry suit, or any PFD with extended hypothermia protection features, is to protect the high heat-loss areas of the body, which are the top of the head, neck, sides of the chest, and groin area.

If shore-based rescue attempts are made, rescue personnel must be aware that the victim immersed in cold water may not be able to grab on to anything extended or thrown to him or her. Therefore, rescue personnel must consider the victim as a passive victim. If rescue throw bags or heaving lines are tossed to the victim, the victim most likely will not be able to grab on to the line in order to be pulled from the water. Rather, the victim must be instructed to twist or wrap him- or herself with the line before the attempt is made to pull or pendulum the victim to shore. If shore-based rescuers attempt to extend something to the victim, that device will have to snag or loop over the victim since the victim will not be able to grab or hold on to the device.
HAZARDS

Low-Head Dams
Low-head dams are constructed barriers in the river designed for flood control, irrigation, or power generation. Water flowing over a low-head dam often causes a hydraulic.

Hydraulics
A hydraulic is a full-depth recirculating current that can keep an object or person for an extended period. Hydraulics are often found at the base of low-head dams but also occur naturally when water rushes over an obstacle or when flowing from a higher to a lower elevation, such as over boulders, immersed or submerged vehicles, etc.

Strainers
A river obstacle that allows water, but not solid objects to pass through, is called a strainer. Strainers are caused by trees, brush, fences, or debris piles in the current.

Rocks and Foot Entrapment
Personnel should never attempt to stand up in moving water that is over knee deep. Rocks and other debris can easily trap your foot in a crack or crevice. When in water over knee depth, assume a safe swimming position on your back, with your feet downstream and at the surface. Angle your body toward shore and stroke with your arms or await a rope to be thrown to you.

When in deep water, swim to shore using a crawl stroke while on your stomach. But, when swimming downstream, attempt to swim away from hazards and toward a safe eddy. Never attempt to stand until you have reached a safe eddy or unless you are in water less than knee deep.

When the water is shallow and the current is not too swift, two or more rescuers can attempt to perform a wading rescue because two or more rescuers are more stable than one alone. Either the wedge or pivot technique can be used.

RESCUE PROCEDURES
• Rescue personnel should not be tethered to shore unless their PFD is equipped with a quick-release belt that allows the tethered rescuer to release him- or herself if necessary.
• When making a throwing assist, do not attach the line to yourself.
• An incident command system must be implemented that includes personnel accountability for all personnel within the warm and hot zones of the operation.
• Anyone operating within these zones must have proper PPE.
• The incident commander must have appropriate backup and should immediately call mutual aid for additional personnel and equipment resources, especially if specialized equipment is required, such as wreckers, helicopters, etc.
• An upstream spotter should be established, as well as downstream safety.
• An effective communication system (radio, hand signals, whistle signals, etc.) must be established and implemented.
• Upstream spotter is responsible for providing warning of hazards, such as trees and debris, floating down into the incident site, and is also responsible for halting all river traffic, other than incident-specific traffic.
• Downstream safety is established as a backup to the primary rescue team and also serves as backup safety for rescue personnel assigned to the primary rescue team.
• Primary rescue team should be assigned and everyone should understand the rescue plan before committing themselves to the rescue.
• A backup rescue plan should also be established in case the initial rescue plan is not practical. If sufficient personnel and equipment resources are available, concurrent rescue attempts can be made, as long as one does not interfere with the other.
• A safety officer should also be established to monitor the conditions in and around the water.
  – He or she is responsible for the overall evaluation of the safety of all primary rescue personnel.

When shore-based or equipment-based rescues cannot be performed, a live-bait or GO rescue may be required:
• Live-bait rescue—a tethered rescuer swims out and grabs the victim and is then pulled or pendulum back to shore by the line tenders.
  – This rescue is extremely dangerous and should only be attempted by trained and competent personnel.
  – There should be no hazards immediately downstream and no obstacles on which to snag the tether line.
  – Rescue swimmer swims upstream, stalling against the current, and intercepts the swimmer, grabbing and securing the victim from the rear.
  – The line tenders pay out the line and keep it slack until the rescuer makes contact then belays and pendulums them to shore.
CONCLUSION

Every rescue agency should conduct an ongoing threat assessment of its community and must constantly train and plan for swiftwater rescue incidents. In addition, as NFPA 1670 advocates, the agency must then PLAN for the incident, TRAIN for the incident, and obtain the RESOURCES necessary to safely and effectively respond to these types of incidents.

BIBLIOGRAPHY


