In-Water Firefighting Units

BY RAY DOWNEY

Photo by Al Trojanowicz

Some of the most difficult fires to fight tactically are pier fires. Incidents of this type are also costly in terms of manpower, equipment, and overtime.

Although basically a barn fire that requires large amounts of water, coupled with an efficient and effective firefighting effort, the frustration lies in the difficulty (at best) or the inability (at worst) of land lines to reach the wood pilings under the pier. Often, these wood pilings are coated with petroleum product(s) (creosote), which gives off thick, toxic, black smoke when it burns. The wind, usually blowing off the water, pushes burning products at advancing fire forces.

Cellar pipes and distributors can be effective—assuming, of course, that we are able to cut through the thick wooden pier and get these devices into operation well before the fire reaches and passes our point of entry. We must remember too that it's not necessarily just wood that we're cutting through. Some piers have been multi-covered with concrete, tar, metal, etc.

Several years ago, a fire had spread rapidly across the South Street Seaport Museum pier, a 200 × 1,000-foot pier along a portion of New York City's waterfront. The pier had been under renovation and was heavily loaded with building materials. The operation of a handline by a three-man in-water (scuba) firefighting team was a major factor in the quick and effective extinguishment of a potential conflagration.

Operating from a 12-foot inflatable boat with a 15-hp motor, firefighters were able to maneuver between pilings. This maneuvering ability and the advantage of close-up extinguishment by operating handlines from the water is a firefighting tactic not afforded land units.

A high degree of coordination and teamwork is required with the in-water operation of handlines. This is because in water, there is no stability or firm footing as there is on land. You have to counterbalance the water reaction in the hose with your position in the water. In-water firefighting teams generally use lines that are fed by land units, which is safer than manning lines fed by fire boats. The reason for this is that in order to draft water, pump, and maintain position, the boat's propellers must be kept rotating, which can pose a

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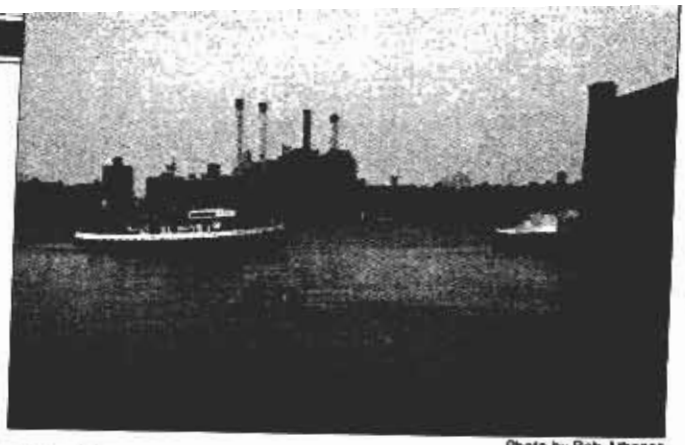

Photo by Bob Athanas

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Extinguishment of inaccessible areas at pier fires is a time-consuming operation for most fire departments. In-water operations from small boats is just one of the services performed by New York City's dive/rescue teams.

danger to operating scuba teams.

In water, setting up equipment requires a greater effort and is more time consuming than it is with land operations; and major obstacles can also impede in-water operations. For example, a pier may be fully involved, requiring scuba teams to enter the water and launch an attack from another area; or a particular area of the pier may be covered with a large number of pilings, so in-water teams have to change their course of action.

Not all in-water fire department operations are for fires. The value of these scuba units has also been seen in rescue operations.

A young man's car ran off an abandoned pier in Staten Island, NY, in the early hours of a foggy, rainy, November morning. The police department was summoned to the scene when civilians reported seeing a car with lights on drive out onto the pier and then the lights disappeared. No one could pinpoint the area of entry.

The situation was further complicated when it was learned that the car went into the water at a location that was used locally as a "graveyard" for abandoned autos.

Divers, operating in dark, murky waters, known as "black water," used hand by hand touch and feel to locate and distinguish which was the occupied vehicle. NOTE: "Black water" is the term used to define water in which the diver expects poor visibility, and, in fact, any initial visibility, which sometimes is six inches, is reduced to zero as the murky bottom is stirred by the diver's maneuvers.

Two dive teams worked in a relay system, taking turns diving and checking the area. The auto was located and the body removed. Had there been an eyewitness to give a quicker notification of the incident and to supply information on the point of entry, the victim might have survived.

Such was the case in an incident last February. About 9 P.M., five youths had been riding in a van when it went out of control, struck a fire alarm box, crashed through a cyclone fence, and plunged into 15 feet of cold, black water.

The knocking over of the alarm box opened the circuit in the Brooklyn, NY, communications office (dispatch center) and transmitted an alarm. This was immediately followed by phone calls reporting that a van had plunged into Mill Basin Creek.

Rescue 2, one of the two in-water firefighting units in New York City, was dispatched to the scene. While en route, Captain Ray Downey, the commanding officer, ordered two firefighters to don scuba gear so that they would be ready to enter the water upon arrival.*

* The rescue company truck carries two full sets of dry suits with AGA mask (a full facepiece designed for underwater use gives a complete face seal with positive pressure of 120–140 ml), regulators, tanks, weights, fins, knives, lights, etc., in the interior compartments of the apparatus. This unique factor allows two firefighters to suit-up while en route to an incident, saving valuable time at the emergency scene.

In-water operations involve removal tactics as well as rescue tactics. A rescue operation depends on many procedures, but one of the major factors in determining the success of a rescue is the ability of the unit to put a searching diver in the water as rapidly as possible after arrival. It takes the average sport diver 16 minutes or more to don his equipment. With proper training for rescue diving, this time can be greatly reduced. We have found that with drilling and testing, dive teams of Rescue 1 and Rescue 2 have donned full dive equipment, while en route, in less than six minutes.

In-water assembly of a floating sprinkler system is one of the skills that is practiced often. Its proper placement under piers provides for extinguishment and exposure protection.

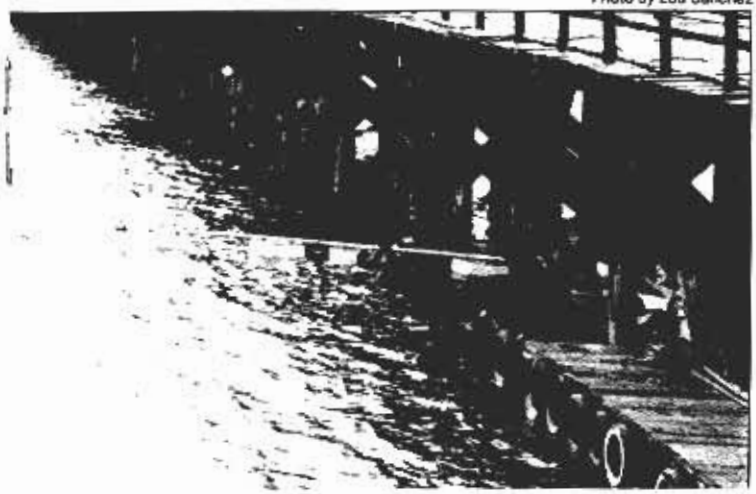

Photo by Lou Sanchez

Photo by Lou Sanchez

Photo by Warren Fuchs

Helicopter operations provide a vital assist to the in-water crew diving to rescue five victims of a submerged auto after a collision.

From shore, the submerged van could just barely be seen in 12–15 feet of water. After the initial dive, debris kicked up from the bottom of the creek obscured this view. Firefighter Dave Van Vorst, attached to a teathered line (guide line), entered the freezing water and made his way toward the van which was about 25 feet from shore. The vehicle was lying on its driver's side. The roof had been crushed down, shattering the front windshield and negating entry through this very narrow opening. Finding all side doors locked, Van Vorst tried the van's rear doors, which were unlocked. He attached his guide line to the handle to secure the location of the van and opened the door.

Opening these 2 × 4-foot double doors required great effort because of water pressure and because the van was on its side, the doors had to be lifted up.

Van Vorst found a 14-year-old girl face down inside the van. Securing her around the waist with his arm, he surfaced, and three other firefighters assisted in removing the girl through the water to the shoreline. Emergency medical service (EMS) personnel standing by began resuscitation and transported the victim to the hospital. This relay operation was executed four more times as Van Vorst, using the line he had attached to the door as his guide, dove back to the van for the other victims.

During the rescue operation, Captain Downey directed the second team of divers to search the area around the van for victims who might have been thrown from the vehicle. The divers were also instructed to attempt to unlock the van's front doors.

After surveying the accident site, the diving team determined that no other victims were in the area, and that victim removal via the van's rear door was the most practical method. It was also decided that only one diver would operate in and around the rear of the van, due to the limited size of the opening, poor visibility in the water, and the many obstacles around the van, such as discarded shopping carts, tires, bicycles, etc. This strategy ensured that rescue efforts were concentrated on the victims and not on one of the divers who could have become trapped or injured.

After all the victims were removed, a secondary search inside and around the van was made.

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The next day, the police department scuba team made a complete search of the entire area and confirmed that all victims had been removed.

One of the five youths removed from the van survived. Fourteen-year-old Dierdre Silverman, who was revived after being legally dead for over an hour, awoke from a coma. Despite some physical problems, her intelligence was returned to normal.

Survival of such an ordeal depends on several factors:

- How long the person is under water;
- How cold the water is;
- Condition of the water (degree of purity, pollution);
- The age of the victim;
- Cause of death (drowning only—absence of additional trauma);
- The speed and level of expertise of the emergency treatment.

A victim is considered clinically dead when all vital signs (pulse, heartbeat, and respiration) cease. Four to six minutes after clinical death, biological death sets in.

Although Dierdre had been under water for 20-25 minutes, her young age and the low temperature of the water were in her favor. Sudden face contact with cold water (below 70°F) sometimes touches off a primitive response called the Mammalian Diving Reflex. This complex series of body responses shut off blood circulation to most parts of the body except the brain, heart, and lungs. Thus, what little oxygen remains in the blood gets transported to and pools in the brain where it is needed the most. Even though there may be very little oxygen in the blood, it can be enough since the cooled brain requires much less oxygen than normal.

A large part of the victim's survival depended, too, on the administering of proper and immediate first aid procedures and cold water resuscitation by EMS personnel. Resuscitation, CPR, must be immediate as possible as is the case normally. However, care must be taken *not* to warm the body extremities prematurely. The following procedures will assist on-site emergency personnel:

- Extend (spread eagle) the extremities away from the body;
- Warm the core of the body first (heart, lungs, and brain);
- Use warmed oxygen in the resuscitator yoke if available;
- Do not warm the extremities;
- Leave wet clothing on and shield from elements;
- Begin intravenous if available;
- Transport cool. Do not use a heater in ambulance;
- Make en route notifications to the medical facility of the pending arrival of a cold water drowning victim. Our goal is to slowly raise the core temperature to 76°F before biological death should be pronounced.
- Continue life support for one hour. The brain is warming from the inside out. The pupils will not react to stimulus even though we are providing efficient oxygen to the brain. That section of the brain will have to be warmed before it can control pupil contraction.

The dive/rescue team passes one of the victims to support units on shore for stabilization and life support operations.

Photo by Warren Fuchs

The efficient and coordinated effort of rescue personnel was another major factor in survival. Some of the general procedures used in this incident can and should be applied to every in-water emergency rescue operation.

INCIDENT MANAGEMENT

Well before an alarm is received, a set of in-water operational guidelines should be established and an on-going training program adopted and attended by every member of the scuba team. A good training program will develop standard operating procedures that will be adaptable at all incidents and will help eliminate confusion, needless communication, and wasted time.

En route and/or on scene

Upon receipt of an alarm for an in-water emergency, the commanding officer of the dive team should, if at all possible, while en route to the incident or as quickly as possible after arrival at the scene:

1. Ascertain the correct location of the incident. Often, in times of emergencies, incorrect streets or avenues are given, causing a delay. When every second counts, vague information must be made as accurate as possible.

2. Obtain the location and phone number of emergency facilities such as recompression chambers (also called decompression and hyperbaric chambers), physicians, hospitals, Coast Guard stations, etc., near the dive location.

3. Call Divers Alert Network (DAN), a 24-hour emergency service information center for dive accidents. For emergencies, call (919) 684-8111 (collect, if necessary). For membership or other information, call (919) 684-2948 Monday-Friday, 9 A.M.–5 P.M., or write: DAN, Box 3823, Duke Medical Center, Durham, NC 27710.

4. Radio the dispatcher to contact someone at the scene and:

a. If a witness is at the scene, hold him until the arrival of the

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dive team. The information as to the location of the submerged vehicle and/or time of entry can be invaluable.

b. Have someone at the scene mark the in-water location of the incident so that valuable time is not wasted in the wrong area. Use a landmark (tree, house, etc.) that lines up with the location. At night, use the apparatus headlights and additional spotlights to illuminate the vehicle's point of entry.

c. Determine how many people are involved in the accident. Special call additional life support teams if necessary. Have them at the scene for stabilization and transport *before* the victim(s) is removed from the water.

d. Have additional fire department land units called to the scene. Additional manpower will be necessary to move dive equipment to hard to reach areas. Extra equipment, ladders, lights, ropes, stretchers, first aid supplies, etc., can be provided by additional ladder units.

e. Have the area close to the scene cleared and sectioned off. Only essential personnel should be allowed entry.

f. Gather the following information concerning the water from the fire department marine division, the dispatcher, Coast Guard, etc.:

i. Current—strength and direction;

ii. Tide — incoming/outgoing;

iii. Depth—in the general area;

iv. Visibility—how much to expect in the waters;

v. Any other information pertinent to the operation.

En route

While en route to the emergency, relay as much information as possible to the dive team.

1. Designate the primary dive team and the back-up dive team.

2. If the response vehicle has the capabilities, have the divers don their gear while en route. This has proven to be the most distinct advantage in successful rescues.

3. All efforts should be directed to getting the primary dive team prepared. This dive team usually consists of two divers. A primary diver is assigned search and rescue and must be fully prepared for immediate water entry. A standby diver also is fully equipped and serves as backup to assist or help in any developing situation. Tenders are assigned each diver to teather and communicate.

4. Monitor the radio for any details or changes in the situation.

On scene

Upon arrival at the scene, the diving supervisor (who may also be the incident commander) should:

1. Assume command.

2. Brief the primary dive team with all the information received from on-scene witnesses. A well-coordinated team effort is essential to a successful operation.

3. Provide the divers with the plan of action. Each incident will

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have unique circumstances, so no single set of rules can be used for every emergency.

4. Have land personnel readied and prepared to treat and transport any victims. Brief or review procedures if unsure. Be wary of the "Yeah, I know" responder.

5. Verify that sufficient ambulances and personnel are available and that they are prepared for cold water resuscitation.

6. Inform the nearest hospital by radio of the type of emergency and the conditions of the victims.

7. Above all, ensure that every safety precaution is taken. A rescue attempt should not compromise the lives of the rescuers.

8. At the conclusion of an operation, a written report comprising all actions taken, information received, problems encountered, results attained, and what was pertinent should be prepared. This will not only provide a permanent record of the incident, but can be used as a critique to further improve the unit's performance. The incident commander (dive commander) should be encouraged to take notes and record times involved to be of valuable assistance to medical treatment personnel and also to assist in preparing the formal report.

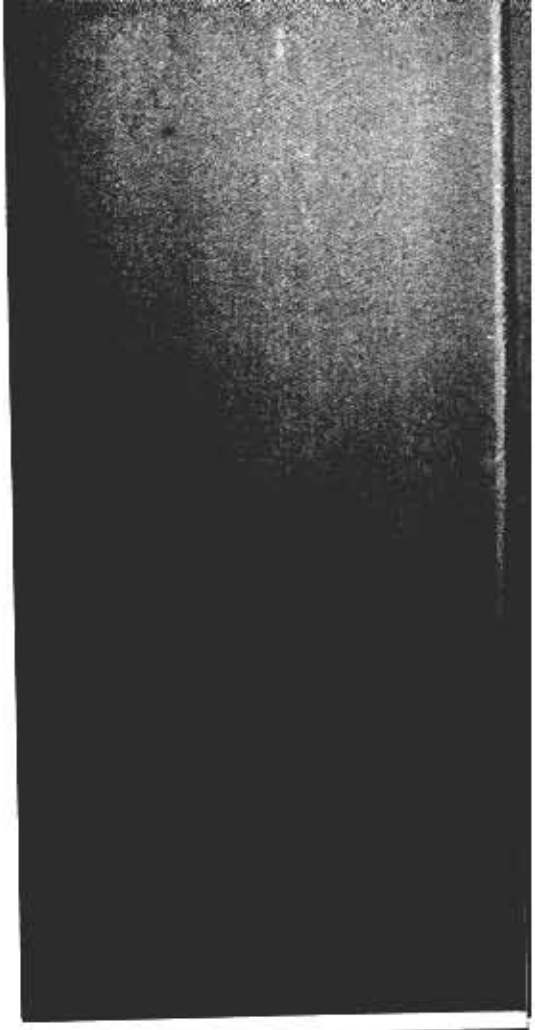
There are certain basic procedures that should be followed by divers and land personnel too, to ensure both their safety and the successful outcome of an operation. Remember, however, that unless it's an emergency and the possibility of a rescue exists, divers should not enter the water until all necessary and possible work preparation has been completed at the surface.

1. All rescue operations are to be considered as life and death situations. Therefore, all divers must react on a rapid deployment rescue mode as per training.

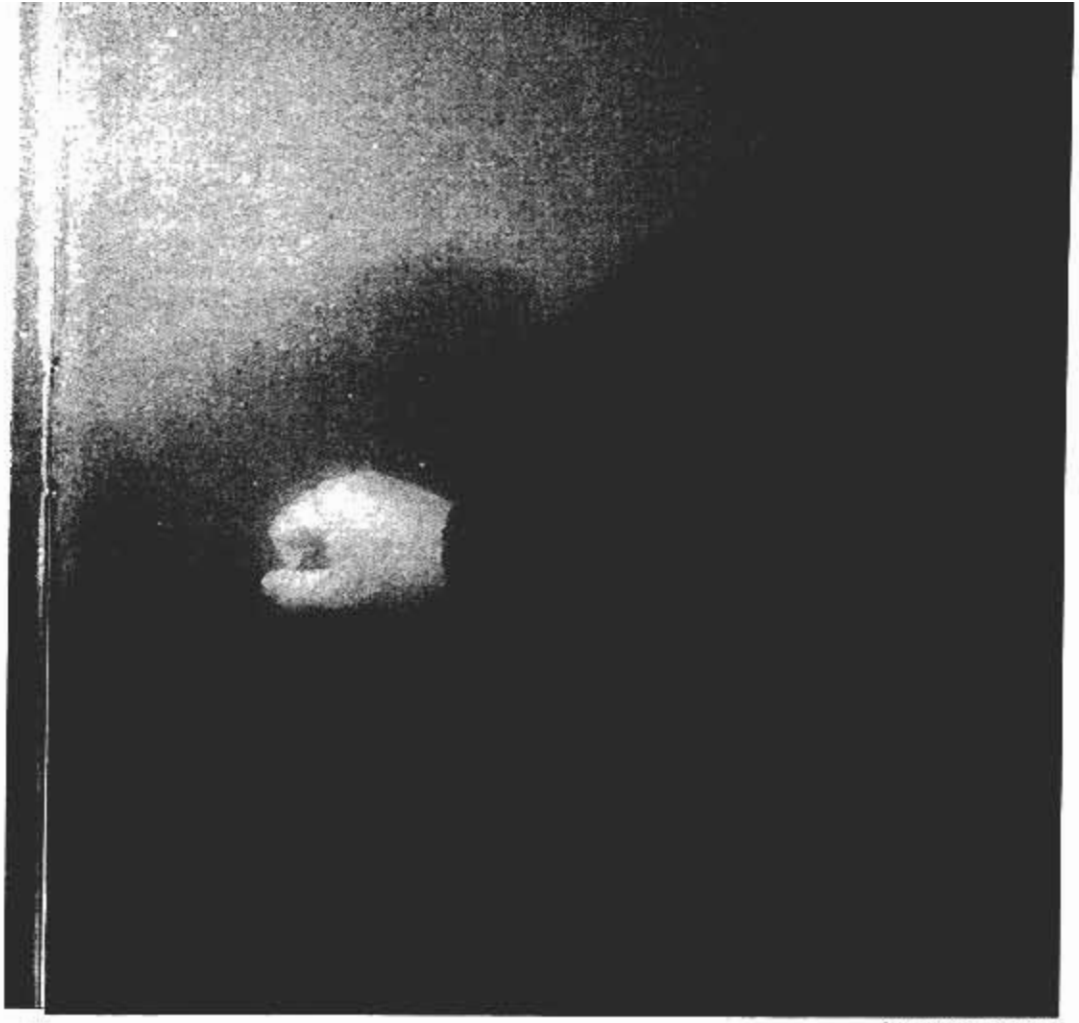
2. All diving should be conducted with a surface tender and line or with direct diver-to-surface communication. Line signals as well as a hard wire communication system should be understood by all divers.

a. In search and rescue operations, there are four functions which must be provided by the diving operations group:

i. Diver. The tending line, minimum 3/8-inch diameter, is attached to the diver either by a carabiner to a harness; by



Search and successful removal of an underwater victim is the dive/rescue team's greatest reward. Costs for training and equipment are high. The rapid, en route donning of clothing and equipment allows for rapid deployment



Photos by Walt Hendrick

a line around the diver's waist with a carabiner and quick release knot (water knot); or by a diver's bowline around the waist.

ii. Tender. The tender is the surface member of the diving team who works most closely with the diver on the bottom. At the start of the operation, the tender checks the diver's equipment and topside air supply for proper functioning, and assists the diver to suit-up. Once the diver is in the water, the tender handles the teathered lines to eliminate slack or tension. The tender exchanges line-pull signals with the diver; serves as a backup to voice communication; and keeps the operation diving supervisor informed of the diver's depth and movements. The tender is also constantly alert for signs of an emergency.

iii. Standby diver. The standby diver is assigned for backup or emergency assistance, and should always be ready to enter the water immediately. He should also monitor the progress of the

at the scene. This, coupled with intensive in-water training in stabilization and life support techniques will assure success.

work as reported by the diver in the water so that if he is called upon for assistance, he is mentally as well as physically prepared to respond.

iv. Operation diving supervisor. On major diving operations, the operation diving supervisor will generally not enter the water. His usual post is on the surface, in a position to direct tenders or standby divers. On simple and limited diving operations, the operation diving supervisor may also assume responsibilities as a diver and team leader.

3. When entering the water, divers should not leap, but be lowered by tending line to avoid contact with sub-surface obstacles.

4. If a vehicle is involved:

a. The diver locating it should tie either his teathered line or a marking line (a spare line) to the vehicle. This will provide a location marker and it can be used as a guide line for the diver to follow.

Proper training and equipment are vital for effective black water search and rescue

Training plays an important part in all firefighting operations, and in in-water search and rescue, it's vital. To prevent a rescue attempt from becoming another rescue situation, an on-going, comprehensive, in-service training program has been instituted for New York City's in-water firefighting units.

The training program, conducted by Lifeguard Systems Inc., New York, NY, and tailored to the fire department's particuler needs, begins with a 40-hour open water rescue training program based on black water search and rescue. Unlike search and recovery, in a search and rescue situation time is of the essence. You don't have time to sit down and map out plans of operation, because you are faced with a life-threatening situation.

The program is geared to the rapid, safe, and effective deployment of rescue forces and the specific problems and conditions that these units encounter in harbors. Practical instruction includes the following techniques as outlined in the Occupational Safety and Health Administration (OSHA) standards:

- Rescue procedures that could be employed during emergencies;
- Safe gearing-up procedures;
- Line tended diving;
- Line tended communications for underwater operations;
- Recompression chamber procedures;
- Emergency equipment repair;
- Underwater rigging using a line and small cable;
- Pre-dive emergency preparation and planning;
- Rapid victim removal from water;
- Understanding of currents and water movement (each diver received specialized training in black water currents and hazard conditions).

Lecture sessions cover, among other topics:

- Diving hazards;
- Cold water resuscitation;
- Secondary drowning;
- Laws of physics as they pertain to underwater;
- Carbon dioxide retention and over-exertion in the water;
- Carbon monoxide retention and water problems;
- Hypothermia and cold water exposure;
- Hydraulics and cold water buoyancy problems;
- First aid/emergency treatment (including mouth-to-mouth and mouth-to-snorkel) and access to professional medical help for water related incidents;
- Wet suits vs. dry suits and their relationship to water diseases.

The waters of New York City's harbors are, to say the least, highly polluted. And the ingestion of water containing raw sewage can result in ameblasis, a disease caused by microscopic organisms called protozoa that affect the intestinal system. This was the case in 1983 when the in-water firefighting teams were first formed.

The fire department reevaluated its equipment and training locations. The dry suits proved to not only keep divers warmer than the wet suits do (an absolute must in winter months) but they also help to prevent skin rashes received from black water.

In addition to the dry suits, the department purchased hard wire underwater communication equipment and AGA full face masks with air tanks. These self-contained underwater breathing apparatus have regulators that can operate in freezing temperatures and prevent ingestion of polluted water. The mask also provides for underwater communications capabilities.

The hard wire communications, a factor in divers gaining confidence and security, especially while working in black waters, is operated from land by a battery powered console with voice amplifiers. This system allows communication between land forces and two divers, and allows the divers to communicate with each other. Immediate feedback is a distinct advantage in an emergency. The divers have a small microphone that is placed inside their facepieces near the ear. The hardwire line is connected at the front of the facepiece. In New York City, this hardwire communication system is used in conjunction with teathered line communications, which consists of a series of tugs or pulls between diver and tender.

Intensive training is conducted to familiarize personnel with the use of this new equipment. To further reduce exposure to polluted waters, training sessions are held at the Commercial Dive Institute in Whitestone, NY. An old pier, formerly used by the United States Navy, provides an ideal training site with all the obstacles and problems that scuba units will most likely encounter while operating in New York City's waterways.

In addition to the protective exposure suit, mask and underwater breathing apparatus (which is an open circuit, demand-type), basic diving equipment consists of:

- Life support body harness worn by divers over dive suit. It contains "D" ring attachments for teather, removal, helicopter lifts, etc.
- Fins.
- Snorkel.
- Weight belt with quick release buckle.
- Scuba tank harness with a quick release device to permit the jettisoning of the entire scuba.
- Life vest that is equipped with a back-up mechanical inflation system that does not involve the breathing gas supply and with a large diameter oral inflator and an over-pressure relief valve.
- Knife with sheath.
- Instruments such as watch, compass, and depth gage.

b. The primary diver should relay all information in relationship to the vehicle to the dive team leader (the position of the vehicle, any obstructions, etc.). Any sign that will assist in the rescue operation is important and should be used to brief other divers.

5. Dive team members standing by should be prepared to assist in removal of victims from the water to land. The time saved can make the difference in the victim's survival.

6. If possible, record the time that the victim was removed. It may be of assistance to medical personnel in their treatment.

7. Dive team members should not be distracted by what takes place by land personnel, nor should other personnel be permitted to distract the dive team in any way.

8. Divers should make mental notes of what they observed during the rescue or search and relay this to the diving supervisor.

9. Remove victims as efficiently and quickly as possible.

10. Never assume that a victim is dead. Remember that time is of the essence.

11. All divers should remain aware of decompression considerations during their dives so that stage decompression is not necessary.

12. Divers working in areas where adjacent water is in excess of 30 feet must be equipped with a depth indicator and appropriate means of recording dive time.

One more point (for both officers and firefighters) that I saved for last, but that may very well be the most important consideration in *any* emergency operation, whether in water or on land, is to know when to quit. Insufficient help, questionable equipment, and/or a too rapid current can make conditions unsafe for divers.

The cancellation of an operation under such conditions doesn't signal defeat—it signifies good common sense. ■