CHAPTER 4

CONSIDERATIONS

When planning, allocating, and executing a diving operation, careful consideration must be given to the following:

- Environment.
- Manning.
- Equipment.
- Medical support.
- Safety.

ENVIRONMENT

The mission, available divers, and weather help determine the type of diving and the equipment used. Surface-supplied diving provides the best safety for the diver and enhances the supervisor's ability to control and direct the divers underwater. Special equipment may be required to provide additional protection for the diver in extremely cold or polluted waters. Factors which influence the selection and deployment of diving teams include--

- Water temperature, depth, and pollutants.
- Current.
- Tides.
- Visibility.
- Bottom condition and type.
- Sea state and wave height.
- Air temperature.

Table 4-1. Diving limitations

Type of Equipment	Maximum Water Depth (ft)	Water Current (knots) (fps)	Duration Under-Water* (min)	NBC Protection	Environmental Protection	Salt-Water Temp (°F)
Deep-sea	190	2.5 4.2	40	None	Best	28
LW	190	2.5 4.2	40	None	Limited	28
Scuba	130	1.0 1.7	10	None	Limited	28

*Also limited by individual diver endurance and type of thermal protection worn.

If water currents exceed the maximum limits listed in Table 4-1, page 4-1, alternative methods should be considered. If employment of a diver is necessary, he must be afforded the highest margin of safety.

DECOMPRESSION

The time a diver can spend underwater is limited by physical considerations. Most of the work should be performed on the surface to minimize the amount of time a diver must spend underwater. The ability to perform work underwater is impaired by poor visibility, restricted movement (by diving equipment and bottom conditions), and limited time. Decompression requirements are a major concern to the diving team. Decompression obligations limit the amount of time a diver can remain on the bottom. As water depths increase, the amount of time a diver may safely spend underwater decreases. Dives are classified as either decompression or no-decompression dives.

When air is breathed under pressure, nitrogen from the air is absorbed in the tissues of the body. A diver's body absorbs and stores excess nitrogen whenever exposed to pressures found at water depths of 40 feet and deeper. The amount of nitrogen absorbed by the tissues increases with depth and time. The water temperature and the diver's physical condition and activity influence the amount of nitrogen stored in the tissues. During ascent, the pressure on the body is reduced, and the nitrogen is released from the tissues and is eliminated through normal respiration. It is essential to control the rate and delay ascent to allow the body sufficient time to process the nitrogen from the tissues. The Navy has developed standard decompression tables (see FM 20-11-1) which are used to determine the rate of ascent and time required to stop for decompression. These tables must be followed during ascent to ensure the diver receives adequate decompression.

DECOMPRESSION DIVING

In a decompression dive, the body absorbs sufficient amounts of nitrogen to require controlled stops during ascent. These stops allow time for the body to off-gas the residual nitrogen. If the diver acsends too quickly or fails to make a scheduled decompression stop, the excess nitrogen will form bubbles. These bubbles may come out of the tissues and become lodged in joint areas, the spinal cord, or other places within the body. The lodged bubbles may cause some form of decompression sickness by blocking blood circulation or pinching nerves. Decompression sickness may range from slight pain to extensive paralysis; severe cases may result in complete stoppage of major organ functions.

Decompression dives must be performed using surface-supplied diving equipment. This equipment provides a continuous supply of air to the diver and communication between the surface team and the diver. A recompression chamber must be available at the site during decompression dives. Deep dives (dives over 100 feet salt water (FSW)) require the expertise of a master diver. Dives to 170 FSW require that a diving medical officer (DMO) be on call. Dives deeper than 170 FSW require a DMO be present to provide medical assistance (per Army Regulation (AR) 611-75). Finally, it is essential that divers performing decompression dives be in good physical condition and get at least eight hours of rest prior to the dive.

Divers are limited to the number of dives they can safely perform in a 24-hour period. Standard air-decompression tables in FM 20-11-1 are used to determine the amount of residual nitrogen in the tissues following a dive. The depth and time spent underwater will determine the amount of time a diver must remain on the surface before diving again.

Decompression dives place inordinate amounts of pressure on the body and require careful planning and specialized equipment. The diving team must be thoroughly trained, pay additional attention to safety details, and be prepared to respond to emergencies.

NO-DECOMPRESSION DIVING

No-decompression diving tables in FM 20-11-1 limit the maximum time a diver can spend at a specified depth without requiring decompression stops during ascent. Safe ascent can be made directly to the surface, at a prescribed rate, with no decompression stops. No-decompression dives can be performed in scuba or surface-supplied diving equipment.

MANNING

Diving operations require from 5 to 20 personnel. For instance, a mission requiring only one diver wearing scuba equipment and performing underwater work needs four additional divers for support from the surface. A mission requiring a LW team with one diver working at a depth of 50 FSW requires a 10-man crew; whereas, a mission requiring two divers working at a depth of 185 FSW requires a 20-man crew. Manning requirements depend on the mission, diving mode, and environment. Engineer diving teams are structured to work independently because the availability of outside diving support is limited. All assigned divers are required to support diving station functions such as operating the recompression chamber, handling hoses, and operating winches and air compressors. Additionally, engineer diving teams must provide their own drivers, mechanics, boat operators, medics, and radio operators. For many underwater engineer construction and salvage missions, two divers are normally required to perform the underwater work. Safety is a key consideration for manning requirements. If a diving team cannot be manned to safely operate in a hazardous work environment, mission accomplishment and diver safety may be compromised. Minimum staffing levels required for various types of diving operations are found in Appendix C of this manual and in AR 611-75.

MODES OF DIVING

Engineer divers use three distinct modes of diving.

• Scuba. Scuba operations are normally conducted to give the diver greater mobility to cover a larger area. The main advantages of scuba operations are quick deployment, mobility, depth flexibility and control, portability, and minimal surface-support requirements. Scuba is limited by time permitted at depth, lack of verbal communications, limited environmental protection, and remoteness from surface assistance. Scuba is used in water depths to 130 feet for underwater survey, inspection of potential work sites, searches, light work, and equipment and victim recovery. A scuba mission requires at least five personnel: one diver, one standby diver, one diving supervisor, two tenders, and one timekeeper/recorder. (The supervisor can perform as timekeeper.)

• Lightweight. Lightweight divers have unlimited air supplied by a flexible hose from the surface, good horizontal mobility, and voice and line-pull communications capabilities. Disadvantages include limited physical protection, limited vertical mobility, and the requirement for a large support platform. LW divers can be deployed to water depths of 190 feet for searches, inspections, light salvage, major ship repair, and working in enclosed spaces. LW missions require at least ten personnel: one diver, one standby diver, four tenders, one diving supervisor, one timekeeper/recorder, one air-control operator, and one communications operator.

• Deep-sea. Deep-sea divers have maximum physical and thermal protection, unlimited air supplied by a flexible hose from the surface, and voice and line-pull communications capabilities. A distinct disadvantage is that a large surface crew and a support platform are needed to operate air-support stations and recompression chambers during deep-sea diving missions. Deep-sea divers can be deployed to water depths of 190 feet for heavy salvage/repair and underwater construction. Deep-sea missions require at least 19 personnel: two divers, one standby diver, six tenders, one diving supervisor, one timekeeper/recorder, one air control operator, one communications operator, one master diver, and one diving officer. Four additional divers are required to operate air-support stations and recompression chamber.

EQUIPMENT

Specific equipment is required to protect and support the diving team. Diving operations can be conducted from the shore, piers, or floating platforms.

RECOMPRESSION CHAMBER

WARNING

A recompression chamber must be located at the dive site if the diver does not have free access to the surface, enters an enclosed space underwater, or plans a decompression dive.

A recompression chamber is a steel or aluminum cylinder large enough to accommodate a diver and necessary medical support personnel. The chamber may be used to treat diving injuries such as decompression sickness or arterial-gas embolisms. When pressurized with air, the chamber can simulate the pressure placed on the human body by a corresponding depth of water. Repressurizing the stricken diver in the chamber reduces the size of the lodged air bubbles. The stricken diver breathes 100-percent oxygen, which further aids in bubble resolution. Tables in FM 20-11-1 dictate times and depths for treatment of diving injuries. The chamber can also be used to perform surface decompression for certain types of decompression dives.

DIVE PLATFORM

If surface-supplied operations are conducted afloat, a suitable diving platform must be available for support. It should have certain minimum characteristics:

- Be able to safely carry all required equipment, including the recompression chamber.
- Provide adequate shelter and working area for support crew and divers, including a wash-down station and a warming area in cold weather.
- Be equipped with adequate navigation, signaling, and mooring gear.
- Include required lifesaving and safety gear.
- Be able to carry an additional small boat (if required) to rescue distressed divers, retrieve floating objects, and provide transportation in the event of an emergency or injury.

MEDICAL SUPPORT

All members of a diving team are trained to recognize diving-related disorders. Many types of diving disorders are life-threatening and require immediate treatment in a recompression chamber. Although the diving officer is in charge of the overall treatment of diving injuries, the master diver is the recognized authority and is responsible for the technical aspects of treatment. Each theater has a trained DMO to perform routine diving physicals and provide assistance for severe diving maladies. Each diving team must have an ETNCO immediately available to provide medical support. The ETNCO is trained in routine medicine as a medical noncommissioned officer (NCO) (military occupational speciality (MOS) 91B) and has received additional training in hyperbaric diving medicine. The hyperbaric medical training qualifies the ETNCO to diagnose and recommend treatment for divers stricken with diving maladies which require recompression therapy. He administers drugs as prescribed by the DMO.

SAFETY

All diving operations center around safety. Diving doctrine is driven by safety considerations. Safety dictates that divers be surface-tended when limited visibility or other hazardous environmental conditions warrant. A standby diver must be ready to deploy during all diving operations.

EXPLOSIVE ORDNANCE DISPOSAL

Engineer divers receive training in demolitions similar to that of MOS 12B. Additional training includes underwater demolition operations, use, hazards, and safety. Divers remove underwater mines and munitions by sympathetic detonation in the same manner as if the mines were surface laid. They can emplace the required explosives underwater, next to existing explosives, to detonate sympathetically. If the munitions must be disposed of or disarmed in another way, qualified underwater EOD units must be requested from the Navy. Engineer divers are neither trained nor equipped for EOD.

WATER-SAFETY MISSIONS

Engineer divers are not trained, qualified, or equipped to perform as certified lifeguards and should not be used as such. Special training and equipment are required to safely perform lifeguard responsibilities. Agencies such as the American Red Cross provide the necessary training and qualifications required for lifeguards.

Engineer divers can perform underwater recovery operations, but not within the time limits needed for emergency rescue. Diving skills are not recognized as a substitute for lifesaving skills. Tactical situations may require the use of engineer divers to prevent drowning. Such situations might include river-crossing operations where the far shore has been secured, or during amphibious operations in the COMMZ or other secured beachheads. Divers assigned to the Special Operations Forces are trained to operate in unsecured areas. The commander must carefully weigh the benefits of using engineer divers in water-safety missions because the loss of divers from their primary mission could have an adverse impact in the TO.

FLYING AFTER DIVING

Divers should not fly for at least 12 hours following a decompression dive or for two hours after surfacing from a no-decompression dive. If aircraft cabin pressure remains below an altitude of 2,300 feet, flying may be done after any type of air dive.