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Dive Operations & Safety Plan

November 14th, 2022

Project Name: **Sevenson – Gasco Outfall Inspection**

AAC JOB# 1122-100
1000.00 for Linnton mobe and de mobe
01110 for onsite dive work

Jobsite Contact: **Chip Byrd**
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1. General Information

1.1 Project Specific Information

Project Name: Sevenson – Gasco Outfall Inspection

Project Description:

Divers will perform the following tasks:

- **A.** General Conditions Inspections of the Outfall and its Components
  - **a.** Perform inspections of conditions noting for outfall characteristics and material accumulations. Reference previous inspections report & drawings.
  - **b.** Inspections to be performed with use of underwater video.

Date: Anticipated diving to occur on November 15th, 2021

Owner / Client: Sevenson - Gasco

Location: Sevenson – Gasco Outfall
8145 NW St. Helens Rd.
Portland Or 97231

Figure 1 - Work Location

Figure 2 – Dive Site Surrounding Activities

1.2 Project Support by Others

- Contact site representative when arriving on site and when departing. Assistance with identifying barge/ship traffic-docking and any surrounding hazards

1.3 Purpose of Dive

AAC Dive Crew will inspect the outfall and document the location of any damage, breaks, or anomalies that would interfere with normal operations.

1.4 Dive Station

Support of the diving operations will be from a mobile, 26’ Dive Boat for dive operations. An HP air dive spread will be used during dive operations. The dive station will also radio communications with all topside crew.

All diver movements will be monitored by two-way communications direct with the diver and live feed video will be used at all times during dive operations

1.5 Diving Equipment

- 26’ Dive Boat
- High Pressure – Compressed Air Cylinders
- Air supply manifold with low pressure alarm and pneumo depth gauges
- 200’ Diver umbilical & 200’ Stand-by Diver umbilical
- Diver Communication and Video Equipment

1.6 Safety Equipment

- Divers Alert Network (DAN) Emergency Oxygen Kit
- First Aid Kit
- Stokes Litter
- Fire Extinguishers
- PPE (Hardhat, Eye Glasses, PFD, High Viz, Gloves)

1.7 Diving Tables

- US Navy Rev. 7 table 9-7 No Decompression Tables
- US Navy Rev. 7 table 9-8 Residual Nitrogen timetable for repetitive dives
- US Navy Rev. 7 table 9-9 Standard Air Decompression Table

1.8 Individual Dive Time

Table 1 - Individual Dive Time

Dive Location	Water Depth FSW	DIVE SCHEDULE	PLANNED DIVE TIME (min.) No Decompression Required	MAXIMUM DIVE TIME (min.) No Decompression Required
Sevenson Outfall	20’	20/205	205	256

1.9 Decompression

No decompression will be planned for work conducted at this location and at this planned depth. AAC will utilize the US Navy No Decompression diving schedules

1.10 Thermal Protection

- Dry Suits or Hot H2O suits will be required for all divers.
- Standby Diver to be dressed in appropriate dress for environmental conditions. Use sufficient thermal underdress to account for environmental conditions topside as well as in the water.
- In the event that water temperature is anticipated to be below 55 degrees Fahrenheit, divers will be required to wear hot water suits for thermal protection.
- If temperatures are below 55 degrees, hot water dive operations will be utilized.

2. Comprehensive Dive Plan

2.1 Scope of Work

AAC Dive Crew will inspect the outfall and document the location of any damage, breaks, or anomalies that would interfere with normal operations.

2.2 Mission Goals

Work being performed is outlined in Section 1.2.

2.3 Diving Mode

Surface Supplied Air Diving will be utilized for this project. Primary & Secondary surface supplied air systems will supply the diver air. Primary Air supply will be supplied from HP bottle bank system. Secondary source will be supplied through a secondary HP Bottle Bank system. Systems are plumbed to the Dive Rack, in which operational systems may be monitored. Diver's umbilical hose / air hose and communications will be maintained continuously between the diver and the top side crew. A tertiary air supply, or "50 CUFT bailout bottle" will be worn by the diver. Decompression, if required, will be performed "in water", referencing the US Navy Standard Air Decompression Table.

Surface supply air equipment components meet regular certification and inspection. Documentation is submitted prior to operations and is available onsite if requested.

2.4 Dive Team Composition

2.4.1 Dive Team Position Table

Table 2 - Dive Team Positions

Dive Crew Personnel					
Name	**Dive Supervisor**	**Alternate Dive Supervisor**	**Diver**	**Stand-By Diver**	**Tender**
Dan Simpson	☑	☑	☑	☑	☑
Jacob Hula	☐	☐	☑	☑	☑
Michael Ivezic	☐	☐	☑	☑	☑
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

2.4.2 AAC Dive Team Manning Plan

Table 3 - AAC Dive Team Manning Plan

DESCRIPTION	Single Diver Air
Dive Supervisor (s)	
Diver (s)	1
Standby Diver (s)	1
Tender (s)	1
Rack Operator / Time Keeper (s)	Supervisor
Chamber Operator (s)	Supervisor
Total	**3**

2.4.3 USACE Manning Requirements

Table 4 - USACE Table G-3 Dive Team Composition (4 Man)

TABLE G-3

Dive Team Composition,
Surface Supplied Air (SSA), 0 to 100 ft (0 to 30.5 m)
Within No Decompression Limits

Personnel	Number	Penetration Dive
Diving Supervisor ***	1	1
Diver	1	2
Standby Diver*	1	1
Tender	1	2
TOTAL TEAM	4	6

- When surface supplied air is being used as the diving mode, the minimum dive team will be composed as shown in Table G-3.
- Deploying the Standby Diver as a Worker Diver. The Standby diver may be deployed as a working diver provided all of the following conditions are met:
  (1) Surface-supplied no-decompression dive of 60 fsw or less
  (2) Divers are in close proximity, (based on site specific requirements), with unimpeded access to each other;
  (3) Divers have communications with each other at all times;
  (4) No entanglement hazards exist;
  (5) Prior to deploying the standby diver, the work area shall be determined to be free of hazards (i.e., suctions, discharges) by the first diver on the job site;
  (6) The dive is NOT a penetration or confined space dive;
  (7) Each diver has a full-time tender (which brings the minimum number of team members to 5).

Table 5 - USACE Table G-4 Dive Team Composition (5/6 Man)

TABLE G-4 Dive Team Composition, Surface Supplied Air (SSA), 0 to 100 ft Requiring Decompression and All Surface Supplied Air, 101 to 190 ft (30.8 to 57.9 m)			
Personnel	Dives within no decompression limits	Dives requiring decompression	Penetration Dive
Diving Supervisor	1	1	1
Chamber Operator**	**/1	****/1	1
Diver	1	1	2
Standby Diver*	1	1	1
Tender	1	1	2
Standby Diver Tender	1	1	1
TOTAL TEAM	5/6	5/6	8

- When surface supplied air is being used as the diving mode, the minimum dive team will be composed as shown in Table G-4

Table 6 - USACE Table G-5 Dive Team Composition (5/6 Man)

TABLE G-5 Dive Team Composition, Surface Supplied Mixed Gas Diving			
Personnel	Dives within no decompression limits	Dives requiring decompression	Penetration Dives
Diving Supervisor	1	1	1
Chamber Operator**	**/1	****/1	1
Diver	1	1	2
Standby Diver*	1	1	1
Tender	1	1	2
Standby Diver Tender	1	1	1
TOTAL TEAM	5/6	5/6	8

- Surface Supplied Mixed Gas Diving. For surface supplied mixed gas diving, to include OEA (Nitrox, etc.), the minimum dive team will be composed as shown in Table G-5.

Notes:

* The standby diver will be rested and capable of performing emergency rescue assistance. When work is limited to no decompression limits, the standby diver shall be sufficiently free of residual nitrogen to allow for 25 minutes of bottom time at the working depth without exceeding "No Decompression Limits."

** The Competent Person/chamber operator may be any non-diving member of the dive team when the chamber is only for emergency use when diving within the no-decompression limits. Saturation diving requires that a life support technician will serve as the chamber operator.

*** The supervisor may be the standby tender for dives under 100 ft (30.5 m).
**** The Competent Person/chamber operator may be any non-diving member of the dive team if all diving ceases during chamber decompression.

2.4.4 Diver Credentials

Divers working under this contract will have the following credentials:

- Current record of commercial dive training
- First Aid / CPR training
- Emergency Oxygen Provider
- Automated External Defibrillator (AED)
- ~~Nitrox Certification~~
- Annual "fit to dive" medical evaluation
- Rigging / Signaling Cards where applicable
- Hazardous Material Training

2.5 Pre-Dive Meeting

Daily predive meetings will be held, discussing the day's work plan activity and review of the Emergency Management Plan and Activity Hazard Analysis. Any deviation from this basic outline will be addressed for approval with the onsite dive supervisor, specified in the predive meeting and added to the dive plan.

2.6 Special Considerations:

3. Know Physlical Hazards:

3.1 This site has a long history of industrial use, which brings with it the possibility of unmarked structures and debris underwater (Figure 4). Seasonal changes in river elevation and flow can also bring debris to the site. These factors present an entanglement risk. All work in industrial areas must be conducted slowly and methodically, with special care taken in low visibility and in areas with structures or a high likelihood of debris.

3.2 The project area may contain cutoff piles that are not be visible above the water's surface but could be encountered while diving. Care must be taken to maintain an unobstructed tending line. Note that the tending line may come into contact with a pile between the boat and the diver that the diver has not encountered.

3.3 There is an abandoned loading ramp at the water's edge. The integrity of the structure is unknown, and diving shall not be conducted underneath the overwater portion of the ramp.

3.4 There are three no wake buoys along the channelward edge of the Gasco Early Action pilot cap placement. These buoys are in the direct vicinity of diving operations for one of the target seepage meter stations so special care will be taken to avoid entanglement with the buoy anchor lines.

3.5 A double row of steel piles extends out from the Siltronic property on the upstream end of the project area. These are outside the work area but could be encountered if the diver is requested to make an excursion upstream to support the installation.

3.6 The project area also has an active barge load/unload facility, and vessel traffic can pose a hazard. It is important to maintain communication with the facility operators and with vessel operators in the area. Contact information and procedures for addressing vessel traffic issues are outlined in Sections 3, 4 and 5.

4. 8 Prevention of Chemical Exposure

4.1 8.1 Contaminants of Concern

4.1.1 Potential contaminants in surface water at this Site that may be encountered during dive operations include bacteria from stormwater runoff and oils on the surface of the water. Contact with and ingestion of river water is to be avoided.

4.1.2 Other potential contaminants may be present in sediment on the diver's suit, equipment or tending line. These chemicals will typically be bound in the wet solid matrix of the sediment.

4.1.3 Chemicals known to exist on the site, and which could be present at relatively elevated concentrations in the sediment, are benzene, ethylbenzene, toluene, xylene, polycyclic aromatic hydrocarbons (PAHs), cyanide and diesel-range hydrocarbons (see below).

4.1.4 Surface personnel will be working in an open-air environment and these chemicals pose a low risk for inhalation. Care should be taken, however, to avoid breathing water mist associated with diver decon procedures. The decontamination zone for divers will be positioned downwind to reduce this risk.

4.1.5 The primary routes of exposure in this marine environment are dermal exposure to and ingestion of sediment. Contact should be minimized through proper use of protective equipment and safety protocols as described in the following sections.

4.1.6 Divers have an elevated risk of exposure, including the possibility of encountering PAHs. It is possible the diver could come into contact with PAH-impacted materials while performing the inspection. Exposure can be minimized through buoyancy control and careful, methodical movements underwater. The most common points of contact are the diver's fins, knees and gloves. Other pieces of equipment the diver touches with a contaminated glove may be contaminated also. The most likely of these are the diver's gauges, buoyancy-compensating device (BCD) inflator hose, tending line and mask.

PAH-impacted material contact is expected to be minimal and likely isolated to the diver's hands. The following procedures will be followed to minimize exposure and facilitate decontamination:

1. The divers will wear light-colored nitrile gloves over their dry gloves and inspect them for stains during the dive, taking care to minimize spreading it to other pieces of equipment.
2. On surfacing and prior to being rinsed, soiled nitrile over-gloves will be removed to avoid spreading material to straps, webbing and the mask as equipment is removed.
3. Dry gloves that become soiled while removing other gear will be cleaned prior to removal and stored in the CRZ. If they cannot be cleaned sufficiently to be re-used, they will be replaced.
4. Areas of exposure on the diver's suit, if any, will be cleaned to allow the diver to enter the CRZ between dives.
5. Exposed equipment and surfaces may be cleaned using a paper towel moistened with Simple Green, then rinsed with potable water.
6. Equipment that cannot be readily cleaned and will be in use throughout the day will be managed as contaminated. Items that have nylon straps, absorbent material, or convoluted surfaces (such as weight belts, BCDs, nylon straps and the diver's harness) will remain in the decontamination zone at the bow. At the end of the project, items that cannot be sufficiently cleaned for re-use will be disposed of and replaced.

Chemical	Physical/Chemical Characteristics (Target Organs/Route of Entry)	OEL (STEL)	Odor Threshold	LEL (%)	IP (eV)
VOCs					
Benzene (71-43-2) 1 ppm = 3.19 mg/m^3	Skin, eye, inhalation, and ingestion hazard. Colorless liquid with an aromatic odor. Air odor threshold 34 to 119 ppm. LEL: 1.2%, UEL: 7.8%. Prolonged skin contact with benzene or excessive inhalation of its vapor may cause headache, weakness, loss of appetite, and lassitude. A human carcinogen. Extremely flammable, keep sources of ignition away. Incompatible with fluorides, chlorides, oxygen, permanganates, acids, and peroxides.	0.5 ppm TWA; (2.5 ppm) Skin IDLH: 500 ppm (CA)	61 ppm	1.2%	9.25
Ethylbenzene (100-41-4) 1 ppm = 4.34 mg/m^3	Skin, eye, inhalation, and ingestion hazard. Colorless liquid with an aromatic odor. Air odor threshold of 0.092 to 0.60 ppm. LEL: 0.8%, UEL: 6.7%. Moderately toxic by ingestion, inhalation, mucous membranes, and skin absorption. Irritant to the skin and eyes.	100 ppm TWA (125 ppm) 800 IDLH	0.60 ppm	0.8%	8.76
Toluene (108-88-3) 1 ppm = 3.77 mg/m^3	Inhalation, absorption, ingestion and eye hazard. Colorless liquid with a sweet, pungent, benzene-like odor. Air odor threshold of 1.6 ppm. LEL: 1.1%, UEL: 7.1%. Poison by intraperitional route. Moderately toxic by inhalation and subcutaneous routes. A skin and eye irritant. Central nervous system effects. May cause impairment of coordination and reaction time.	20 ppm TWA (150 ppm) 300 ppm Ceiling 500 ppm IDLH	1.7 ppm	1.1%	8.82

4.2 Final Statement

If for any reason the dive plan, as approved, is altered in mission, depth, personnel, or equipment, the Project Manager shall be notified prior to commencing diving operations.

All diving activities will be accomplished in accordance with:

- EM 385-1-1, 30 November 2014, U.S Army Corp of Engineers Safety and Health Requirements Manual, Section 30, Contract diving Operations.
- NWPR 385-1-93 (May 2009 Revision) Portland District USACE, Diving Safety Regulation.
- NAVSEA 0910-LP-106-0957 Revision 7 U.S NAVY Diving Manual.
- Occupational Safety and Health Standards, 29, CFR 1910, Subpart T.
- US Coast Guard, 1 CFR 197, Subpart B

5. Emergency Management Plan

5.1 General Statement

Notice is hereby given that Advanced American Construction, Inc. Has set forth the following operations policy:

Safety shall be the prime consideration of all officers and employees of Advanced American Construction, Inc. All employees shall read and receive a copy of the comprehensive and continuing safety program.

In the planning of diving operations, the job superintendent or designated "Person in Charge" shall carefully observe the state of the water conditions, weather tides currents and any other potential hazards that may be encountered, both above and underwater.

Further, all officers and employees of Advanced American Construction, Inc. shall comply with all aspects of the Oregon Safety Code for Places of Employment, Chapter 25, Commercial Diving and Compressed Air Work, of the workmen's compensation board; sub part, "The Commercial Diving Operations" of the Occupational Safety and Health Standards act; U.S. Army Corps of Engineers safety manual as they pertain to each individual job.

Each employee shall hold a current First Aid, CPR, O2 provider, BLS certification and maintain a current annual “fit for diving” physical.

In the event of an accident, all work shall be suspended, and all necessary action taken to insure the welfare of the injured person. Advanced American Construction, Inc. office shall be notified immediately of the accident and the necessary reports shall be completed. No work shall continue until a solution has been devised to prevent further accidents. When questions occur as to an operation, the senior Dive Supervisor or diver shall be responsible to adhering to both AAC Operations Manual and Safety Manual.

If the solution cannot be found within these manuals and any type of safety is in question, no other work shall be performed until such time as it has been approved by the Advanced American Construction, Inc. office.

All necessary clearance shall be taken and tagged out during the diving operation. Hazardous sources that are identified and tagged out, must be reviewed with the working dive team.

5.2 Emergency Phone Numbers & Transportation Plan

All emergencies – The primary means of activating emergency services shall be through dialing 911. Locate designated muster area for our workstation prior to commencing work.

Transport of subjects as deemed applicable to the nature of the injury. Primary means of transport is maintained through Activation of emergency response systems for transport of subjects. If not possible, Secondary means of transport is through self resources.

Onsite determination is required - Secondary means must only be implemented in the event the primary systems are not effective. Identify location for egress, vehicle transportation, and emergency services location. **(ref. attached contact phone numbers & map directions).**

All coordination will be the responsibility of the onsite Dive Supervisor, or Designated Person in Charge (DPIC). Maintain emergency phone numbers, and Map directions for emergency facilities. A checklist is provided for jobsite specific details, and is to be completed onsite and reviewed in Daily Pre Dive Meetings.

5.2.1 Worksite checklist - Secondary Victim Transport

1.	Location of emergency equipment onsite	☐
2.	Optimal location for egress of victim	☐
3.	Transport Vehicle & Location	☐
4.	Vehicle Location (Near Egress Location)	☐
5.	Driver of Vehicle	☐
6.	Secondary Driver of the Vehicle	☐
7.	Map Directions to Emergency Facility	☐

5.2.2 Project Address

Sevenson Outfall
8145 NW St. Helens Rd.
Portland OR 97231

5.2.3 Emergency Phone Numbers

a.	Advanced American Construction	503-445-9000
b.	Hospitals: Legacy Emanual	
c.	2801 N Gentenbein Ave Portland OR 97227	503-821-7453
d.	**Fire & Rescue / Medical**	**911**
e.	Police:	911
f.	Air Lift Northwest:	800-426-2430
f.	Life Flight Oregon	800-621-5433
g.	Chemtrec	800-424-9300
h.	Divers Alert Network:	919-684-9111
j.	Offsite recompression Chamber	
	1. Providence Med. Center Portland, OR **(Single Place 2 ATM Chamber)**	**503-215-1111**
k.	Doctors	
1. Kevin Walters	Hyperbaric Physician	
	Office	**503-361-5400**
	Cell Phone	**503-314-9397**
	Home Phone	**503-825-1595**
2. William Spisak	Providence Med.	**503-282-7731**

5.2.4 Direction to: Legacy Emanual

2801 N Gentenbein Ave Portland OR 97227
503-821-7453

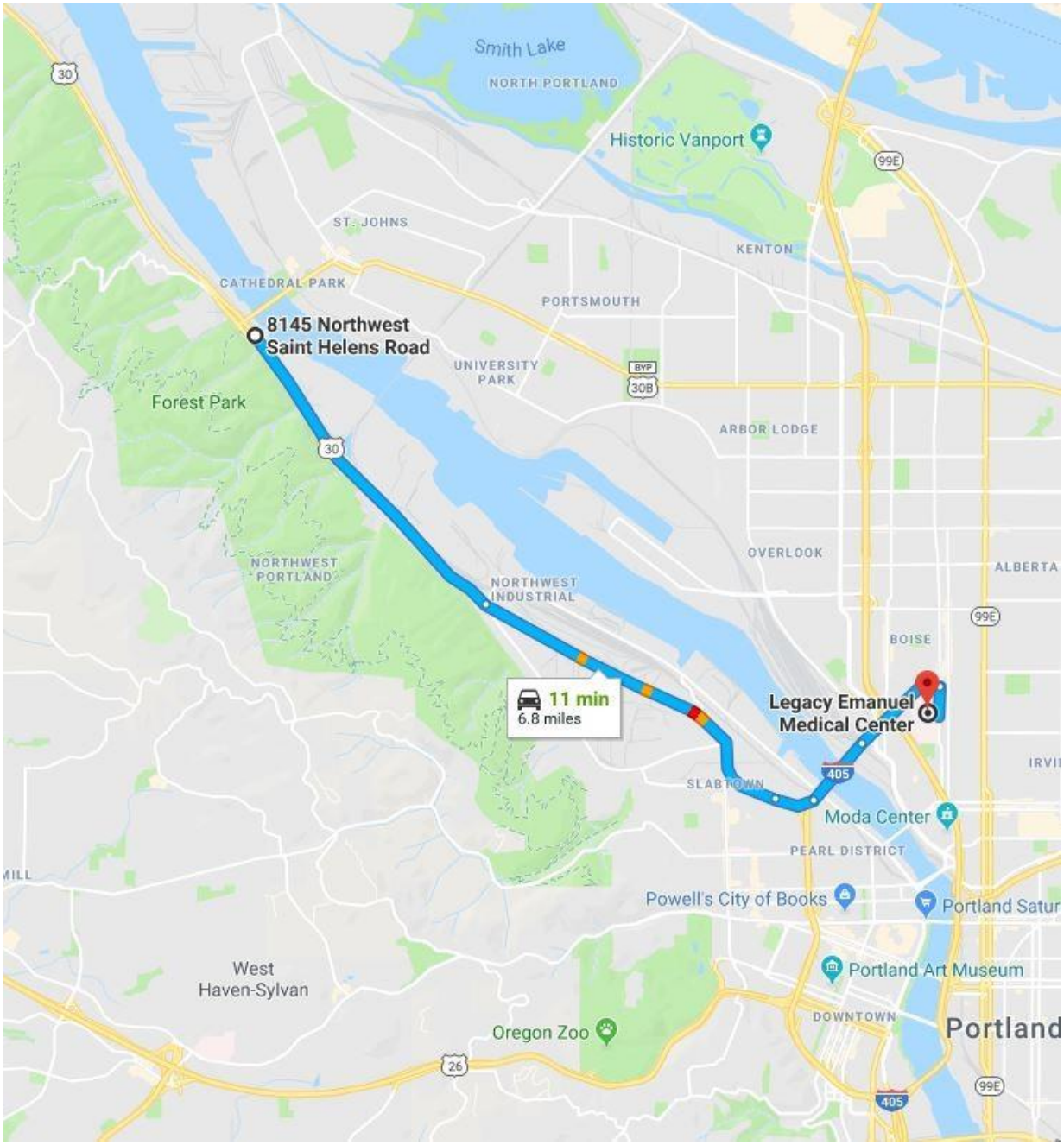

Figure 3 - Map to Hospital

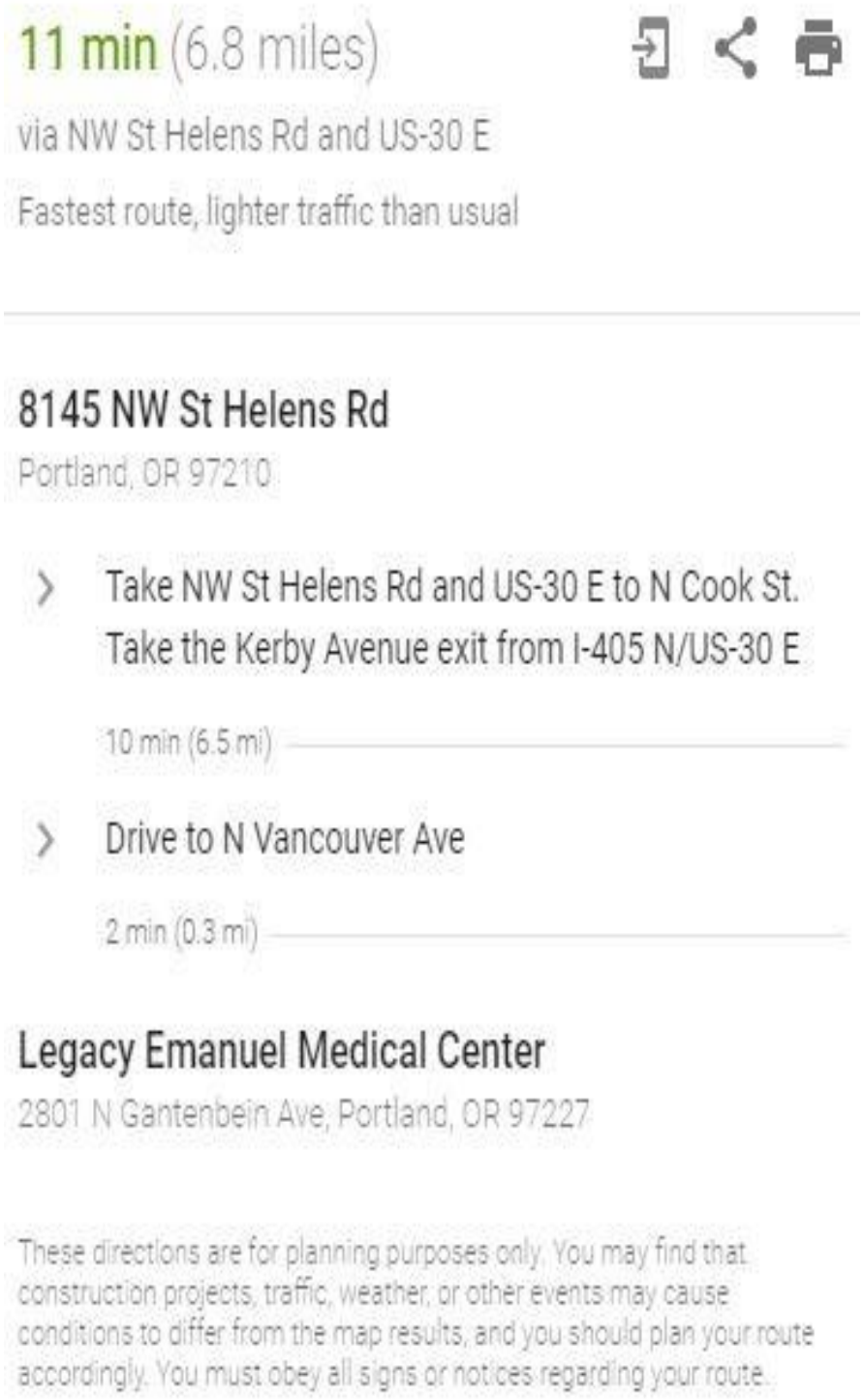

Figure 4 - Direction to Hospital

5.3 Emergency Procedures

5.3.1 Procedure to deal with entrapped or fouled diver

Dive Supervisor shall talk to the diver and direct the diver to follow and coil his hose to the point of the foul at this time the diver shall try to free his hose. If the diver is unsuccessful, the Standby Diver in the water will assist the first diver in freeing his hose. Both divers shall then return to the surface.

5.3.2 Action upon loss of vital Diver support equipment

- Establish standby breathing media system.
- Order the diver to surface immediately.
- Inform the diver of the situation as he ascends toward the surface.
- Abort dive until the cause has been fully corrected.

5.3.3 Action upon loss of air

- Re-establish breathing media supply by:
  - Activating topside secondary breathing media supply.
  - Notify diver to go on bail-out bottle
  - Activate pnemo air supply for possible insertion into diver's helmet.
- Alert the standby diver. If required, send standby diver to diver for assistance.
- Diver to resurface, and abort dive until the cause has been fully corrected.

5.3.4 Action upon loss of communications

- Attempt to establish line-pull signals.
- Put air to diver's pnemo.
- Alert Standby diver. Send standby diver if line-pull signals cannot be established.
- Signal diver to leave bottom. Stop diver at water stops if required.

5.3.5 Lost Diver Plan

Surface supplied diver maintained with umbilical. If the diver should become confused as to his position on the bottom, the divemaster shall order him to face his air supply hose (umbilical). The surface crew will pick up on the divers hose (umbilical) and bring him to the surface for reorientation.

5.3.6 Injured Diver In-Water Plan

1. Diver informs topside / determine nature of injury.
2. Alert standby diver, and deploy standby diver if further assessment is needed, or to assist diver to surface.
3. Proper decompression should be followed unless the extent of the injury does not allow completion in-water.
4. Apply first aid as necessary and transport as applicable to injury. Coordinate and notify medical assistance and emergency evacuation if necessary.

5.3.7 Action upon discovery of fire

1. Remove Diver from water immediately if in imminent danger, accounting for required decompression.
2. Control fire. Fire extinguisher, water or smother.
3. Contact Project Representative.
4. Contact Local Fire Department if necessary.

5.3.8 Severance of Divers Umbilical

1. Establish gas supply to diver's pnemo.
2. Diver activate bail-out bottle.
3. Alert standby diver, and deploy standby diver if communications cannot be established via. 2-way or line pulls signals.
4. Terminate dive, return diver to surface, and follow proper decompression procedure if applicable.

5.3.9 Oxygen Toxicity in Water

1. Noted signs of oxygen toxicity or symptoms reported by the diver.
2. Reduce Oxygen partial pressure (switch to air).
3. Ventilate and wait for symptoms to subside, then wait for 15 minutes.
4. Recommence oxygen at point of interruption.
5. If symptoms recur, switch to applicable air schedule.

5.3.10 Emergency Evacuation

1. Notify diver of emergency and terminate the dive.
2. Decompress diver according to applicable decompression schedule if diver is not in imminent danger.
3. If in danger follow omitted decompression procedures.
4. Evacuate unessential crew to a safe area.
5. Inform onsite representative and home office and inform them of conditions.

5.3.11 Diver Blow Up / Uncontrolled Ascent

1. Definition: Unexpected surfacing of the diver from depths in excess of 20 feet.
2. Diver must exhale continuously to avoid embolism.
3. Diver to slow ascent by exhaust of air from suit (if applicable), and position body in horizontal position to increase body surface area.
4. If diver is within no decompression limits, upon surfacing should be observed for at least 1 hour, for potential symptoms.
5. Implement Omitted Decompression procedure for Uncontrolled Ascent requiring decompression.

5.3.12 Diver Loss of Consciousness

1. Evaluate the situation, and potential hazards.
2. Verify the gas supply and switch to standby system if contamination is suspect
3. Alert standby diver, and deploy standby diver if further assessment is needed, or to assist diver to surface.
4. Standby diver to ventilate Divers hat, and reposition the diver to open the airway.
5. Proper decompression should be followed unless the diver has not regained consciousness and does not allow completion in water.
6. Apply first aid & CPR - Recompress and treat accordingly.

5.3.13 Mechanical Injury of Topside Crew with Diver In-Water

1. Notify diver of emergency and terminate the dive.
2. Decompress diver according to applicable decompression schedule if diver is not in imminent danger.
3. Implement First Aid as required and take care of the topside emergency.

5.3.14 Carbon Monoxide (CO) Poisoning

1. Monitor Carbon Monoxide meter.
2. Note signs of carbon monoxide poisoning or symptoms reported by the diver.
3. Switch to alternative breathing media.
4. Ventilate and wait for symptoms to subside.
5. Relocate the compressor intake to an area free of CO.
6. If symptoms do not subside or if symptoms worsen, terminate dive.
7. Breath 100% O2 on surface and monitor diver.

5.3.15 Carbon Dioxide(CO2) Excess

1. Note signs of carbon dioxide poisoning or symptoms reported by the diver.
2. Ventilate / Circulate dive helmet.
3. Switch to backup breathing media.

4. Wait for symptoms to subside.
5. If symptoms do not subside, terminate dive, breath 100% O2 at surface.
6. Reference Attached Flow Charts and Tables, **(US Navy Flow Charts 20-1, 20-2, 20-3 and Treatment Tables 5, 6, 6A)** Additional Documentation also Available in Chamber Supply Box.

5.3.16 Man Overboard

1. Notify diver of emergency and terminate the dive.
2. Decompress diver according to applicable decompression schedule if diver is not in imminent danger.
3. Alert Crew & deploy life ring to aid in the recover of Man Over Board.
4. Personnel exposure to cold water (Man Overboard)
   a) Minimize movement, do not swim unless can reach a fellow survivor, boat, or floating object. Swimming lowers body temperature.
   b) Maintain head and body out of the water to fullest extent possible. If available, pull up on large debris to decrease body exposure to water. (fig. 4)
5. Deploy Safety Boat and/ or alert BRZ Boat (If Applicable) as required to assist in recovery.
6. Upon recovery implement First Aid as required.
7.

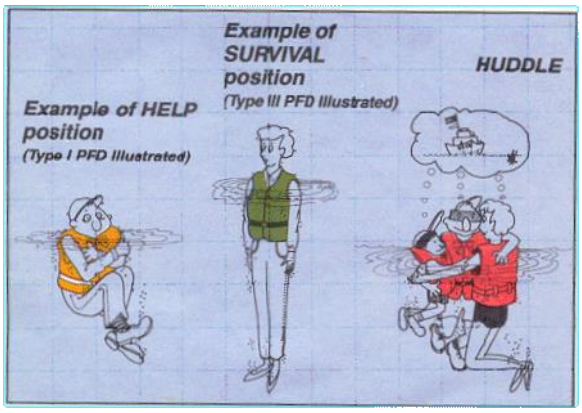

Figure 5 - Survival Position

5.3.17 Flying (Altitude) After Diving

- Divers should not fly for 12 hours after reach of water surface following a decompression dive.
- Divers should not fly for 2 hours after reach of water surface following a Non-decompression dive.
- If Aircraft cabin pressure is maintained below 2300 feet altitude, then flying may be done immediately.
- Correct for dives conducted above 1000'. Correct for dives conducted deeper than 145 fsw at altitudes between 300 and 1000 feet.
- Utilize Altitude Tables for:
  a. Prior to Altitude Dive (Equilibration)
  b. At Altitude (Sea Level Equivalent Depth - **SLED**)
  c. Further Ascent to Altitude following a dive (Surface Interval before Altitude Ascent)

5.3.18 Differential Pressures

1. Identify potential Hazardous Energy sources prior to Diver entry into the water.
2. Implement Lock Out - Tag Out procedures for isolation of hazardous energy sources.
3. If a differential in pressure is identified during operations, Abort the Diving Operation until a safe means of isolation / equalization is obtained.
4. If an Aborted Dive is implemented, clear the Diver from the differential pressure area if can be cleared in a safe manner.
5. If Diver cannot be cleared from area in a safe manor - remain in location in-water that is safe and implement means of isolating / equalizing the differential pressure.
6. DO NOT SEND THE STANDBY DIVER IN THE WATER UNLESS THE ASSISTANCE MAY BE CONDUCTED SAFELY.

5.3.19 Inclement Weather

1. Monitor Weather Conditions and take appropriate precautions to protect personnel and equipment from effects of severe weather.
2. In Hot Environment - Maintain Hydration (One Cup of Water every 15-20 minutes)
3. In Cold Environment (Air Temp 36° or less)
    a. Maintain Shelter Area to enable Personnel to get out of the elements as required.
    b. Wear appropriate Thermal Protective Clothes including Gloves.
    c. Diver Dress to be appropriate for Environmental Conditions.
    d. Topside Crews:
        i. Wear Outer Clothing impermeable to Water.
        ii. Wet Clothes to be replaced with Dry Clothes.
        iii. Monitor Wind Conditions and Effect with Air Temperature. (Ref. EM 385 1-1 Nov. 03 Page 130)
    e. Equipment & Environmental Conditions
        i. Perform Warm Up Periods and ensure equipment is of operating condition.
        ii. Maintain Coolant and Fuel appropriate for the conditions.
        iii. If weather conditions do not allow for proper operation of equipment, suspend operations until condition is remedied.
    f. Treatment of Frost Bite.
        i. Expose Area to Warm Environment.
        ii. Take off any wet or restrictive clothing.
        iii. Gently exercise affected area after it has been re-warmed.
        iv. Do not rub or massage the skin.
        v. Maintain in a warm area to prevent further heat loss.
        vi. Maintain slow warming and Treat as applicable.

5.3.20 Thermal Stress

1. In Hot Environments - Maintain hydration and proper thermal protection for diver.
2. In Cold Environments
    a. Wear appropriate thermal protective clothes including gloves.
    b. Diver dress to be appropriate for environmental conditions.
    c. Topside Crews:
        i. Wear Outer Clothing impermeable to Water.

ii. Wet Clothes to be replaced with Dry Clothes.
iii. Monitor Wind Conditions and Effect with Air Temperature. (Ref. EM 385 1-1 Nov. 03 Page 130)

d. Equipment & Environmental Conditions
   i. Perform Warm Up Periods and ensure equipment is of operating condition.
   ii. Maintain Coolant and Fuel appropriate for the conditions.
   iii. If weather conditions do not allow for proper operation of equipment, suspend operations until condition is remedied.

e. Treatment of Frost Bite.
   i. Expose Area to Warm Environment.
   ii. Take off any wet or restrictive clothing.
   iii. Gently exercise affected area after it has been re-warmed.
   iv. Do not rub or massage the skin.
   v. Maintain in a warm area to prevent further heat loss.
   vi. Maintain slow warming and Treat as applicable.

5.3.21 Drowning (Wet and Dry)

1. **Wet)** The introduction of external fluid into the lungs (diver and topside personnel) causing asphyxiation and death if not treated immediately.
   a. Terminate Dive
   b. Identify drowning victim
   c. Begin first aid (ABC's)
   d. Begin Rescue Breathing Immediately
   e. Begin CPR if Necessary
   f. Give 100% O2
   g. Get to Emergency Personnel

2. **Dry)** The inability to respire due to injury or damage to the interior of the lungs or airway.
   a. Terminate Dive
   b. Identify drowning victim
   c. Begin first aid (ABC's)
   d. Begin Rescue Breathing Immediately
   e. Begin CPR if Necessary
   f. Give 100% O2
   g. Get to Emergency Personnel

5.3.22 Decompression Sickness (Type 1 and Type 2)

Definition: The separation of inert gas from solution in the diver's blood stream causing a blockage. **Caused by improper decompression or unforeseen physiological characteristics in the diver.**

Symptoms Type 1:

- **Pain Only**
- Muscle or Joint / Bone Pain
- Skin and Lymph Node Pain

Symptoms Type 2:

- Fatigue Worsening With Time
- Neurological Symptoms
- Cardiopulmonary Symptoms
- Inner Ear Symptoms

Treatment Type 1 and Type 2:

- 100% O2
- Immediate Recompression
- Reference Attached Flow Charts and Tables, **(US Navy Flow Charts 20-1, 20-2, 20-3 and Treatment Tables 5, 6, 6A)** Additional Documentation also Available in Chamber Supply Box.

3.3.23 Barotrauma

Sinus and Middle Ear Injuries

Barotrauma is a pressure-related injury. Middle ear barotrauma, known as "ear squeeze," is the most common diving injury. Sinus barotrauma also occurs, but is less common. How does it happen? Pressure changes when diving cause barotrauma. During descent, air spaces in the sinuses and middle ear must be able to equalize to the surrounding water pressure, which increases with depth. When pressure in air spaces can't equalize, the diver may sense pressure or pain from one of these areas. During ascent, if the expanding air can't be vented, the cavity pressure increases, resulting in discomfort. This type of injury can range in severity - from mild to extreme. A sinus or middle ear injury may occur suddenly and lead to inner ear damage. For this reason, divers should know and use the "clearing," or equalizing, maneuver that works best for them.

How to Equalize

The Valsalva Maneuver.

In what is probably the most commonly taught means of equalizing pressure during diving, divers close their mouths, pinches their noses and blow gently. Avoid blowing too hard and over-inflating the middle ear space. This can occur if divers are overly excited or having a difficult time equalizing during descent - and especially if they have waited too long before attempting to equalize. The result could be injury to the middle or inner ear.

The Frenzel Maneuver.

This method is similar to the Valsalva maneuver, except that instead of blowing air into the sinuses, the diver closes the nose and mouth, and drives the tongue backwards on the roof of the mouth. The muscle contraction opens the nasal cavities and eustachian tubes, which allows air into the middle ear.

The Yawn & Swallow.

Some divers can simply swallow, yawn or thrust their lower jaw forward and open their mouths while using their lips to maintain a seal with the regulator mouthpiece. This opens the eustachian tube to the middle ear, which equalizes pressure. As long as the sinuses also equalize easily, this maneuver is acceptable.

For many divers, a combination of these methods - even switching back and forth during a single descent - works best.

Prevention is the Key
The most common reason divers suffer barotrauma is a failure to inflate their ears and sinuses with additional air during descent. Often divers mistakenly wait to equalize their ears or sinuses when they feel discomfort. Begin the equalizing process by inflating your ears and sinuses with air before entering the water or beginning your descent - this ensures that the air passages are open and clearing is possible. A slow, steady descent with frequent inflation (every 1 to 2 feet) is then possible without barotrauma.
If you feel discomfort, stop your descent and ascend a few feet until the discomfort is relieved. Attempt to clear but do not continue your descent unless your sinuses and middle ear spaces have equalized.
Some divers may use topical nasal vasoconstrictors such as Afrin®, which may help with the process of equalizing when used before a dive. Regardless of the technique you use to equalize your ears and sinuses, remember to descend slowly until you can easily clear these air spaces.
To avoid barotrauma, remember:

- Test your ears and sinuses by equalizing prior to entering the water or prior to your descent;
- Descend at a slow, steady pace and keep up with your clearing maneuvers;
- Do not continue to descend and forcefully clear if you're having difficulty - stop your descent before you experience ear or sinus pain (waiting until you feel discomfort to begin clearing means you've waited too long);
- Descend and equalize in a feet-first position; it is easier than head-first;
- If you do experience pain or discomfort, ascend until it is relieved;
- Equalize early and often to stay "ahead" of barotrauma.

Difficulty Equalizing
What if you can't equalize? First, don't dive until the problem is resolved. If a diver has trouble equalizing the sinuses and middle ear, there may be some pre-existing problem - the most common is diving with a cold or flu. Frequently the mucous membrane will retain fluid and swell, partially occluding the air passages to your sinuses and the Eustachian tube going from the back of your throat to the middle ear. This not only makes clearing difficult, but it may prevent it altogether.

Other recognizable factors in equalizing problems are:

- a history of childhood ear infections or even one severe infection that may leave the eustachian tube scarred and partially occluded;
- a history of a broken nose or a deviated septum that prevents one ear or set of sinuses from clearing as fast as the opposite side;
- hay fever, which may produce swelling of the mucous membranes or cause nasal polyps that can partially or completely occlude a sinus cavity or airway.

If you have a history that includes these conditions and want to dive successfully, it may require referral to an ear, nose and throat physician or allergy specialist who is familiar with these conditions.

Symptoms of Barotrauma
The most common barotrauma symptom a diver experiences may be mild discomfort to intense pain in the sinus or middle ear - this is usually the first indication of a problem in equalizing. Middle ear barotrauma may also include symptoms of ringing or hearing loss. As blood or fluid accumulates in the middle ear a diver may experience a partial, complete or muffled hearing loss as well as damage to the inner ear. Roaring in the ear, nausea, vomiting, dizziness, a sensation of spinning and decreased hearing may also indicate inner ear barotrauma, which requires urgent specialized treatment. Blood from the nose or in the sputum is also an indication of barotrauma and does not have to be associated with other symptoms. These are symptoms that should probably end the day's - and possibly the week's - diving. Continuing to dive with barotrauma may result in serious injury.

Treatment and Medication
If you experience any symptoms during or after a dive, then you should consult a physician to determine the extent of the injury, or if there is some treatable condition causing the problem. Your physician can determine the correct treatment and medication for sinus or middle ear barotrauma and refer you to an ear, nose and throat specialist if necessary. Proper care and medication under a physician's supervision can reduce the time divers experience barotrauma symptoms - and the sooner they can get back into the water to enjoy diving.

3.3.24 Arterial Gas Embolism

Definition: Obstruction of blood flow caused by bubbles entering the diver's arterial circulatory system. If the bubbles affect the arteries of the brain or heart they can cause death if not promptly treated. **Caused by holding one's breath during ascent.**

Symptoms:
- Extreme fatigue
- Difficulty in thinking
- Vertigo
- Nausea and/or vomiting
- Hearing abnormalities
- Bloody sputum
- Loss of control of bodily functions
- Tremors
- Loss of coordination
- Numbness

Treatment:

- Basic First Aid
- 100% O2
- Immediate Recompression
- Reference Attached Flow Charts and Tables, **(US Navy Flow Charts 20-1, 20-2, 20-3 and Treatment Tables 5, 6, 6A)** Additional Documentation also available in Chamber Supply Box.

3.3.25 Mediastinal / Subcutaneous Emphysema

Definition: Gas is forced through damaged lung tissue into the tissue surrounding the heart, trachea, and subcutaneous tissue of the neck. **Caused by holding breath during ascent.**

Symptoms:
- Pain under breast bone
- Feeling of fullness around neck
- Difficulty swallowing
- Voice pitch change

- Crackling sound and feeling of skin in area

Treatment:

- 100%O2 at surface
- Shallow Recompression
- Reference Attached Flow Charts and Tables, **(US Navy Flow Charts 20-1, 20-2, 20-3 and Treatment Tables 5, 6, 6A)** Additional Documentation also Available in Chamber Supply Box.

Pneumothorax

Definition: Gas trapped in the cavity between the lung and the chest wall. **Caused by physical impact or over pressurization.**

Symptoms:

- Sharp chest pain
- Shortness of breath
- Trouble breathing
- Anxiety
- **Symptoms will get progressively worse with tension pneumothorax**

Treatment:

- 100% O2
- Reference Attached Flow Charts and Tables, **(US Navy Flow Charts 20-1, 20-2, 20-3 and Treatment Tables 5, 6, 6A)** Additional Documentation also Available in Chamber Supply Box.

ATTACHMENTS

Table of Figures

Table 9-7. *No-Decompression Limits and Repetitive Group Designators for No-Decompression Air Dives.*

Depth (fsw)	No-Stop Limit	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
10	Unlimited	57	101	158	245	426	*										
15	Unlimited	36	60	88	121	163	217	297	449	*							
20	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	1102	20	33	47	62	78	97	117	140	166	198	236	285	354	469	992	1102
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	63	7	12	17	22	28	33	39	45	51	57	63					
70	48	6	10	14	19	23	28	32	37	42	47	48					
80	39	5	9	12	16	20	24	28	32	36	39						
90	33	4	7	11	14	17	21	24	28	31	33						
100	25	4	6	9	12	15	18	21	25								
110	20	3	6	8	11	14	16	19	20								
120	15	3	5	7	10	12	15										
130	12	2	4	6	9	11	12										
140	10	2	4	6	8	10											
150	8		3	5	7	8											
160	7		3	5	6	7											
170	6			4	6												
180	6			4	5	6											
190	5			3	5												

* Highest repetitive group that can be achieved at this depth regardless of bottom time.

Figure 6 - No-Decompression Air Dive Table

Table 9-8. *Residual Nitrogen Time Table for Repetitive Air Dives.*

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in the Air Decompression Tables to compute decompression for such dives.

Repetitive Group at Beginning of Surface Interval

Repetitive Group at the End of the Surface Interval																
Dive Depth	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58
15	**	**	**	**	**	**	**	**	450	298	218	164	122	89	61	37
20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27
25	†	†	470	354	286	237	198	167	141	118	98	79	63	48	34	21
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11
55	114	105	96	88	80	72	65	58	51	44	38	32	26	20	15	10
60	101	93	86	79	72	65	58	52	46	40	35	29	24	19	14	9
70	83	77	71	65	59	54	49	44	39	34	29	25	20	16	12	8
80	70	65	60	55	51	46	42	38	33	29	25	22	18	14	10	7
90	61	57	52	48	44	41	37	33	29	26	22	19	16	12	9	6
100	54	50	47	43	40	36	33	30	26	23	20	17	14	11	8	5
110	48	45	42	39	36	33	30	27	24	21	18	16	13	10	8	5
120	44	41	38	35	32	30	27	24	22	19	17	14	12	9	7	5
130	40	37	35	32	30	27	25	22	20	18	15	13	11	9	6	4
140	37	34	32	30	27	25	23	21	19	16	14	12	10	8	6	4
150	34	32	30	28	26	23	21	19	17	15	13	11	9	8	6	4
160	32	30	28	26	24	22	20	18	16	14	13	11	9	7	5	4
170	30	28	26	24	22	21	19	17	15	14	12	10	8	7	5	3
180	28	26	25	23	21	19	18	16	14	13	11	10	8	6	5	3
190	26	25	23	22	20	18	17	15	14	12	11	9	8	6	5	3

Residual Nitrogen Times (Minutes)

** Residual Nitrogen Time cannot be determined using this table (see paragraph 9-9.1 subparagraph 8 for instructions).

† Read vertically downward to the 30 fsw repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time. Decompress using the 30 fsw air decompression table.

[A]Figure 7 - Residual Nitrogen Time Table for Repetitive Air Dives

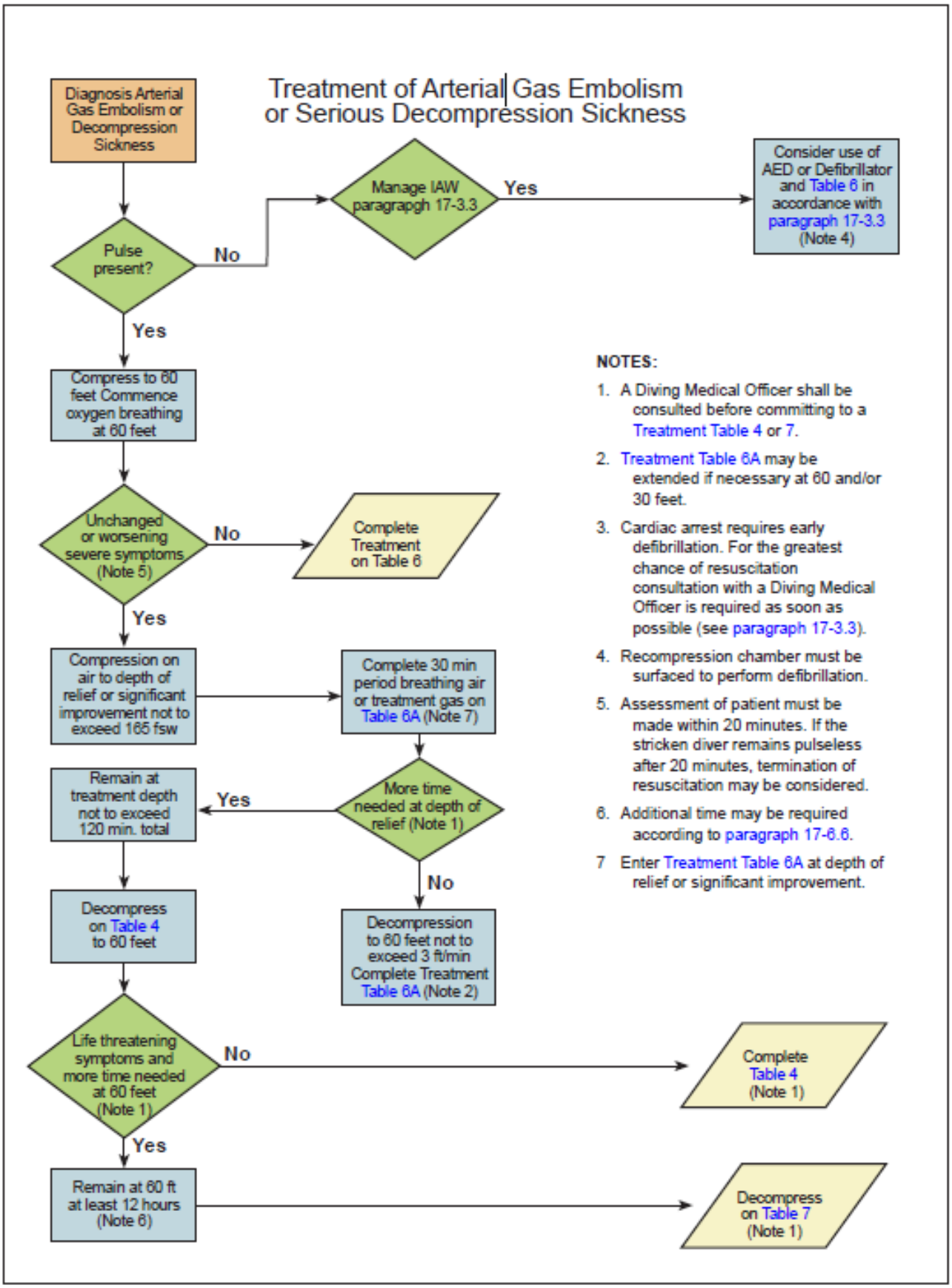

Figure 8 - Treatment of Atrial Gas Embolism or Serious Decompression Sickness

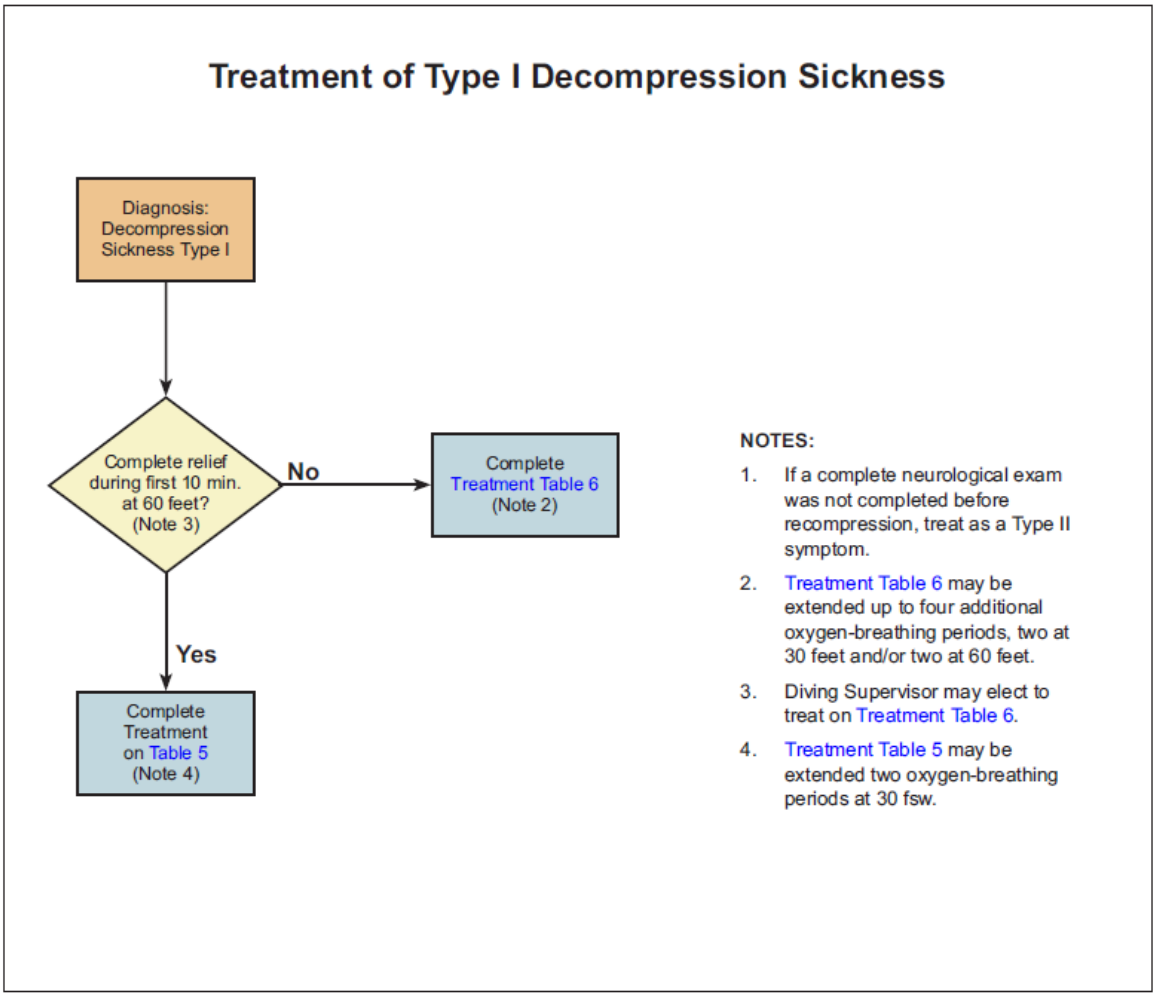

Figure 9 - Treatment of Type 1 Decompression Sickness

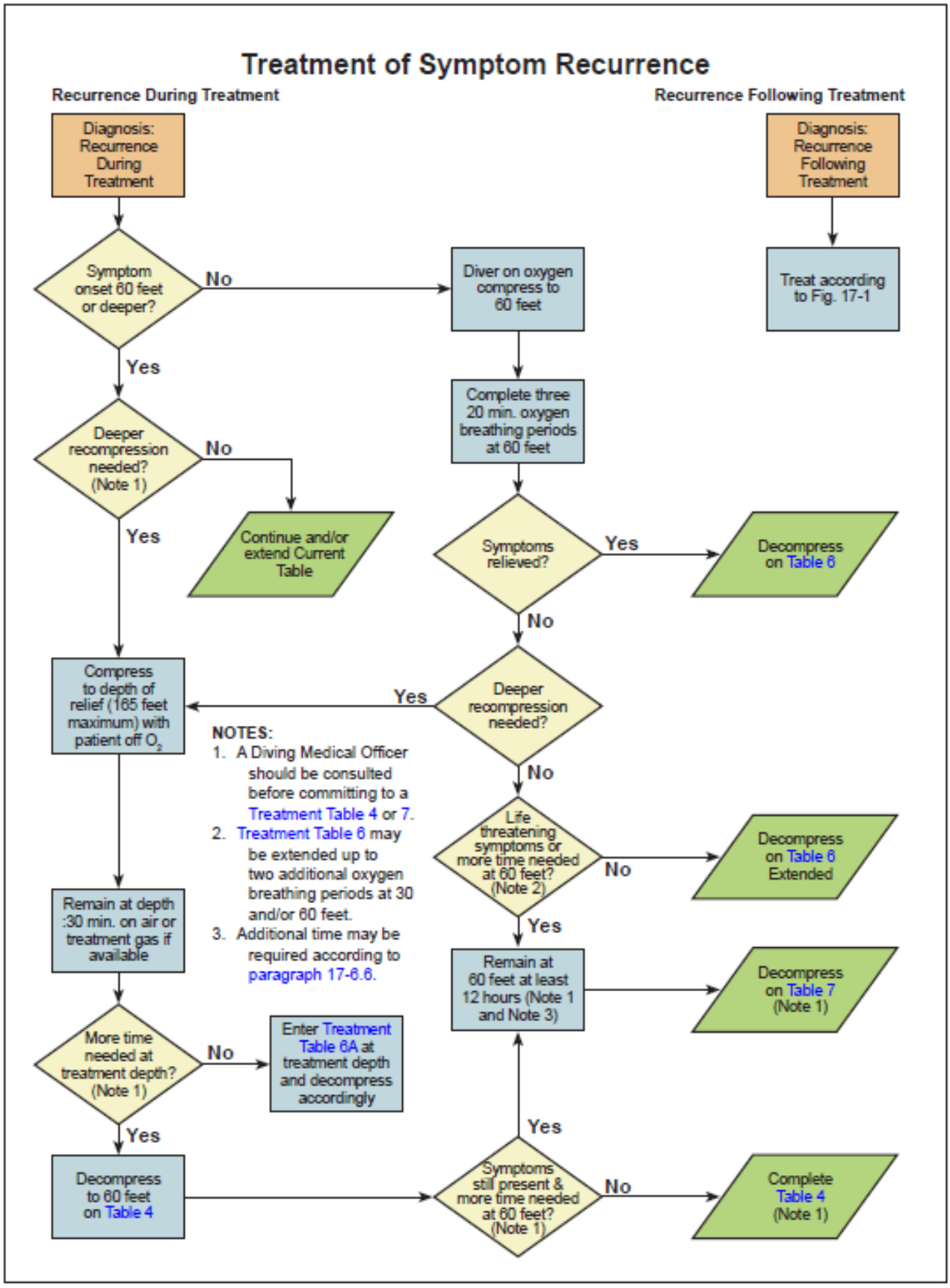

Figure 10 - Treatment of Symptom Recurrences

Treatment Table 5

1. Descent rate - 20 ft/min.
2. Ascent rate - Not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time on oxygen begins on arrival at 60 feet.
4. If oxygen breathing must be interrupted because of CNS Oxygen Toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 17-8.10.1.1)
5. Treatment Table may be extended two oxygen-breathing periods at the 30-foot stop. No air break required between oxygen-breathing periods or prior to ascent.
6. Tender breathes 100 percent O_2 during ascent from the 30-foot stop to the surface. If the tender had a previous hyperbaric exposure in the previous 18 hours, an additional 20 minutes of oxygen breathing is required prior to ascent.

Treatment Table 5 Depth/Time Profile

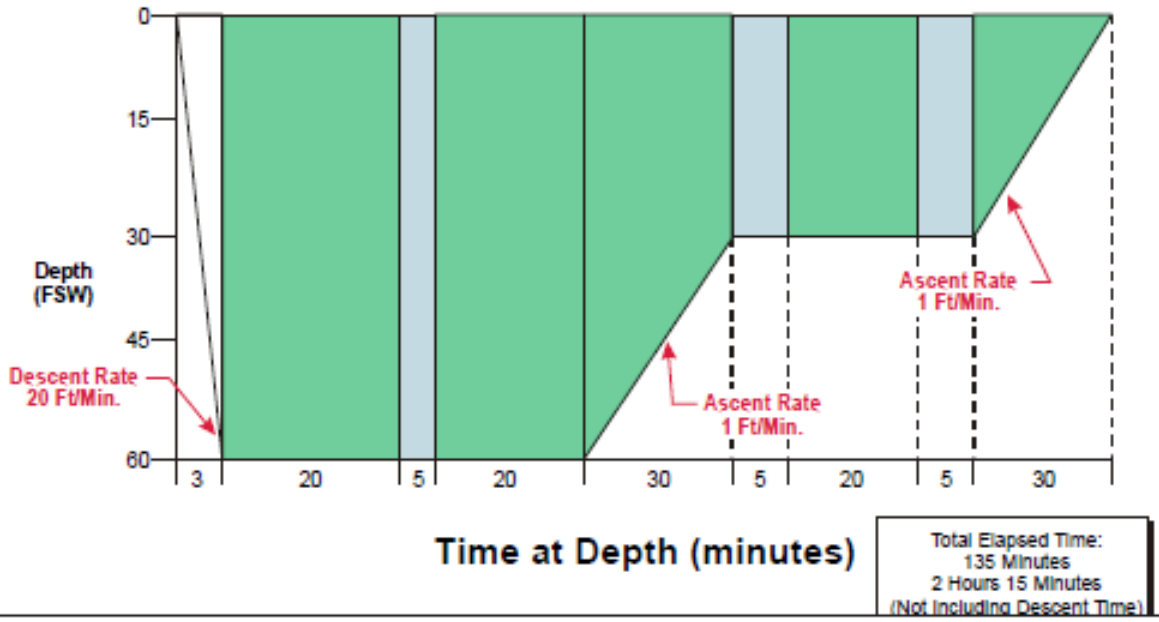

Figure 11 - US Navy Dive Manual Treatment Table 5

Treatment Table 6

1. Descent rate - 20 ft/min.
2. Ascent rate - Not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time on oxygen begins on arrival at 60 feet.
4. If oxygen breathing must be interrupted because of CNS Oxygen Toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 17-8.10.1.1).
5. Table 6 can be lengthened up to 2 additional 25-minute periods at 60 feet (20 minutes on oxygen and 5 minutes on air), or up to 2 additional 75-minute periods at 30 feet (15 minutes on air and 60 minutes on oxygen), or both.
6. Tender breathes 100 percent O_2 during the last 30 min. at 30 fsw and during ascent to the surface for an unmodified table or where there has been only a single extension at 30 or 60 feet. If there has been more than one extension, the O_2 breathing at 30 feet is increased to 60 minutes. If the tender had a hyperbaric exposure within the past 18 hours an additional 60-minute O_2 period is taken at 30 feet.

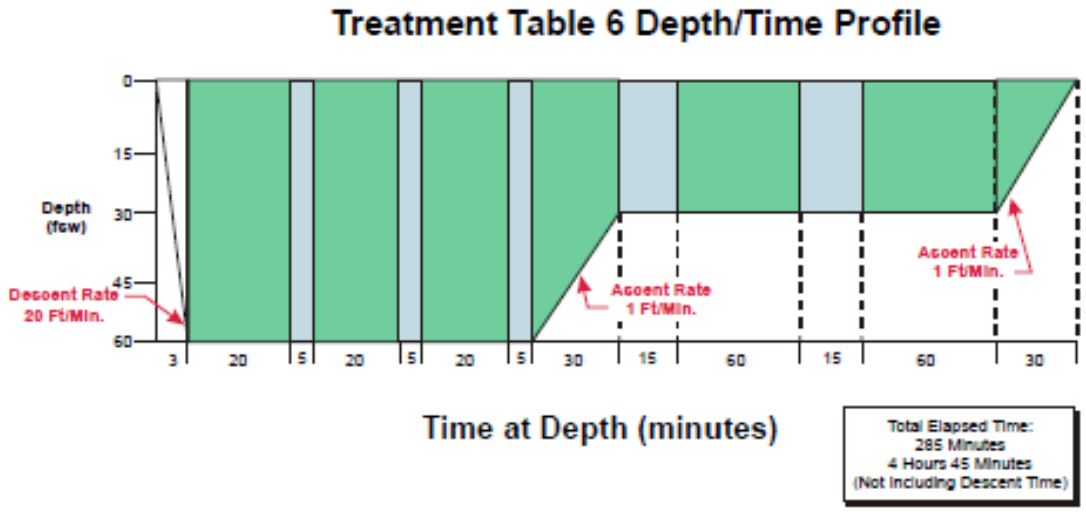

Figure 12 - US Navy Dive Manual Treatment Table 6

Treatment Table 6A

1. Descent rate - 20 ft/min.
2. Ascent rate - 165 fsw to 60 fsw not to exceed 3 ft/min, 60 fsw and shallower, not to exceed 1 ft/min. Do not compensate for slower ascent rates. Compensate for faster rates by halting the ascent.
3. Time at treatment depth does not include compression time.
4. Table begins with initial compression to depth of 60 fsw. If initial treatment was at 60 feet, up to 20 minutes may be spent at 60 feet before compression to 165 fsw. Contact a Diving Medical Officer.
5. If a chamber is equipped with a high-O_2 treatment gas, it may be administered at 165 fsw and shallower, not to exceed 3.0 ata O_2 in accordance with paragraph 17-8.9. Treatment gas is administered for 25 minutes interrupted by 5 minutes of air. Treatment gas is breathed during ascent from the treatment depth to 60 fsw.
6. Deeper than 60 feet, if treatment gas must be interrupted because of CNS oxygen toxicity, allow 15 minutes after the reaction has entirely subsided before resuming treatment gas. The time off treatment gas is counted as part of the time at treatment depth. If at 60 feet or shallower and oxygen breathing must be interrupted because of CNS oxygen toxicity, allow 15 minutes after the reaction has entirely subsided and resume schedule at point of interruption (see paragraph 17-8.10.1.1).
7. Table 6A can be lengthened up to 2 additional 25-minute periods at 60 feet (20 minutes on oxygen and 5 minutes on air), or up to 2 additional 75-minute periods at 30 feet (60 minutes on oxygen and 15 minutes on air), or both.
8. Tender breathes 100 percent O_2 during the last 60 minutes at 30 fsw and during ascent to the surface for an unmodified table or where there has been only a single extension at 30 or 60 fsw. If there has been more than one extension, the O_2 breathing at 30 fsw is increased to 90 minutes. If the tender had a hyperbaric exposure within the past 18 hours, an additional 60 minute O_2 breathing period is taken at 30 fsw.
9. If significant improvement is not obtained within 30 minutes at 165 feet, consult with a Diving Medical Officer before switching to Treatment Table 4.

Treatment Table 6A Depth/Time Profile

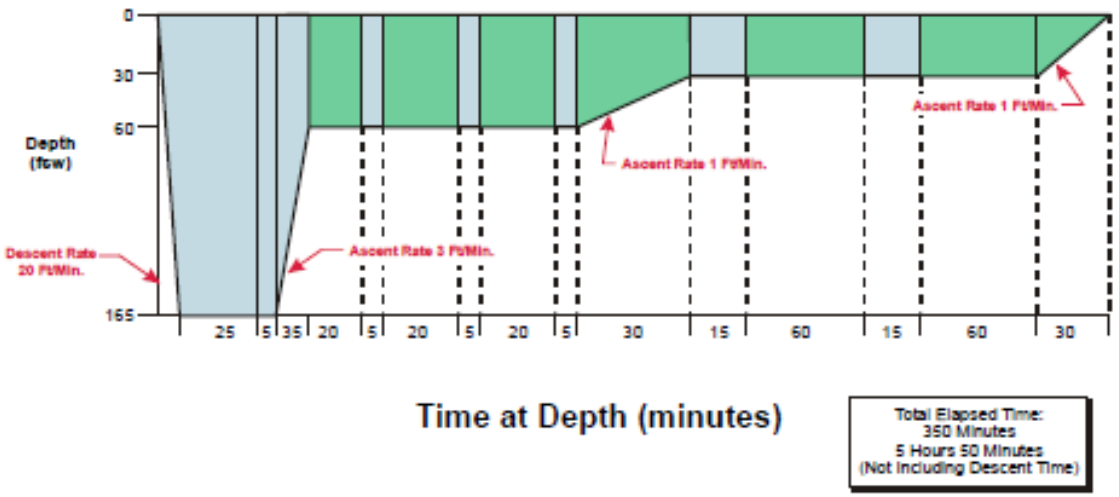

Figure 13 - US Navy Dive Manual Treatment Table 6A