Diving Operations Plan

Prepared by:
TITAN Associates Group Inc.
130 West Washington Ave
Athens, TN 37371

Revised by:
Tetra Tech, Inc.
Munitions Response Services
19803 North Creek Parkway
Bothell, WA. 98011

Under contract to:
Apex Companies, LLC
1600 Commerce Circle
Trafford, PA 15085

Dated: December 2021
Project: Dominion Energy South Carolina, Inc.
Congaree River Project UXO Support

This page intentionally left blank.

DIVING OPERATIONS PLAN

This Diving Operations Plan (DOP) is a general overview of the underwater diving operations to be performed while conducting intrusive underwater activities at the Congaree River Project in Columbia, South Carolina. This DOP addresses the health and safety practices and controls that will be implemented by all Tetra Tech, Inc. (Tetra Tech) employees and subcontractors participating in this contract.

This phase of the work to be performed cannot be fully accomplished by means other than diving (i.e., through the use of cameras, remotely operated vehicles, or dewatering of the work area). This work prepares the project site for dewatering prior to final clearance.

Activities to be performed under this DOP comply with applicable sections of:

- 29 Code of Federal Regulations (CFR) 1910.120,
- 29 CFR 1910 Subpart T – Commercial Diving Operations,
- United States (U.S.) Department of Defense Explosives Safety Board (DDESB) – Technical Paper 18,
- U.S. Army Corps of Engineers – Engineer Manual (EM) 385 1-1 Section 30,
- U.S. Navy Diving Manual Revision 7, and
- Tetra Tech Diving Safe Practices Manual, which is included as Attachment D to this DOP.

This DOP is not meant to be a stand-alone document. This DOP will be implemented in conjunction with the associated site-specific Final Work Plan (WP)). The WP is the overarching plan for the project. Sections of the WP are referenced (or duplicated in some cases) in this DOP. All project planning documents will be available and accessible to personnel during diving activities. Diver personnel must be familiar with the WP and this DOP before beginning fieldwork.

If, for any reason, the DOP is altered in mission, depth, personnel, or equipment, the corporate Dive Safety Officer will be contacted to review and accept the alteration prior to actual operation.

Plan prepared by:
David Farmer
TITAN Associates Group Inc.
130 West Washington Ave
Athens, TN 37371

Plan revised by:
Scot Wilson
Tetra Tech, Inc.
Munitions Response Services
19803 North Creek Parkway
Bothell, WA. 98011
Scot.wilson@tetratech.com
360-626-31931

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

List of Attachments

Acronyms and Abbreviations

ADCI	Association of Diving Contractors International
AHA	activity hazard analysis
APEX	Apex Companies, LLC
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CRP	Congaree River Remediation Project
DDESB	Department of Defense Explosives Safety Board
DESC	Dominion Energy South Carolina, Inc.
DoD	Department of Defense
DOP	Diving Operations Plan
DPIC	Designated Person in Charge
DS	Dive Supervisor
DSO	Dive Safety Officer
DSPM	Tetra Tech Diving Safe Practices Manual
EM	Engineering Manual
EZ	exclusion zone
FFM	full-face mask
ffw	feet of fresh water
GPS	global positioning system
HAZWOPER	Hazardous Waste Operation and Emergency Response
HASP	Health and Safety Plan
HP	High Pressure
IAW	in accordance with
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
MGP	Manufactured Gas Plant
MPPEH	materials potentially presenting an explosive hazard
MRA	Modified Removal Action
NMRD	non-munitions related debris
OSHA	Occupational Safety and Health Administration

PM	Project Manager
psi	pounds per square inch
PSIG	pounds per square inch gauge
QC	quality control
QCP	Quality Control Plan
RTK	real-time kinematic positioning
SADS	surface air delivery system
SC	South Carolina
SCDHEC	South Carolina Department of Health and Environmental Control
SCUBA	self-contained underwater breathing apparatus
SHM	Safety and Health Manager
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
Tetra Tech	Tetra Tech, Inc.
TLM	Tar Like Material
U.S.	United States
USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
VCC	Voluntary Cleanup Contract
WP	Work Plan

1. PROJECT INTRODUCTION

1.1 PROJECT WORK AUTHORITY

Apex Companies, LLC (APEX) has contracted Tetra Tech, Inc. (Tetra Tech) to revise plans to perform underwater clearance of Munitions and Explosives of Concern (MEC in support of contaminated sediment removal on the Congaree River Project (CRP), Columbia, South Carolina (SC).

This Diving Operations Plan (DOP) is a living document. A living document is one that can be modified, as necessary, to best achieve the goals and objectives stated within. Based on field observations, site conditions, and other unknown circumstances or conditions, this document may be modified best to achieve the objectives of the intrusive underwater activities

This DOP provides the technical approach, rationale, and field procedures to be followed to achieve the objectives of the underwater clearance activities during the CRP, Columbia, SC. This DOP was revised in accordance with the APEX Contract Number 87500614, dated October 29, 2021.

1.2 PROJECT PURPOSE

The purpose of the CRP diving activities in the cofferdam and remediation areas shown in Figures 1-1 through 1-3 is to remove MEC which, which will reduce hazards from Civil War-era military munitions co-located within the Tar Like Material (TLM) contaminated sediment removal areas. Tetra Tech will be performing dive operations to remove MEC materials potentially presenting an explosive hazard (MPPEH) from cofferdam footprints prior to installation. The intrusive underwater activities will be completed IAW United States Army Corps of Engineers (USACE) approved procedures and an Explosives Safety Plan IAW Department of Defense (DoD) Explosives Safety Board (DDESB) guidance.

1.3 PROJECT LOCATION

The CRP area is located on the Congaree River in Columbia, SC. The site, also referred to as the "project area", has been divided into two separate areas and begins directly south of the Gervais Street Bridge. Area 1 consists of approximately 2.6 acres, and Area 2 is approximately 0.5 acres in total and extends downriver towards the Blossom Street Bridge. Cofferdam installations are planned around each area, so the areas may be dewatered, and MEC screening and sediment removal may occur on dry land. The intrusive underwater activities will occur within the cofferdam footprint areas prior to installation on the eastern side of Congaree River between Gervais and Blossom Street Bridges, shown in Figure 1-1.

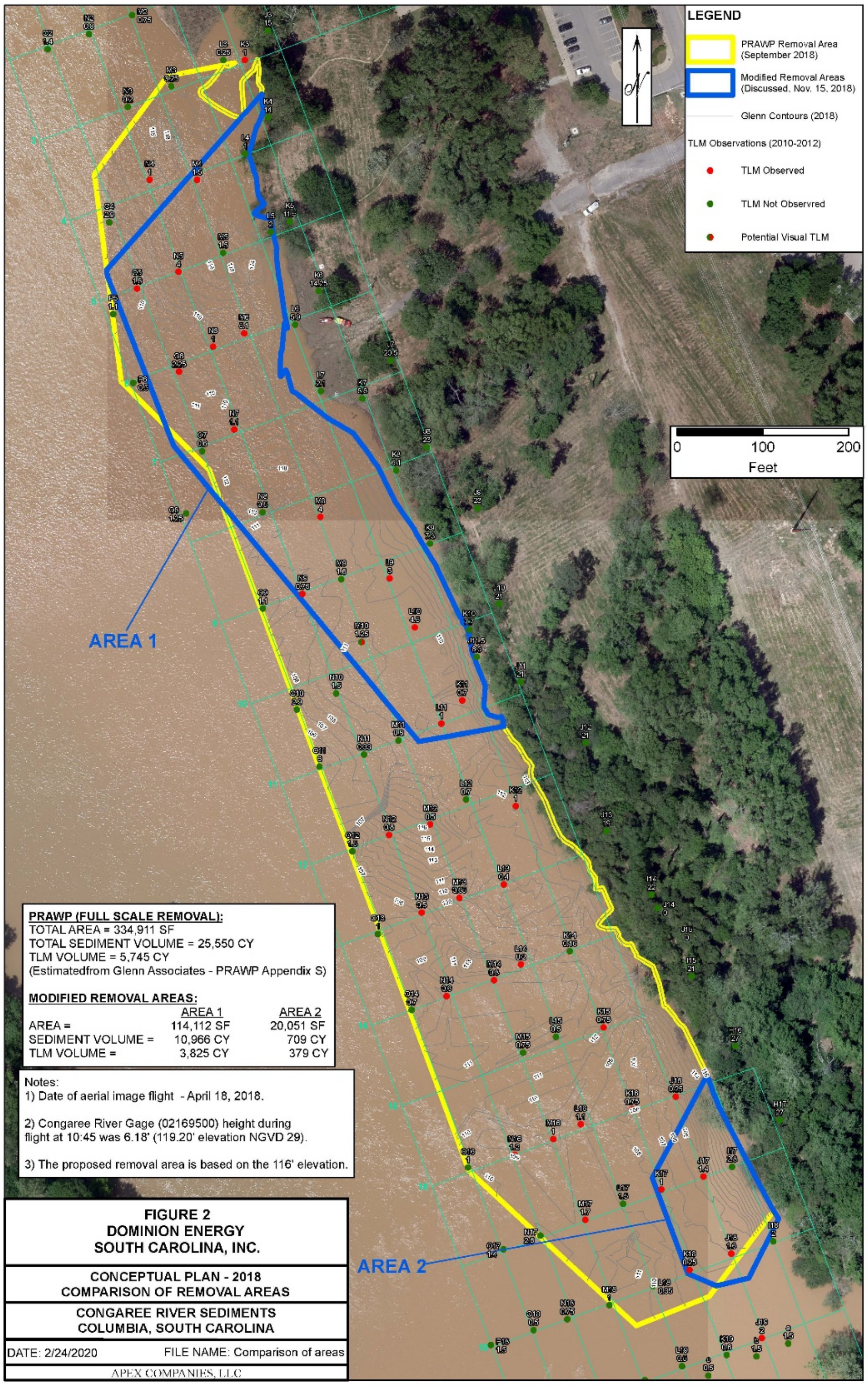


Figure 1-1. Site Location

1.4 SITE BACKGROUND, AND DESCRIPTION

In 1865, during the Civil War, live munitions and other articles of war produced by the Confederacy were dumped into the Congaree River near the Gervais Street Bridge by Union forces under the direction of General Sherman. This activity took place during Sherman's occupation of Columbia. The Union Army kept some of these items for its own use, and the remainder was destroyed. One of the methods for destruction was dumping the items into the river.

Archeological investigations, conducted as late as 1980, recovered some live and unstable munitions or MEC from the area as well as some other potentially historically significant artifacts. Specifically, this work was focused on the unnamed tributary entering the river just south of the Gervais Street Bridge. Several live cannonballs were identified during this operation and properly disposed of by trained explosive ordinance disposal personnel located at nearby Fort Jackson.

Due to the potential presence of live munitions within the project area, an additional reconnaissance and screening of the area in question were conducted as part of the investigative activities. An acoustic (side-scan sonar) and magnetic (magnetometer) remote sensing survey was performed to identify ordnance and other submerged cultural resources in the remediation area by Tidewater Atlantic Research, Inc. and a report submitted on February 8, 2012. Analysis of the survey data identified concentrations of anomalies with the potential to be MEC in the immediate vicinity of the Senate Street landing and scatters extending into the river. A terrestrial magnetometer investigation of the unnamed tributary below the Gervais Street Bridge was also carried out, and that investigation identified eight additional anomalies with a potential association with ordnance.

In June 2010, the occurrence of a TLM within the Congaree River was reported to the South Carolina Department of Health and Environmental Control (SCDHEC). Preliminary testing indicated that the material might be attributable to the Huger Street former Manufactured Gas Plant (MGP) that was operated by predecessor companies of Dominion Energy South Carolina, Inc. (DESC) beginning in the early 1900s and ending in the 1950s.

Preliminary sample results conducted on the material by SCDHEC and DESC indicated that the TLM had similar chemical and physical characteristics as coal tar, a by-product of Manufactured Gas Operations that were common in cities from the late 1800s until the 1950s. Additional research found that the most likely source of the TLM was a former MGP located northeast of the river at 1409 Huger Street that operated from about 1906 until the mid-1950s. Later this was the location of the city bus terminal until 2008. Figure 1-2 shows the location of TLM detected during the investigative activities.

DESC had previously entered a Voluntary Cleanup Contract (VCC) with SCDHEC in August 2002 to conduct environmental assessment and cleanup activities at the former Huger Street MGP site. DESC has worked proactively and cooperatively with SCDHEC under its existing VCC to determine the extent of TLM in the Congaree River and to develop a plan for cleanup.

To address the presence of TLM within the river, a Stakeholder-Developed Modified Removal Action (MRA) was developed and submitted to SCDHEC in December 2018. Two areas within the river, along the eastern shoreline, were proposed for the removal of impacted sediment. The TLM-impacted sediment varies in thickness from a few inches to approximately 6 feet thick in some areas. The current total estimate of sediment requiring removal is approximately 11,675 cubic yards. The total project area within the river, including cofferdam footprints and removal areas, is estimated to be 5.8 acres. Sediment removal from within the river will occur after coffer dams are installed, and water has been removed. Intrusive Dive removal operations of metallic anomalies will be conducted prior to the installation of the coffer dams.

In December 2018, a Stakeholder-Developed Plan for the MRA was developed to reduce the footprint of the project area. The footprint was reduced to the current 2.6-acre area 1 and area 2 approximately 0.5 acres. See figure 1-3.

1.5 REMOVAL OBJECTIVES

The objective of this DOP is to locate and remove MEC from underwater sediment in the location of future cofferdam area footprints. The cofferdams are to be installed prior to coal tar contaminated sediment removal. Figure 1-3 shows the location of the footprint to be cleared for each project area. The overall objective of removing MEC is to reduce the risk to environmental construction workers and eliminate/reduce the potential of MEC within the removal action area boundaries.

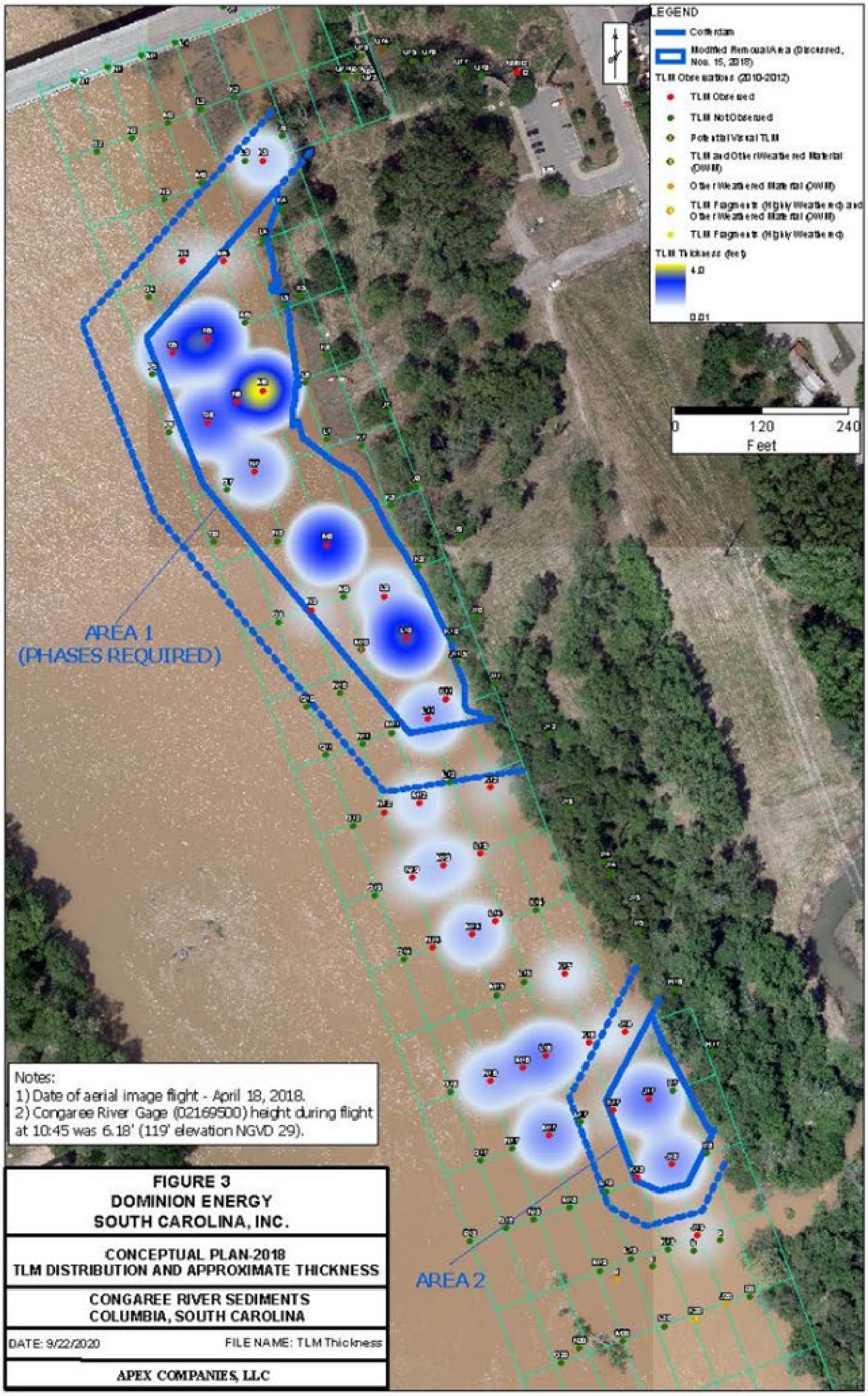


Figure 1-2. TLM Distribution and Thickness

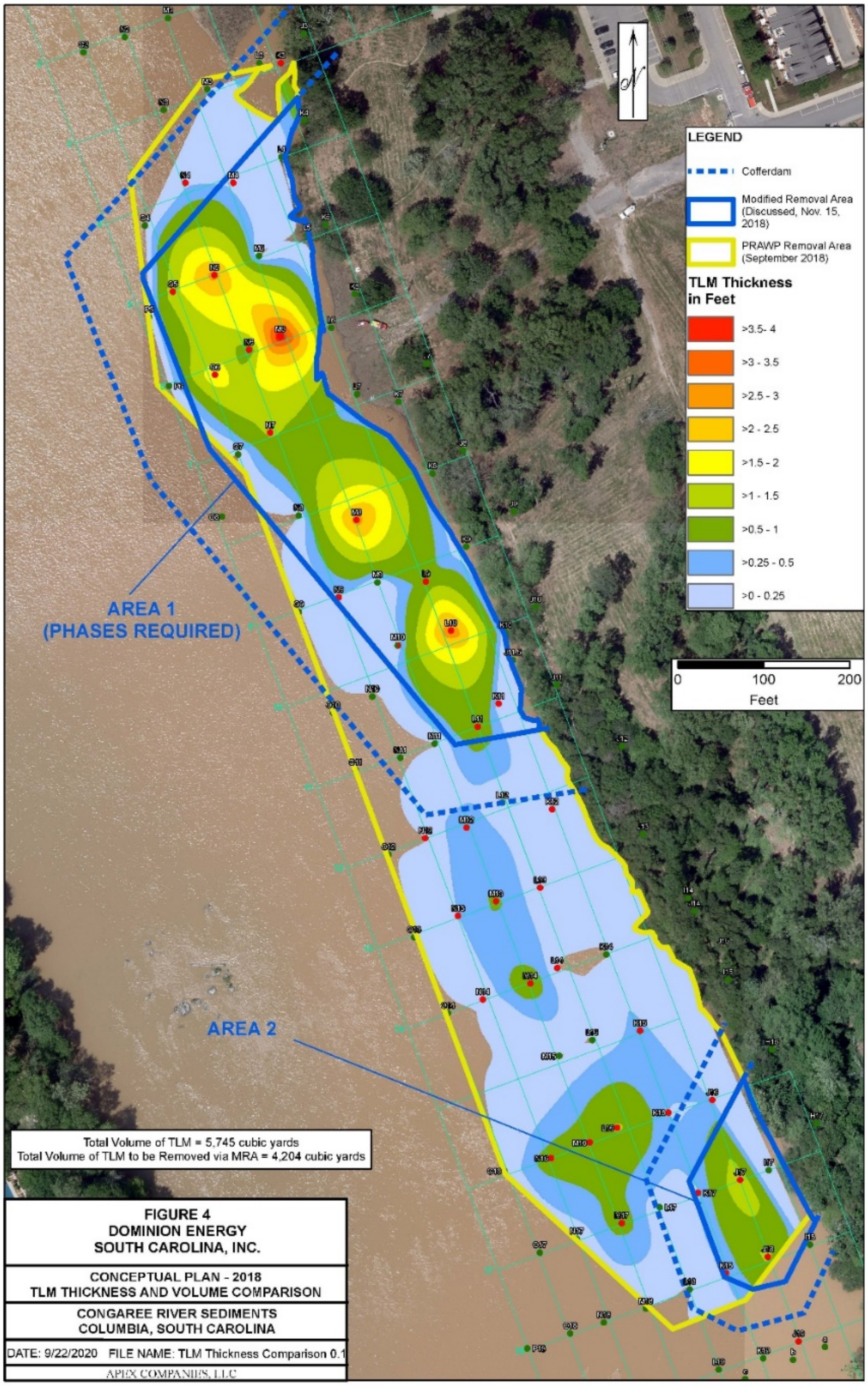


Figure 1-3. Modified Removal Area

1.6 SCHEDULE

The intrusive underwater activities for the cofferdam footprints are tentatively scheduled to begin in Spring/Summer 2022. The preliminary schedule is as follows:

- Respond to comments and finalize DOP in January 2022.
- Complete Area 1 and 2 coffer dam underwater intrusive activities in May up to August 2022.
- Project reporting activities November to December 2022.

During intrusive underwater activities, modifications to the schedule may be necessary. The schedule modifications will be submitted to DESC, and will include:

- Reasons for the modification
- Descriptions of the alternatives evaluated to increase productivity (e.g., increase manpower, lengthen workdays, more efficient equipment, etc.)
- Methods that will be used to prevent similar delays from happening again

1.7 DIVING OPERATIONS PLAN ORGANIZATION

This DOP is organized as follows:

- **Section 1 – Introduction**. Presents the authority, purpose, project description and general scope, personnel, site description and history, removal objectives, and tentative schedule for CRP underwater intrusive activities.
- **Section 2 – Dive Team**. Summarizes the names and duties of personnel involved with diving operations for CRP.
- **Section 3 – Equipment**. Provides a description of the required equipment and platform to be utilized during diving operations.
- **Section 4 – Tasks**. Summarizes the tasks for intrusive underwater activities.
- **Section 5 – Dive Operations**. Details the procedures to be followed during diving operations, intrusive underwater activities, field Quality Control (QC) procedures, and requirements to be followed.
- **Section 6 – Key Personnel**. Describes project key personnel and organization for diving activities.
- **Section 7 – Project Records and Reporting**. Lists project reporting deliverables for the CRP underwater intrusive activities.
- **Section 8 – References**. Provides references used to develop this DOP.

This section provides information on the CRP Dive Operations Team for intrusive underwater activities.

2. DIVE TEAM

2.1. PERSONNEL

Listed in Table 2-1 below are the minimum team requirements, as defined in the Tetra Tech Diving Safe Practices Manual (DSPM), that will be met for surface air delivery system (SADS), self-contained underwater breathing apparatus (SCUBA)), and Surface Supplied Air (SSA) diving operations:

Table 2-1. Dive Team Personnel Composition

SCUBA – Tethered with communications, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor **	1
Diver in water	1
Standby Diver* (tethered with communications)	11
Tender	1
TOTAL TEAM	**44**

Surface Supplied Air – 0 to 100 FSW 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**

** The stand-by diver will be rested and capable of performing emergency rescue assistance. When work is limited to no-decompression limits, the stand-by 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 supervisor will be dual-hatted as SUXOS. The supervisor may be the stand-by Tender.*

2.2. SCUBA AND SADS OPERATIONS

- SADS diving operations will not be conducted at depths deeper than 4 feet.
- SCUBA diving operations will not be conducted at depths deeper than 100 feet.
- During all SADS/ SCUBA dives, a stand-by diver will be available while a diver is in the water.
- A SCUBA diver will be line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operations. If any SCUBA diver is tended, they will wear a harness meeting the following standard:
  - Each tethered SCUBA diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious.
- The planned time of such a diving operation will not exceed the no-decompression limits according to the United States (U.S.) Navy Dive Manual, or the air supply duration of the cylinders in use, exclusive of the reserve supply. The cylinder pressure will be determined immediately before each dive.
- The diver will surface when the primary bottle pressure is 500 pounds per square inch gauge (PSIG.).
- The daily maximum bottom time for each diver is 300 minutes.

2.3. SURFACE SUPPLIED OPERATIONS

- SSA diving operations will not be conducted at depths deeper than 100 feet.
- During all SSA dives, a stand-by diver will be available while a diver is in the water.
- The diver will surface when the topside console pressure is 200 PSIG.
- The daily maximum bottom time for each diver is 300 minutes.
- The diver's surface-supplied air supply may originate from an air compressor, a bank of high-pressure air flasks, or a combination of both. Regardless of the source, the air must:
- Meet the purity standards;
- Be supplied in an adequate volume for breathing;
- Have a rate of flow that properly ventilates the helmet or mask; and
- Be provided at enough pressure to overcome the bottom water pressure and the pressure losses due to flow through the diving hose, fittings, and valves.
- The air supply requirements depend on specific factors for each dive, such as depth, duration, level of work, number of divers being supported, and type of diving system being used.
- The capacity of the primary air supply must meet the consumption rate for the designated number of divers for the full duration of the dive (bottom time plus decompression time). The maximum depth of the dive, the number of divers, and the equipment to be used must

be considered when sizing the supply.

- The secondary air supply must be sized to support the recovery of all divers using the equipment and dive profile of the primary supply, if the primary supply malfunctions or fails at the worst-case time (i.e., immediately prior to completion of the planned bottom time of maximum dive depth, when decompression obligation is greatest).

Breathing gas supply hoses will:

- Have a working pressure at least equal to the pressure of the total breathing gas system;
- Have a rated bursting pressure at least 4 times the operating pressure;
- Be tested annually (at a minimum) to 1.5 times their working pressure;
- Have their ends taped, capped, or plugged when not in use;
- Have connections made of corrosion-resistant material, and be resistant to accidental disengagement; and
- Have connectors with a working pressure at least equal to the hose to which they are attached.

Umbilical's will:

- Be marked (starting from the diver's end) at 10-foot increments for the first 100 feet; and 50-foot increments thereafter;
- Be made of kink-resistant material; and
- Have a working pressure greater than the pressure equivalent of the maximum depth of the dive plus 100 pounds per square inch. (psi).

The Project Dive Operations Team is identified in Table 2-2.

Table 2-2. Dive Team Personnel and Duties

NAME	DUTIES
Don Schwalback	DS, SUXOS, DPIC, UXO Diver, Standby Diver, Tender, Boat Operator
Patrick Oberley	UXOQCS Diver, Standby Diver, Dive Tender, Boat Operator
Kevin Borkowski	UXOSO, DS (alternate), DPIC (alternate), Standby Diver, Dive Tender, Boat Operator
Noah Esparza	UXO Team Leader, UXO Diver, Standby Diver, Dive Tender, UXO Technician III, Boat Operator
Jason Null	UXO Diver, Standby Diver, Dive Tender, UXO Technician III, Boat Operator
Ralph Gibeson	UXO Diver, Standby Diver, Dive Tender, UXO Technician III, Boat Operator
Derek Gaudin	Dive Tender, Standby Diver, UXO Technician I, Boat and Equipment Operator

If for some reason, a diver is unable to complete the project (e.g., health, family emergency, etc.), a qualified alternate diver will be substituted. Alternate diver qualification will be submitted to DESC prior to a new diver joining the dive operations.

The dive station will be manned by no less than a Dive Supervisor (DS), Diver, Standby Diver, and Tender. Under normal operations, one diver will be in the water at a time. The Tender will maintain constant contact with the diver, tend the tether and monitor potential hazards to the diver. A stand-by diver will be dressed and ready to assist in an emergency any time that a diver is in the water. The primary / DS / Senior Unexploded Ordnance Supervisor (SUXOS) is Don Schwalback. He is the person responsible for all dive operations.

The DS is responsible for all diving operations on this project. The DS is also the Designated Person in Charge (DPIC) for all aspects of the diving operations affecting the health and safety of dive team members. As the DPIC, the DS will be physically at the dive location where the dive operations are conducted. The Alternate DS (and alternate DPIC) is the UXO Safety Officer (UXOSO.).

The SUXOS, UXOSO, and UXO Quality Control Specialist (UXOQCS) will maintain the overall field management of the project site. The dive location is defined as the surface or vessel from which a diving operation is conducted.

The organizational structure and responsibilities of the Project Manager (PM), Scot Wilson, DS, UXOSO, UXOQCS, and SUXOS are included in the Work Plan (WP.). The Tetra Tech Diving Safety Officer (DSO), Patrick Tatman, is the person to whom the PM, DS, and UXOSO report for all diving and explosive safety-related matters, including near misses or event reporting. Should this approved DOP require modification, or should any of the diving procedures or activities change, any changes must be approved by the PM, Tetra Tech DSO, and procedurally as outlined in WP.

Support for boating operations (boats and equipment operators) will be provided by a subcontractor, Global Remediation.

Prior to mobilization, personnel records will be reviewed by the DSO, PM, DS and confirmed by the UXOSO to ensure that dive personnel has the appropriate training, licenses, certifications, and experience and that all are following the regulations. Copies of certifications/qualifications will be submitted for review two weeks prior to beginning dive operations, and copies will be maintained on-site and available for review by DESC representatives. The relevant personnel requirements for intrusive underwater activities at CRP will include the following:

- Workers who may be exposed to contaminated media will have completed 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certification, 8-hour HAZWOPER refresher certification as appropriate, and medical monitoring set forth in 29 Code of Federal Regulations (CFR) 1910.120. Workers who are not in direct contact with contaminated media will be exempt from this requirement. Exempt workers include Quality Assurance representatives and project management, if they are protected from exposure to contaminated media and remain outside the exclusion zone (EZ) for intrusive activities.[1]

- Divers will meet or exceed the minimum qualification IAW DDESB Technical Paper 18.
- Site supervisors must successfully complete the Occupational Safety and Health Administration (OSHA) 8-hour HAZWOPER Supervisor Course.
- Diver personnel has completed the OSHA-approved basic 40-hour health and safety training HAZWOPER course, annual refreshers of the same, military diver course for the apparatus utilized on-site, oxygen administrator, first aid, and cardiopulmonary resuscitation (CPR). Field personnel, required training, and the most current completion date of training are presented in a separate stand-alone document submitted to DESC and are not included in this DOP.
- Divers will meet or exceed the requirements of Engineering Manual (EM) 385-1-1, Section 30.A.0505 through 30.A.09.
- All workers will be required to read and understand the WP, Health and Safety Plan (HASP), DSPM, Emergency Management Plan, Activity Hazards Analysis (AHA), Standard Operating Procedures, and daily safety briefings will be completed as work.

[1] [1] 29 CFR 1910.120(e)(3)(i) defines employees who are required to have 40-hour HAZWOPER training. It requires workers "…engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards…" to receive 40 hoursof HAZWOPER training. An OSHA Interpretation Letter dated November 19, 1991 states that "if potential for exposure is extremely unlikely the standard would not apply." Employees protected from exposure and that remain outside of the exclusion zone during intrusive operations are extremely unlikely to be present.

This section provides information on the anticipated diving and support equipment to be utilized at CRP.

3. EQUIPMENT

3.1 DIVE EQUIPMENT, ACTIVITIES AND PLATFORMS

The diving method for this project will utilize SADS, SCUBA and SSA where appropriate. The associated equipment and requirements to support SADS and SCUBA operations:

- Divers will wear appropriate thermal protection and PPE consisting of a wet suit or dry suit and sufficient undergarment layering for warmth for the anticipated diving conditions as required. Impermeable gloves, hoods, and boots will also be worn. Overalls may be used to protect diving equipment and divers from exposure to TLM.
- Intrusive investigation diver's gloves will be impermeable, and the outer layer will have Kevlar (or suitable equivalent) palm lining for the handling of debris, with potentially sharp edges of the debris being investigated.
- Professional grade diving mask (optional)
- Swim fins (as required)
- Dive knife
- Weight belt and weights
- Buoyancy compensator having a manually activated inflation source, an oral inflation device, and an exhaust valve. (SCUBA operations)
- Primary and secondary regulator system with pressure and depth gauges
- Dive light
- Compass
- Safety harness positively attached to buoy, tending line, or SADS
- Minimum 80-cubic-foot compressed air cylinder (having passed the visual and hydrostatic test) filled with certified Grade D breathing air (diver carried or SADS).
- Minimum 30 square feet bailout bottle for emergency use pressurized to at least 90 percent of its working psi rating and equipped with a separate first and second stage regulator (diver carried or SADS).
- Communication device (if not equipped with mask) or line pull signal capability, as well as a means of timekeeping.
- Surface emergency recall system on the dive boat

For SSA operations, the UXO divers are outfitted with the following equipment:

- Dive helmet or full-face mask (FFM) with umbilical adapter for communication system,
- Buoyant diver's umbilical with integrated primary air, pneumo, and comms
- Minimum 30CF30 cubic-foot tank secondary air source – bail/out,
- Diver visible pressure gauges for secondary air source (bail out),
- Emergency Gas Supply–switch over the manifold block (if FFM used and not integrated with dive helmet),
- Quick-release weight system,
- 5-point safety harness w/ jock strap, attachment, and positive buckling device for umbilical
- Appropriate thermal protection,
- fins (optional),
- knife,
- Submersible time keeping device,
- An auditory signaling device
- abrasion/protection for body, feet, and hands,
- an underwater metal detector,
- hand tools

Surface Supplied Air Dive Station on the support boat will include:

- Divers Air, High Pressure (HP) - K bottles (min 3 @ 1800 psi)
- Buoyant diver's umbilical with integrated primary air, pneumo, and comms (2 min)
- Air Control System – 2 Diver min - configured for HP with independent air source capability (two HP input)
- Topside comms and video systems
- Ladder – (Min 400 pounds rated and long enough to extend 3 feet below the surface if necessary)

The minimum support equipment to be utilized will include the following:

- Dive Flag
- Medical Kit
- Underwater Camera
- Current Flow Probe
- Oxygen Kit

- Marine Radio
- Fathometer
- Litter/Backboard
- Cellular Phone

All dive equipment used on this project is subject to a Diving Equipment Preventive Maintenance Program (see Section 13 of the DSPM). This program ensures that equipment is inspected and serviced to meet the manufacturer's maintenance interval. In addition, equipment will be maintained in compliance with the manufacturer's recommendations. Damaged or worn equipment will be repaired or replaced as required prior to being put into service.

All dive equipment and safety gear will be inspected daily before use. Damaged equipment will be taken out of service and repaired or replaced. After use, equipment will be cleaned (with light soapy water and rinse according to manufacturer instructions) and will be stored in a dry location when not in use. Diving inspection checklists (pre- and post-dive) are included in Attachment 11 of the DSPM.

3.2 PRE-DIVING ACTIVITIES

Pre-diving activities will include the following:

- The UXOSO will verify that all team personnel, including divers and supervisors, boat operators, and geophysical personnel, have reviewed site-specific HASP and any DOP training sessions and have reviewed the AHAs in Appendix B, and that copies of all certifications and training are on-site (prior to first dive and all new divers).
- The DS will hold a briefing each day to discuss personnel assignments, techniques, and equipment to be used, and the UXOSO will review the AHAs and emergency procedures.
- Diving equipment will be inspected each day by the divers and prior to the dive by the DS.
- Appropriate thermal protection will be worn under the dry suit if used.
- The DS will review the Dive Plan Brief (Attachment 1 in the DSPM) to ensure the proper checks are made and documented each day prior to starting dive activities.
- The Pre-Dive Checklist in Attachment 2 of the DSPM will be filled out daily by the DS prior to commencing diving activities. Daily before diving, and during diving, the DS will evaluate conditions such as temperature (water and air), tide (high and low), current speed/direction, wind speed/direction, sunrise and sunset times, and wave action (height and direction), as necessary. The boat operator will monitor the weather forecast or be in communication with the SSHO/UXOSO, who will monitor the weather forecast.
- The DS will ensure divers have not flown within 12 hours prior to a dive. The DS will ensure that no team members fly within 24 hours if previously exposed to hyperbaric pressure during multiple dive days.
- A working means of communication will be verified (cell phone and/or project radio between boats and the DS and SUXOS, and designated very high frequency radio channel)

before starting the project and daily to ensure that communications work in the area and that communications are working between the boat(s) and the other team members. The emergency contact list in Attachment A of this DOP will be on board each boat and in the project office.

- All emergency signals, including any communication recall, re-call commands, air/boat horn signals, hand signals, and line pull signals (see Attachment 8 of the DSPM), will be reviewed. The DS will use the diver(s) underwater communications system as the primary diver recall method. If the communications system is inoperative and the diver is tended, line pull signals will be the secondary diver recall method. The tertiary diver recall method will be the surface diver recall system if the above methods prove unsuccessful. If there is no response to these methods, the stand-by diver will then be used to recall, recover, or assist the diver.
- The physical condition of the divers will be checked.
- The anticipated hazards of the dive will be reviewed.
- Ensure a litter or backboard with flotation is available for emergency retrieval of an injured or unconscious diver onto the boat or, if diving is done from land entry, is immediately available onshore.
- Emergency procedures, contacts, and numbers will be reviewed, and a vehicle will be available at (or within proximity to) the designated evacuation site for transportation of personnel to the hospital if required.

3.3 DIVING PROCEDURES

The specific diving procedures are summarized below.

SADS:

- When the team arrives at the dive site, the boat coxswain will position the boat at the diving work zone as briefed by the DS and secure, place the motor in neutral or hold position as required. The divers will suit up, and don required diving, safety equipment, and gear.
- Prior to entry into the water, the DS will ensure the boat operator has the boat motor in the off or neutral position and that diver(s) are entering the water only when the propeller is off or not engaged. The DS will notify the boat operator when diver(s) or any diver tending, or diver buoy lines are not in proximity to the propeller and when it is safe to engage the propeller.
- A stand-by diver will be readily available on the dive boat in case of emergency.
- Diving will be discontinued if sudden squalls, electric storms, or any other condition exists that, in the opinion of the DS, jeopardize the safety of the team. At no time will diving operations be conducted in poor weather conditions.
- The boat will always be positioned between the divers and any potential hazard.
- A red and white “diver down” and a Code “Alpha” flag (international diver signal) will always be prominently displayed at the dive site during all diving operations. A Code “Bravo” flag will also be prominently displayed during intrusive investigation and recovery operations.

- All dives will be planned “no decompression” dives during this project using the USU.S. Navy no decompression dive tables.
- If required, a ladder must extend a minimum 3 feet below the surface of the water, and handrails above the diving platform will be provided to assist the divers on entry and exit from the water (inflatable boats are exempt from this requirement).
- The propeller(s) of the dive vessel will be verified to be in the neutral position or switched off before the diver(s) approach the dive boat and exit the water.
- The diver dons the FFM, will enter the water, and with the SADS positively attached, wade over to the previously marked anomaly targets.
- If the FFM is removed, the diver may use the attached surface radio on the SADS in the voice-activated mode to communicate with the DS when on the surface during the initial reacquisition of the anomaly target.
- Once the diver has reacquired the anomaly target or entry to the assigned transect, and conditions (depth) required him to break the surface of the water to conduct the investigation and excavation, the diver will contact the DS and report “leaving surface”.
- Once the diver has left the surface, the diver will do a communications check with the DS on the underwater communication system before beginning work, and then normal dive communication protocol will be followed.
- If the diver encounters MEC during the investigation, the diver will contact the DS to receive acceptable to move approval if identification is confirmed. If identification cannot be confirmed, he would surface, return to the platform or boat to confer with the DS and UXOSO. Additional reconnaissance will be conducted until a positive identification and confirmation of status can be made by the DS and UXOSO IAW the WP.
- Once excavation, investigation, and recovery of the anomaly target is complete, diver will surface and complete reporting on the target using the surface radio on the SADS if necessary to ensure all pertinent information is obtained.
- Diver will wade over to the next target or continue the transect and repeat this process.
- If confirmed to be MEC and if it is categorized as acceptable to move, the MEC will be moved to a temporary collection point at a designated collection buoy or transported to an established collection point on shore IAW the ongoing munitions response operations. The land based UXO Team will take possession of all MEC/MPPEH, munitions debris (MD,), and non-munitions related debris (NMRD) targets brought ashore and will manage and process them. In such cases, the DS and UXOSO must concur and agree with the UXO Divers identification, risk determination and document this decision in writing prior to movement of the MEC.

SCUBA/SSA:

- When the team arrives at the dive site, the boat coxswain will position the boat at the diving work zone as briefed by the DS and secure, place the motor in neutral or hold position as required. The divers will suit up, and don required diving, safety equipment, and gear.
- Prior to entry into the water, the DS will ensure the boat operator has the boat motor in the off or neutral position and that diver(s) are entering the water only when the propeller is off or not engaged. The DS will notify the boat operator when diver(s) or any diver tending, or diver buoy lines are not in proximity to the propeller and when it is safe to engage the propeller.

- A tended stand-by diver will be readily available on the dive boat in case of emergency. Diving will be discontinued if sudden squalls, electric storms, or any other condition exists that, in the opinion of the DS, jeopardize the safety of the team. At no time will diving operations be conducted in poor weather conditions.
- The boat will always be positioned between the divers and any potential hazard. For SSA operations, the boat will be anchored and secure. Live boating will not be permitted during SSA operations. DS will ensure approval by the DSO for live boating during SADS and SCUBA operations.
- A red and white "diver down" and a Code "Alpha" flag (international diver signal) will always be prominently displayed at the dive site during all diving operations. A Code "Bravo" flag will also be prominently displayed during intrusive investigation and recovery operations.
- All dives will be planned "no decompression" dives during this project using the U.S. Navy no decompression dive tables.
- If required, a ladder must extend a minimum 3 feet below the surface of the water, and handrails above the diving platform will be provided to assist the divers on entry and exit from the water (inflatable boats are exempt from this requirement).
- The propeller(s) of the dive vessel will be verified to be in the neutral position or switched off before the diver(s) approach the dive boat and exit the water.
- Once the diver has left the surface, the diver will do a communications check with the DS before beginning work, and then normal dive communication protocol will be followed.
- Once diver has reacquired the anomaly target, they will contact the DS and begin work on the anomaly target.
- If the diver encounters MEC during the investigation, the diver will contact the DS to receive acceptable to move approval if identification is confirmed. If identification cannot be confirmed, he would surface, return to the boat to confer with the DS and UXOSO. Additional reconnaissance will be conducted until a positive identification and confirmation of status can be made by the DS and UXOSO IAW the WP.
- Once excavation, investigation, and recovery of the anomaly target is complete, diver will complete reporting on the target using the underwater communication system to ensure all pertinent information is obtained.
- Diver will surface and will swim or be transported over to the next target or continue the transect and repeat this process as anomalies are encountered.
- If confirmed to be MEC and if it is categorized as acceptable to move, the MEC will be moved to a temporary collection point at a designated collection buoy or be transported to an established collection point on shore IAW the ongoing munitions response operations. All MEC, MPPEH, MD and NMRD brought ashore will be managed and processed as outlined in the WP. In such cases, the DS and UXOSO must concur and agree with the UXO diver's identification, risk determination and document this decision in writing prior to movement of the MEC.

3.4 POST DIVE ACTIVITIES

The DS will check the physical conditions of the divers between rotations and/or at the end of the shift. Any adverse health problems, however minor they may seem (including any rashes, itching, etc.), must be reported to the DS and UXOSO as soon as the diver has knowledge of the condition.

Additionally, all divers will report conditions that could present a potential hazard to the divers so appropriate measures can be taken to remove or minimize the potential for exposure. Additional Post-diving procedures are summarized below.

- Upon completion of each diving operation or at the end of each day, a dive team debriefing will be conducted by the DS.
- The DS must follow the Tetra Tech Post-Dive Checklist in Attachment 3 of the DSPM.
- Team members will clean and stage equipment for the next day’s diving event.
- The DS will complete the Tetra Tech Working Dive Log for each dive (see Attachment 6 of the DSPM).
- The DS will forward copies of the Working Dive Log to the UXO/ DSO.
- Information from the daily dives reviewed and progress evaluated. Plans will be made for the next day’s diving activities.
- Upon completion of the project or weekly, all Working Dive Logs will be recorded by the DS on the Dive Smooth Log (Attachment 7 of the DSPM).
- This log will be submitted to the PM for inclusion in the project files and submission to the client with a copy to the UXO/ DSO for the Tetra Tech files.

3.5 PLATFORMS

During all operation phases, the diver will be walking/wading in from the shore, working off the MK3 zodiac inflatable dive boat or Global Remediation dive support vessel. During operations, one of these vessels will be designated as the safety boat.

This section provides the required tasks for intrusive underwater activities at CRP.

4. TASKS

4.1 TASK 1 MOBILIZATION AND DEMOBILIZATION

Once pre-mobilization activities are complete, the dive crew and all associated materials and equipment necessary to perform the intrusive underwater activities will mobilize to CRP. The personnel and operations-specific equipment are summarized in Sections 2 and 3.

Demobilization of all diving-related personnel and equipment will occur after all intrusive underwater objectives have been safely completed and accepted by DESC.

4.2 TASK 2 DOCUMENTATION

Tetra Tech will prepare all required diving-related documents and plans for review by APEX and DESC. All plans will be approved by SCDHEC prior to mobilization to CRP. Required documents include the safety, pre and post-dive checklists, and dive logs from the DSPM and this DOP with its attachments, including an Emergency Management Plan and AHA. These documents will be available on-site during the field work.

4.3 TASK 3 CRP REMOVAL ACTION

The goal of the removal action is to locate and remove MEC from within the cofferdam footprint. The Dive Operations Team will perform underwater mag and dig of all anomalies encountered using manual search pattern techniques described in the DSPM. Each anomaly identified will be manually investigated. The maximum depth that the divers can safely hand excavate an anomaly will be three feet below grade level of the river bottom. If additional excavation depth is required, it will be implemented using mechanical excavation techniques, which would require approval and modification of DOP.

This section details the procedures to be followed during diving operations and the conditions anticipated while conducting intrusive underwater activities.

5. DIVE OPERATIONS

Diving operations shall be performed IAW with USACE EM 385-1-1, Section 30. If for any reason, the DOP is altered in mission, depth, personnel, or equipment, the Tetra Tech DSO will be contacted to review and accept the alteration prior to actual operation.

Direct communications between the dive site, project office, DESC representative, Tetra Tech DSO and other involved personnel will be via cell phone. Divers will have communication with the surface, and diver-to-diver. The DS will positively control diver movement within the designated work area. Divers will be monitored by thru-water communication system.

Required dives as outlined in EM 385-1-1 30.A.07 and emergency drills may be required and will be conducted prior to the commencement of field operations.

5.1 CRP REMOVAL ACTION

The goal of the removal action is to locate and remove MEC from within the cofferdam footprint in two separate areas, as shown in Figure 1-3. The Dive Operations Team will perform an underwater mag and dig of anomalies encountered. Each anomaly identified will be manually investigated not to exceed a depth of 33 feet or to bedrock, whichever is encountered first. Removal of MEC from the area within the coffer dams will be done after the water has been removed under a separate effort covered under a work plan for the dry land portion of the MEC clearance.

Divers will gather information describing the source of each anomaly, including the following: item description, item weight, MEC condition, MEC nomenclature, bottom type/condition, and any other notable features. Acceptable to move MEC and MD will be transferred to land for final disposition. Unacceptable to move MEC will be detonated in place. Non-munitions-related debris will be left in place during this task.

Each MEC or MD item found will be marked using a global positioning system (GPS) unit to an accuracy of +/- 36 inches. Once an item has been positively identified, and determined acceptable to move, it will be relocated within the land portion of the project area. The final explosives safety status of a discovered MEC item as acceptable or not acceptable to move will be made by the SUXOS-qualified DS in consultation with the diver who investigated the item. Information such as the munition type, nomenclature, condition, and surrounding environment will be considered when determining if an item is acceptable to move or not.

Divers will use an all metals locator along grid lines established as part of the stationary jackstay method described in the DSPM. Each target anomaly location will be manually investigated and resolved not to exceed three feet in depth below the river bottom. The anticipated maximum depth of dives is 30 feet of fresh water (ffw). Divers will be utilizing a "no decompression limit" of 30 ffw for a maximum bottom time of 371 minutes.. A maximum daily dive bottom time for any diver will not exceed 300 minutes.

Munitions Constituents (MC) sampling of the sediment is not required for this field effort. Should MC sampling be needed, it may be conducted by divers either during the removal process or as a separate dive. If sediment sampling is needed, the DSDS will coordinate all underwater sampling activities.

At the end of each diving day, all data, including field notes, site photographs, and positioning data will be consolidated and submitted to the Tetra Tech PM.

5.2 DIVING CONDITIONS

The Dive Operations Team will perform all assigned tasks during the daytime within allowed current restrictions. General factors that affect diving operations include:

- Surface conditions – No diving will be performed if the surface conditions do not permit the diver to maintain depth control. Dive operations will be suspended at Beaufort scale Sea State 3.

- Boat Traffic – Anticipate some boat traffic during the operation period. Whenever boat traffic is present in the vicinity of diving operations, the Tetra Tech safety boat will keep other boats away from the area of dive operations. The safety boat will be positioned with visibility of the dive operation and avenues for approaching boats. Communication will be maintained between the safety boat and dive location. If possible, the safety boat will divert boat traffic around the EZ. If a boat enters the EZ the DS will be notified and will immediately halt intrusive operation until the boat is safely outside of the EZ.

- Underwater conditions – Shallow dives are heavily influenced by the surface conditions and may impact diving operations. No dives will be performed if conditions do not permit the diver to maintain depth control. The DS will have the ultimate decision to cease diving operations if unsafe conditions occur.

- Visibility – Visual survey will be suspended when nominal visibility is less than 1 foot. A tactile survey with tethered divers may be conducted if visibility is degraded below 3 feet.

- Water Temperature – Thermal protection for the divers will be provided by a wetsuit or dry suit, as needed, to ensure diver protection and comfort. Divers will choose dive dress, and selection will be approved by the Tetra Tech DS/SUXOS.

- Currents – Prior to conducting dive operations and prior to deploying any divers, the DS will measure current velocity using an FP 211 Global Flow Probe or similar instrument. If currents exceed 1-knot, SADS/ SCUBA divers will not be deployed, and dive operations will be continued after the team switches the diving method to SSA.

5.3 SITE HAZARD CHARACTERIZATION

The primary hazards associated with diving include drowning, dive-related illnesses (e.g., arterial gas embolism and barotrauma), hypothermia or heat stress, hazardous areas, munitions-related explosive hazards, encountering dangerous animals (e.g., venomous snakes), severe weather, and being struck by surface vessels. These hazards, as well as boating-related hazards, heavy equipment, and other physical hazards, are described below and referenced to the appropriate section of the HASP. In addition, the hazards and mitigation strategies to follow to minimize potential injuries during diving operations are also addressed in AHAs, which are included as Appendix C to this Dive Operations Plan. As stated before, the boating AHA in the HASP will also be reviewed by all team members prior to the start of the diving activities. Before beginning work, all site personnel will be informed of these hazards and the means that will be taken to control them. In addition, the full requirements of the HASP will be reviewed with all site personnel.

5.4. DIVING HAZARDS

The DSPM states that anyone on the dive team can stop work if they feel that the work environment is or may become unsafe. Prior to diving, the DS and UXOSO is responsible for examining the dive site to identify potential hazards (see Section 15 of the DSPM).

5.4.1. Slips, Trips, and Falls

There is a potential for site personnel to fall while walking to and from the dive boat and while onboard the dive boats. Carrying loads (e.g., SCUBA air tanks) while suited up in diving equipment can be cumbersome and easily result in a loss of footing. In addition, beach staging and launching areas are often soft and uneven, which can result in poor footing. These concerns will be addressed by monitoring the loads being transported and staging equipment to the extent practical prior to donning of diving gear. The dive boat deck and other surfaces can be slippery and uneven or be limited in space for maneuvering or hindered by lines and other equipment on board. Good housekeeping will be maintained in work areas, and workers will wear sturdy deck shoes on waterfront, structures, and on boats.

5.4.2. Drowning

Falls overboard from boats or structures can result in drowning, and diving operations can result in drowning. The requirement to use personal flotation devices on piers and boats is described in the HASP and in each AHA.

Drowning hazards during diving operations could result from running out of breathing air, a medical emergency of a diver, or equipment malfunction while underwater. Procedures in this plan will be followed to minimize the potential for drowning under these scenarios. Such procedures include regular gear and equipment inspection, servicing, and maintenance of dive gear; re-call procedures to manage the dive bottom times; use of certified Grade D breathing air; diver-carried reserve air supply for emergencies; dive team configuration and buddy system observation; and evaluation of diver fitness through the Tetra Tech medical surveillance program. Divers will terminate their dives when a minimum tank pressure of 500 psi is observed.

5.4.3. Diver-Related Illnesses

The maximum planned depth of the dives during this project is 15 feet, and the average depth of dives is anticipated to range from 1 to 10 feet. All dives at this site will be planned "no decompression" dives. At these depths, arterial gas embolism, shallow water blackout, or barotrauma is a primary risk if divers' surface improperly, run out of breathing air, or do not follow the safety precautions. These illnesses can be prevented by following the procedures in this plan and those in the DSPM (Attachment D). In addition, equipment for the dive team will include emergency oxygen, which can only be administered by qualified persons for diving emergencies. As a precaution, the location and telephone numbers of the recompression chamber in the local area will be available in the project trailer and on the dive boats.

5.4.4. Thermal Stress

The likelihood of this occurring depends on environmental conditions, the level of work activity, and the control measures that are used to manage body heat (work-rest cycles, physical conditioning, and wearing of protective clothing, such as wet suits or thermal garments under a dry suit).

Appropriate control measures will be taken to manage thermal stress concerns, as described in the Heat and Cold Stress Monitoring Plan if applicable. The DS will monitor water temperatures in the work area and will monitor the effectiveness of the personal protective gear, and modify these controls as needed to provide for diver safety and comfort. Rotation of diver personnel may also be used as necessary to allow divers to warm up between dives. In addition, ambient air temperatures will range depending on the season. Workers could be exposed to thermal stress from hot or cold temperatures at the surface, including the effects of wind. If wearing a dive ensemble on the surface, workers could also have heat stress effects on warm days or under direct sun. Ambient air temperatures and wind conditions will also be monitored by the DS, and appropriate control measures will be taken to manage these stress concerns, as described in the HASP. Shade for surface support staff on boats may be required and will be implemented as necessary (e.g., Tarp or Bimini top on boat).

5.4.5. Severe Weather

Severe weather (flash flooding, strong winds, or thunderstorms, including associated lightning) could occur. Severe weather hazards for marine work are addressed in the HASP. Weather conditions and water conditions will be monitored before and during dives, and weather that is determined hazardous to boating and/or diving operations will result in halting of those operations at DS direction.

5.4.6. Boating

Operating boats or vessels on the water carries the risk of having a crew member fall overboard and possibly drown, striking or being struck by other vessels operating in the area, losing power or steering, and drifting into hazardous areas (e.g., shore, piers), or onboard fires or other vessel emergencies. The risk of a boating accident can be reduced by ensuring the boat operators are experienced, and when applicable, licensed; operating the vessel in compliance with U.S. Coast Guard rules and regulations; maintaining the vessel in good mechanical order; avoiding bad weather and dangerous seas; and ensuring emergency equipment is available on board (life vests, life rings, lifeboats, fire extinguishers, communication equipment, first aid equipment, etc.). The DS will discuss safe boating near diving operations in the diving safety brief. All dive team members will be trained in first aid, CPR, and emergency oxygen administration through the American Red Cross, Divers Alert Network, or equivalent course. A first aid handbook will be available on-site for reference as needed.

All work conducted from small vessels will comply with Tetra Tech Procedure HSE 1-10, Working Over or Near Water, and applicable U.S. Coast Guard regulations. The boat operator will be responsible for the safety of all personnel on the boat and for the integrity of the vessel and its safety equipment. The boat operator will have successfully completed a boating safety course meeting the criteria of the U.S. Coast Guard Auxiliary and National Association of Safe Boating Law Administrators or equivalent, and will have motorboat handling training, based on the type of boat the operator will use and be designated boat operators by their employer. A Boating Pre-Operation Checklist is included in Attachment 11 of the DSPM.

5.4.7. Boat Strikes

Divers could be struck by boats, including propellers if engaged and operating. In addition, other boats could come into the work area where dive operations are being conducted. To minimize the potential for injury to divers from project boat traffic, work zone controls will be established during diving operations. A red and white “diver down” flag will be displayed at the dive site. During the intrusive investigation, a code “bravo” flag will be added. An explosive arc EZ will also be established to maintain safe team separation and to keep unauthorized personnel a safe distance away from active operations, including non-essential site personnel that could come into the area.

Live boating is not authorized without specific acceptance by the DSO. When divers enter or are retrieved from the water, all motors will be in the neutral position or in the off position so that potential strikes from propellers do not occur.

5.4.8. Explosive Hazards

Non-UXO-qualified employees or non-essential subcontractors will not be authorized in the EZ during underwater anomaly reacquisition, investigation, identification, and removal operations. Site access and enforcement of diving restrictions will be coordinated by the DS and SUXOS following the requirements and procedures in the IRA, Interim Removal Action, Quality Control Plan (QCP,), the Explosives Safety Submission, and the HASP, as well as this DOP.

A significant challenge to the diving operations in the Congaree river is the soft sediments, which can negatively impact the diver's visibility, unnecessarily release, and possibly spread contaminates when disturbed. Divers used in this operation will have extensive training and experience in standard diving techniques (e.g., buoyancy control) and in MEC removal operations.

5.4.9. Biological Hazards

Biological hazard mitigation is described in the Biological Hazards section of the HASP.

5.4.10. Underwater Obstacles

Underwater obstacles consist of concrete, metal, and other debris in the footbridge area; this debris may be present in and on top of the sediments. This debris can pose entanglement hazards to divers, or if divers are working around large debris, debris could shift and may trap a diver. Each location where divers will work will be evaluated for debris hazards and safety concerns. Penetration dives are not authorized. Divers will not position themselves underneath or within voids in debris or dig underneath large debris during this task and will observe debris for sharp edges that could cut dive suits or equipment, and entanglement hazards that equipment could become snagged on.

5.5. OTHER HAZARDOUS CONDITIONS

Other hazardous conditions, though not as likely to occur during the diving activities as the above, include:

- Electrical Shock – Electrical shock is rare under or in the water but may occur when using power equipment underwater or topside. A ground fault circuit interrupter must be used with electrical equipment employed on the boat, both on the surface and in the water.
- Bacteria – Divers could encounter potentially unpleasant forms of pollution in the Congaree River.
- Pollution – TLM and other contaminants are present in the sediments in the Congaree River. These contaminants should not pose a risk to divers performing work in protective SCUBA gear due to the protection the gear provides and because most sediment on diver's suits will wash off in the water column when resurfacing to the boat. Other potential contaminants could

include contact with munition constituents if ruptured DDEC is found and handled during intrusive investigations. Divers' gloves will help prevent skin contact with any ruptured items found during diving activities. In addition, it is possible that other unforeseen contamination could be discovered (e.g., unknown sheen or discoloration of the water, drums, or other potentially hazardous material) during the investigation. If unanticipated contamination or hazards are discovered, they will be reported by the DS to the PM, the Safety and Health Manager (SHM), UXO/DSO, and the Project Environmental and Safety Manager. If contamination gets onto the diver, the SHM will be notified, and the process for decontamination and follow-up will be established.

5.6. COVID-19 GUIDANCE FOR DIVING OPERATIONS

Diving operations will follow the applicable recommended guidelines outlined by the Association of Diving Contractors International (ADCI). The following general protocols will be implemented along with the current Federal and State guidelines:

- Ensure project team members are not infected before mobilization and during project execution.
- A means and equipment to deal with a possibly infected individual to prevent the spread to other team members.
- Evacuation plan should an individual's condition worsen, such as dock facility and medevac via boat or helicopter.
- Daily ongoing procedures to reduce the risk of exposure to the crew to include but not limited to social distancing, personal hygiene, and equipment cleanliness/sterilization.
- Verifying that items such as project tools and equipment are not contaminated.
- The single greatest point of contamination risk for this task is via the Diving helmet, FFM and second stage regulators on the SADS or SCUBA equipment. Divers will be assigned or verified to have individual FFMs and regulators. The corporate dive helmets will be sanitized before each diver's use. They will be responsible for keeping clean and returning company equipment when the project is complete. Additionally, all common area project equipment will be cleaned daily IAW project HASP guidance.

5.6.1. COVID-19 Hygiene Measures for Diving Equipment

The following recommended hygiene measures will be implemented during post-dive activities. Records of cleaning activities should be logged and retained.

The USU.S. Navy recommends the use of MadaCide FD for diver-worn equipment. MadaCide disinfectant is a more aggressive disinfectant and requires less time for cleaning. MadaCide FD is a "fast drying" agent, and no wiping or rinsing is required. Once the agent is applied and allowed to dry, the component is ready for use. This agent is recommended for use on all dive helmets, BIBS, and mattresses (Surface Diving Decompression Chamber). The ADCI publication outlining these COVID-19 measures will be available on-site. The DS, SSHO, and team members will be familiar with the protocols and response measures outlined in this guidance that are applicable to this project task.

5.7. QUALITY CONTROL/QUALITY ASSURANCE OVERSIGHT

The QC process for the target investigation will consist of a daily check of the real-time kinematic positioning (RTK) GPS system by comparing the RTK GPS location to a known location (control point) and documenting the results as outlined in the project QCP. The GPS location must read within 6 inches of the control point, or it will be deemed a QC failure. Each handheld metal detector will be checked daily by passing it over a known metal object at the designated functional check area. The handheld detector must produce an audible or visual indication when passed over the item. The UXOQCS diver will conduct QC dives on a total of 10% of each grid. The UXOQCS may designate an alternate QC diver for any days that the UXOQCS diver does not dive. If the UXOQCS diver locates any item larger than a 37mm37-millimeter projectile, it will be considered a QC failure for that grid.

Oversight of field activities may be requested by offsite DESC, SCDHEC, or other stakeholders. At least 48 hours prior notice will be given to Tetra Tech by those requesting oversight for purposes of coordination.

It is anticipated that DESC will have an on-site representative assigned in a safety and quality oversight role and may also be present during diving operations. If there is a need to answer questions, etc., the Tetra Tech DS will be the primary point of contact.

This section describes project key personnel and organization for diving activities

6. KEY PERSONNEL

6.1 DIVE TEAM

6.1.1 DIVE SUPERVISOR/SUXOS

The DS is responsible for all diving operations on this project. The DS is also the DPIC for all aspects of the diving operations affecting the health and safety of dive team members. As the DPIC, the DS will be physically at the dive location where the dive operations are conducted. The DS will also serve as the SUXOS and is responsible oversight of diving operations, field documentation, submittal of Daily Contractor Production Reports (DCPR) the Tetra Tech PM and DESC representative and assisting in the preparation of progress reports. The DS will report directly to the Tetra Tech PM and is responsible for leading and coordinating the day-to-day activities of the various resource specialists. Specific DS responsibilities are identified in the DSPM.

6.1.2 UXOSO/SSHO

The UXOSO and is responsible for ensuring safety and health procedures outlined in the HASP, AHAs, oversight of diving operations, field documentation, submittal of daily safety reports and inspections to the Tetra Tech PM, Tetra Tech health and safety, and DESC representative. The UXOSO is also designated as an Alternate DS (and alternate DPIC). The UXOSO will assist in the field management and preparation of progress reports.

6.1.3 UXOQCS Diver

The UXOQCS Diver and is responsible for ensuring QC procedures outlined in the QCP, field equipment calibration, oversight of diving operations, field documentation, submittal of Daily Quality Control Reports to the Tetra Tech PM, Tetra Tech QC Manager and DESC representative. Also, the UXOQCS will assist in the field management and preparation of progress reports.

6.1.4 UXO Diver

The diving UXO Specialist is the diver in the water. He is a U.S. Navy-trained diver that is UXO qualified with the proper diving and MEC experience to perform assigned tasks. Specific requirements and responsibilities for the position are described the DSPM.

6.1.5 Standby Diver

The stand-by diver meets all the requirements of the UXO diver and is dressed and prepared to enter the water to assist the diver anytime the diver is in the water. Specific requirements and responsibilities for the position are described in the DSPM.

6.1.6 Tender

A dedicated tender will be assigned to the diver while he is in the water. If the stand-by enters the water, the DS will serve as his Tender. The responsibilities of the Tender are described in the DSPM.

6.2. FIELD PERSONNEL REVIEW

The Field Personnel Review form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the DOP. It is maintained on-site by the SSHO/UXOSO as a project record. Each dive team member will sign this section after site-specific training is completed and before being permitted to work on site. In addition, the HASP and project AHAs will be reviewed and signed by all team members prior to beginning work.

FIELD PERSONNEL REVIEW FORM

I have read, or have been informed of, and understand the information contained in this DOP for the anomaly reacquisition, investigation, MEC, and MD recovery activities to be conducted at the CRP in Columbia, SC. I have the ability and obligation to stop work if I see any safety or procedural issue which may cause a personnel or equipment incident. I will comply with the provisions contained herein.

Name (Print and Sign)	**Date**

This section presents the Project Records and Reporting for intrusive underwater activities during the MEC clearance diving activates.

7. PROJECT RECORDS AND REPORTING

7.1. PROJECT RECORDS

7.1.1. Field Documentation

Field documentation includes daily reports for each day of fieldwork that present information pertaining to field activities. These reports will be maintained by the DS and include field notes, photographs, and positioning data. Reports are submitted to the Tetra Tech PM and the DESC representative.

7.1.2. Dive Logs

Dive logs/records will be completed for each diver on each diving day during intrusive underwater activities. The individual dive logs will document conditions and exposure to diving. Dive logs will be maintained by members of the dive team and crosschecked for completeness at the end of each day by the DS. They will be signed and dated by each individual diver making their personal entries, their dive buddy (if applicable), and the DS. Dive logs will be submitted to DESC upon completion of dive operations.

7.2. PROJECT REPORTING

Project reporting requirements include the preparation of reports that document all diving-related field activities completed at CRP. These will include draft/draft final deliverable project reports, as well as documents summarizing field activities. These reports will be based on project records that include field logbooks; discrepancy reports; and records of conversations, meetings, and correspondence.

This section provides references used to develop this DOP

8. REFERENCES

Association of Diving Contractors International (ADCI) 2020. COVID-19 Guidance for Surface Diving Operations, Revision 2. July 17.

DDESB2016 (Department of Defense Explosives Safety Board). 2016. TP 16. Revision 5 Methodologies for Calculation Primary Fragment Characteristics. December 19.

DDESB (Department of Defense Explosives Safety Board).). 2016. Technical Paper 18,, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities. September 1.

Department of Defense (DoD) Ammunition and Explosives Safety Standards. 2012. DoD Ammunition and Explosives Safety Standards DOD Manual 6055.09-M. February 28. Administratively Reissued August 4, 2010

Department of Defense (DoD). 20152015. DoD Instruction (DoDI) 4140.62, Material Potentially Presenting an Explosive Hazard. 20 August 20.

Dominion Energy South Carolina, Inc. (DESC). 2018. Congaree River Project Conceptual Plan for a Modified Removal Action Revision 1 – December 20212021.

Management and Technical Resources, Inc. 2013. Final Engineering Evaluation/Cost Analysis (EE/CA), Congaree River Sediments, Columbia, South Carolina. January.

NAVY (United States Department of the Navy). 2018. Diving Manual,, Volumes 1-5, Revision 7, Change A, Commander, Navy Sea Systems Command, Supervisor of Salvage and Diving. April 30.

OSHA (United States Department of Labor). 2011. 29 CFR; Subpart T, Commercial Diving Operations. Occupational Safety and Health Administration. December 27.

South Carolina Department of Health and Environmental Control (SCDHEC) 2013. Public Notice-Congaree River Project. August 21.

Tidewater Atlantic Research, Inc. 2012. A Terrestrial Remote-Sensing Survey of the Congaree River Below the Gervais Street Bridge, Phase IV Report, Columbia, South Carolina. February 8.

Tetra Tech (Tetra Tech, Inc.). 2021. Diving Safe Practices Manual. Corporate Policy DSP-01. February 15.

United States Army Corps of Engineers (USACE) 2013. Safety and Health Requirements Manual EM 385-1-97 (with Errata) May 17.

USACE (U.S. Army Corps of Engineers). 2014. Safety and Health Requirements. Engineer Manual (EM) 385-1-1, Section 30. November 30.

This page intentionally left blank.

ATTACHMENT A

EMERGENCY MANAGEMENT PLAN

This page intentionally left blank.

Note: *This Emergency Management Plan is to be used in conjunction with the Site Safety and Health Plan. Ensure that all personnel are familiar with the policies, procedures, and requirements outlined in both plans.*

Emergency Service (Ambulance, Fire, Police)—911

Columbia Fire Dept.
1800 Laurel St Columbia, SC
(803) 545-3700

Palmetto Health Richland
5 Richland Medical Park Drive Columbia, SC 29203
(803) 434-7000

Nearest Hyperbaric Chamber Facility

Palmetto Health Richland
5 Richland Medical Park Drive Columbia, SC 29203
(803) 434-7000

Divers Alert Network (D.A.N.)
Emergency +1-919-684-9111 Phone 1-800-446-2671

Poison Control Center
(800) 962-1253

DESC Project Manager
Rusty Contrael
Cell: (412) 721-6494
Email: rcontrael21@outlook.com

APEX Project Manager
William Zeli
Office: 412-829-9650 x5004
william.zeli@apexcos.com

Tetra Tech Project Manager
Scot Wilson
Direct : 360-626-3193
scot.wilson@tetratech.com

Nearest Hospital Information and Route

Name: Palmetto Health Richland
Address: 5 Richland Medical Park Drive; Columbia, SC 29203
Phone: (803) 434-7000

See the description and map of the route below.

Nearest Recompression Chamber

Name: Palmetto Health Richland Hyperbaric Medicine
Address: 5 Richland Medical Park Drive; Columbia, SC 29203
Phone: (803) 434-7000

From the Project Area, 9 min (3.2 miles)

Take US-176 W/US-21 N/US-321 N and US-76 E to Bull St

Head east on Gervais St/Gervais St Bridge toward Gist St 0.3 mi

Turn left onto US-176 W/US-21 N/US-321 N/Huger St 0.8 mi

Keep right at the fork, follow signs for US-21/US-176/US-321/Elmwood Ave

Continue onto US-176 W/US-21 N/US-321 N/US-76 E 0.9 mi

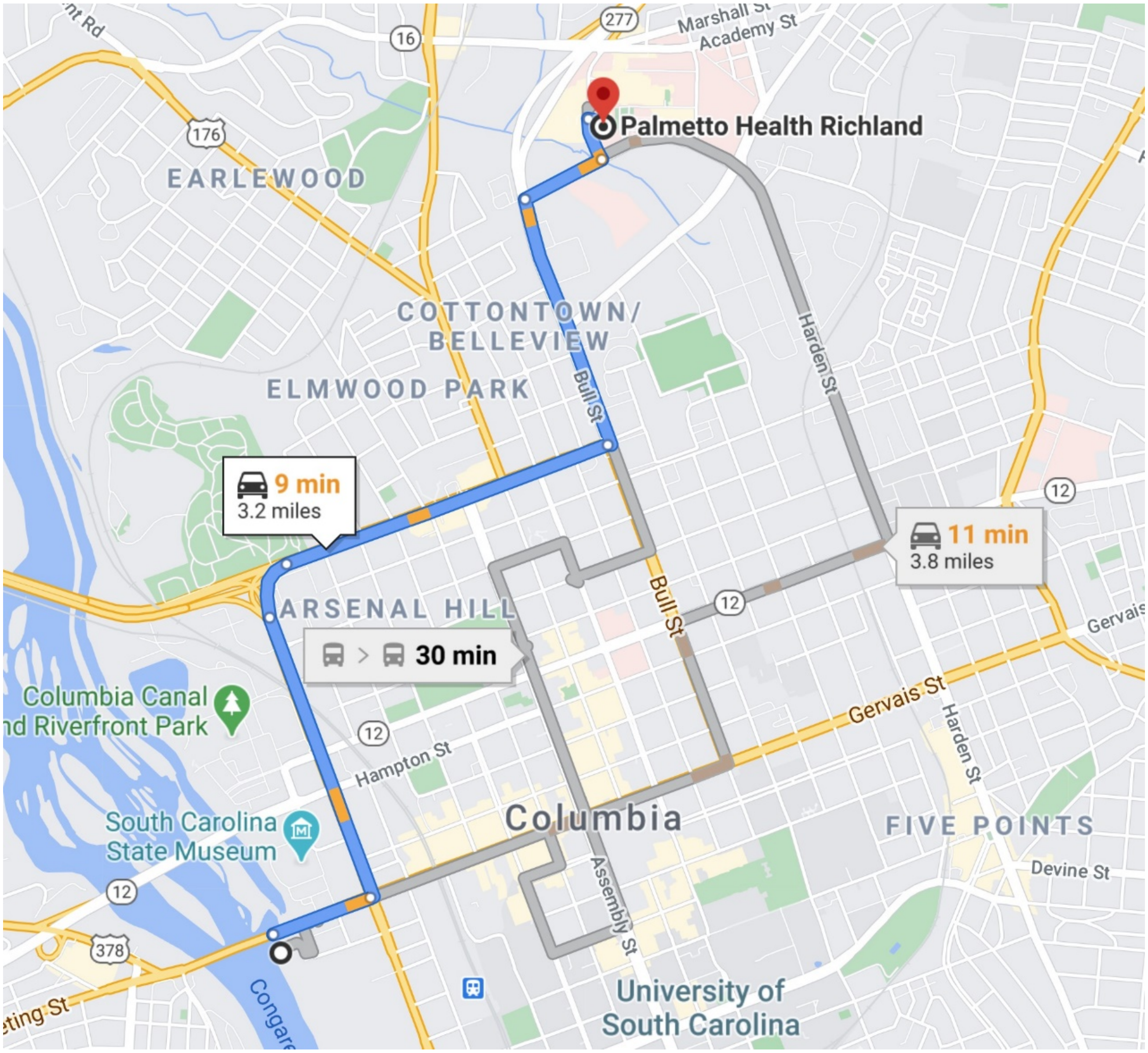
Continue on Bull St to your destination

Use the left 2 lanes to turn left onto Bull St 0.7 mi

Turn right onto Harden Street Extension (signs for Harden St) 0.2 mi

Turn left onto Medical Park Rd 0.1 mi

Arrived.



Hospital Route

Emergency Procedures

In every diving operation, the possibility of an accident occurring must be considered. The need for a prompt, decisive plan of action in an emergency is essential for the safety of all diving personnel. The Dive Supervisor (DS) will implement the following procedures for the respective situations described below.

1. **Buddy Separation**
   - The divers will look/feel 360 degrees around for his dive partner; and
   - Both divers will come to the surface with one hand above their head.
2. **Lost Diver**
   - Initiate diver re-call and wait one (1) minute for response;
   - Mark the last known position of the lost diver with a buoy to establish a reference point where searches can start;
   - Deploy the stand-by diver (DS direction) to swim after bubbles or to conduct a circle line search starting at the lost diver buoy;
   - Notify ship/boats in the area to look out for the lost diver;
   - Request emergency medical help and report the situation to DESC Project Office and Tetra Tech Corporate Offices; and
   - Ensure stricken divers recovered, get immediate, effective treatment.
3. **Loss of Air/Equipment Malfunction**
   - Signal dive partner and abort dive;
   - Buddy breath/activate reserve; and
   - Exhale to the surface.

NOTE: No diving will proceed until the equipment is replaced/repaired (with functional checks performed) and the Dive Supervisor has given the OK to proceed with the operation.

4. **Mechanical Injury**
   - Diver will inform the DS of any mechanical injuries, no matter how slight they may seem;
   - DS will rule out any doubt of decompression sickness; and
   - If immediate treatment is required, re-call all divers and transport to recompression chamber/emergency Room.
5. **Decompression Sickness (“The Bends”) or Arterial Gas Embolism (air embolism)**
   - Re-call all divers from the water;

- Arrange immediate transport of stricken diver(s) to chamber;
- Notify DESC Project Office and Tetra Tech Corporate Office of circumstances;
- Perform neurological exam and record on Tetra Tech Diving Safe Practices Manual (DSPM); and
- Treat for shock.

6. **Fouled Diver**
   - Diver will notify dive partner, if appropriate, otherwise will notify DS through line pull signals;
   - If only one diver is in the water, then the stand-by diver will assist the fouled diver under the direction of the DS;
   - Diver and dive boat personnel must remain calm; and
   - Take additional cylinders of air to the fouled diver, if needed.
7. **Explosive Detonation with Diver (s) in the Water**
   - Attempt to establish communications with the diver via tending line:
   - If communications are established with the diver, immediately re-call diver to the surface;
   - If no communications are reestablished, slowly pull the tending line to the surface to recover the diver. If the tending line is fouled, deploy the stand-by diver;
   - If the tending line has parted, mark the last location of the diver and begin a surface search of the area. If no contact is made, deploy the stand-by diver in the last known diver location and begin a systematic search of the area.
8. **Diver Emergency Recall**
   - If diver is tended use standard line-pull signals to re-call diver (See Attachment 4 of the DSPM);
   - If diver is untended, use diver audible (Metal-on-metal in the water) or mechanical re-call; and
   - Upon notification of re-call by any means, the diver will surface immediately.
9. **Injured Diver:** If a diver is injured and unable to enter the boat under his/her own power, the remaining team aboard the boat/platform (**DS**, Tender/assistant, etc.) will be used to assist or place the injured diver into/on the boat/platform or may hold onto the diver and use the boat/platform to get to the shoreline. Contact first responders immediately and render emergency first aid as necessary.
10. **Fire:** Fire extinguishers will be maintained ready at the dive site location. Only attempt to put out small fires as necessary to prevent injury or loss of life. Contact first responders immediately upon discovery. Also, see HASP submitted as part of the Work Plan (WP)**.**
11. **Inclement weather:** All diving operations will be suspended if lightning is located within 10 nautical miles of the dive site. During high winds greater than 30 miles per hour, boating and

platform operations will be suspended. Also, see HASP submitted as part of the WP.

12. **Medical Injury or Illness:** See Attachment 4 to the **DSPM** as well as the HASP submitted as part of the **WP**. Contact first responders immediately. Render first aid as necessary until an emergency medical team arrives.
13. **Critical Equipment Failure:** In the event of an equipment failure of a critical component of the dive operations, all dive operations will be discontinued until the equipment is replaced or repaired and the **DS** has given authorization for dive operations to continue.
14. **Injury/illness of surface crew:** If a severe injury or illness occurs while a diver is in the water, the diver will be **re-called** immediately to the surface. Diver will either enter the boat/platform to help render assistance or head to the shore and provide assistance as necessary.
15. **Dive Blow Up / Over Rapid Ascent to the Surface:** Depths of dives for the project are unlikely to produce a requirement for decompression during ascent. If a diver is believed to have ascended too rapidly, the **DS** will evaluate the situation to confirm that no decompression stop was required. Dive tables will be consulted. The diver will be observed on the surface for one hour. If symptoms of decompression sickness are observed or suspected, the diver will be treated for decompression sickness as described above.
16. **Loss of Communications:** If communications are lost between a tender and diver and cannot be regained quickly, an audible **re-call** signal will be sounded. If the diver does not surface in a reasonable amount of time after the audible re-call signal has been initiated, the stand-by diver will be dispatched to the last known location of the diver. If communications are lost between the diver and the T**ender** and cannot be regained quickly, the diver will surface immediately. The reason for the loss of communications will be investigated and remedied prior to the continuation of the dive.
17. **Emergency Victim Transportation:** If an injury or illness requires treatment beyond first aid, the victim will be transported to the appropriate medical facility, identified above (or as determined by first responders). The first aid-trained technician treating the victim will make the initial assessment related to the need for additional treatment. First responders will be notified of the situation through a call to 911. If the situation requires transportation by ambulance, the victim will be moved (if determined safe and necessary to do so) to a pick-up location where first responders can be directed. Two personnel will remain with the victim until emergency responders arrive. One will administer first aid and monitor the victim, and the other will maintain communication with the first responders. If it is appropriate or necessary for **Tetra Tech** to transport a victim for follow-up care, three personnel will accompany the victim. One will administer first aid and monitor the victim, one will drive, and the third will maintain communication with the treatment facility, as necessary.

FIRST AID FOR DIVING RELATED INJURIES

1. FIRST AID FOR INJURIES REQUIRING IMMEDIATE TRANSPORT TO A CHAMBER FACILITY

1.1 AIR EMBOLISM

Recognition - Usually occurs during or immediately after surfacing Symptoms (one or more of the following)

Disorientation or Fatigue Skin Itch

Chest Pain

Numbness, Tingling, Paralysis or Weakness Dizziness, Vertigo, or Ringing in the Ears Blurred Vision

Personality Change

Signs (one or more of the following)

Bloody froth from nose or mouth, Paralysis or Weakness Unconsciousness, Convulsions

Shortness of Breath or Cessation of Breathing Apparent Death

Note: Symptoms and signs usually appear within 15 minutes to 12 hours after surfacing; in severe cases, symptoms may appear immediately or even before the dive is completed. Delayed occurrence of symptoms is rare but can occur, especially if air travel follows diving. The quicker treatment begins, the better the chances of a full recovery.

Early Management

Cardiopulmonary resuscitation (CPR), if required

Open airway, prevent aspiration, and incubate if trained person available Give O^2; remove only to open airway or if convulsion ensue

- If conscious, give non-alcoholic liquids, place in a horizontal, neutral position
- Restrain convulsing person loosely and resume O^2 as soon as airway is open Protect from excessive cold, heat, water, or fumes
- Arrange emergency transport, send divers profile with the diver, and send all diving equipment for examination or have it examined locally.

1.2 DECOMPRESSION SICKNESS

Recognition - Symptoms usually appear 15 minutes to 12 hours after surfacing Symptoms (one or more of the following):

- Tired Feeling

- Itching
- Pain, arms, legs, or trunk
- Dizziness
- Numbness, tingling, or paralysis

Chest compression or shortness of breath Anything unusual after the dive

Signs (one or more of the following)

- Blotchy Rash
- Paralysis or weakness anywhere in the body
- Coughing Spasms
- Staggering or instability
- Unconsciousness
- Personality change

Early Management

Stabilize patient the same way as for Air Embolism

Arrange for emergency transport, send divers profile with the diver, and send all diving equipment for examination or have it examined locally

3.1 FIRST AID FOR INJURIES REQUIRING TRANSPORT TO A HOSPITAL FACILITY

3.2 PNEUMOTHORAX

Symptoms (one or more of the following)

- Pains in the chest
- Shortness of breath

Signs (one or more of the following)

- Shallow Rapid Breathing
- Cyanosis (blue skin, lips, fingernails)
- Possible crackling under the skin of the neck
- Possible mediastinal shift (heart sounds not in the usual place)

Emergency Actions:

Call for help and immediate transport

Mediastinal Emphysema (Lung overpressure accident)
Recognition - Always associated with pneumothorax

3.3 Symptoms (one or more of the following)

Pain in the chest (beneath the breastbone) Faintness

Shortness of breath

Signs (one or more of the following)

- Obvious difficulty breathing

Brassy change in voice

Emergency Actions:

- Transport to a medical facility for evaluation

3.4 DROWNINFG-NEAR DROWNING

Recognition

- Unconsciousness
- Lack of respiration

Cyanosis (blue skin, lips, fingernails)

Management

- Try to identify the time the victim was last seen breathing
- Assess ABC's airway, breathing, and circulation
- Removal of gear
- Transport to the boat or shore
- Immediate call for help and transport to facility Start CPR

3.5 OXYGEN TOXCITY (WITH CONVULSIONS)

Signs (one or more of the following)

- Decreased or loss of consciousness; followed by Convulsions

Symptoms (one or more of the following)

- Nausea Dizziness

- Ringing in the ears
- Abnormal Vision
- Confusion Prevention

Avoidance of gases with high O2 concentrations (as in Nitrox at inappropriate depth) Avoid CO2 retention that can precipitate O2 convulsions at any depth

If convulsions occur at depth, be prepared to treat near drowning and/or air embolism TREATMENT - Call for help and immediate transport

3.6 SEVERE TRAUMA OR LARGE PREDATOR INJURY (HEAD INJURY, LIMB INJURY DUE TO FALLS, EQUIPMENT CRUSH, PROP INJURIES)

- call for help and immediate transport
- open airway
- treat for shock on site and stabilize before evacuation
- face up neutral position
- direct pressure over bleeding wounds
- CPR if no pulse or respiration
- keep warm
- be mindful of the possibility of neck injury
- splint limb injuries call for help and immediate transport

3.7 SUSPECTED HEART ATTACK OR STROKE

- Call for help and immediate transport
- Treat for shock
- CPR if no pulse or respiration
- Keep warm
- Call for help and immediate transport

3.8 SEVERE ALLERGIC REACTION

- Remove any remnant of allergen (i.e., jellyfish tentacles, foreign material)
- Wash out wounds of injury with alcohol, vinegar, or water
- Call for help and immediate transport
- Treat for shock
- CPR if no pulse or respiration

- Keep warm
- Pain Relief, if available
- Transport to a medical facility for evaluation

3.9 STINGING FISHES (STINGRAYS, SCORPIN FISH)

- Immobilize
- Remove spine and debride (scrub the wound)
- Irrigate wound
- Soak in hot water (thermolabile toxin) 122 degrees F, for 30-90 minutes
- Call for help and immediate transport
- Treat for shock, hydrate

3.10 HYPOTHERMIA

- Keep the core temperature above 95º F
- Keep airway open
- Immobilize
- Wrap in blankets, preferably next to another person
- Basic life support, CPR, if needed
- Warm liquids, if alert, unless very cold - then avoid due to possibility of ventricular tachycardia (rapid, useless fluttering of the heart)
- Call for help and immediate transport

3.11 HYPERTHERMIA (HEAT EXHAUSTION DUE TO EXCESSIVE FLUID LOSS)

- Remove from source of heat
- Lower temperature (cool compresses at arterial points and head)
- Keep calm
- Keep airway open
- Call for help and immediate transport if unstable

3.12 HEAT STROKE

- Remove all clothing
- Cover with cool wet sheet
- Place in an air-conditioned area

- Cold packs to neck, scalp, groin, and armpits
- If convulsions occur, ensure the victim does not cause further harm to themselves
- Call for help and immediate transport

3.0 AID FOR INJURIES THAT CAN BE TREATED ON BOARD

3.1 NITROGEN NARCOSIS

Signs (one or more of the following)

- Inappropriate behavior at depth
- Ignoring hand signals and instructions
- Stupor or coma

Symptoms (one or more of the following)

- Inflexible thinking and attitude
- Decrease or loss of judgment
- False sense of security
- Lack of concern for safety
- Inability to think through problems
- Panic
- Near unconsciousness or loss of consciousness at depth

Treatment

- Ascend until free of symptoms
- Surface with a controlled ascent
- Transport to a medical facility for evaluation

3.1 CARBON DIOXIDE POISONING

Symptoms (one or more of the following)

- Rapid breathing
- Feeling of suffocation or shortness of breath
- Headache, nausea, dizziness
- Rapid heartbeat

Confusion and unclear thinking Signs (one or more of the following)

- Slowed responses

Muscle irritability (twitching) Loss of consciousness

- Treatment

Remove the cause (over-exertion, equipment failure, rebreathers, etc.) Stop and rest during early symptoms to avoid loss of consciousness Surface, Transport to a medical facility for evaluation

3.2 EAR DISORDERS

Middle Ear Barotrauma

- Keep quiet and calm
- Without DCS or rupture of the round or oval windows, give Benadryl 25 mg
- Transport to a medical facility for evaluation
- Discontinue diving until cleared by an emergency medical technician (EMT)
- Inner Ear Barotrauma
- Recognize round or oval window damage (loss balance, ataxia, tinnitus, deafness) Keep head up, and affected ear elevated
- Discourage straining
- Transport to a medical facility for evaluation
- EMT evaluation, no more diving until cleared by EMT

3.3 SEASICKNESS

The best medications have been found to be Meclizine, Bonine, Dramamine, and Trans-derm Scope.

- Keep your eyes on the horizon
- Stay on deck
- Keep yourself well hydrated with non-alcoholic beverages
- Try antacid tablets or lemon drops
- If diving, try to be the first diver in water.

ATTACHMENT B

ACTIVITY HAZARD ANALYSIS

This page intentionally left blank.

Activity Hazard Analysis (AHA) #1

Activity/ Work Task: Mobilization and Site Preparation (Dive Ops)	**Overall Risk Assessment Code (RAC) (Use highest code)**	**M**

Project Location: Congaree River, Columbia, SC

Contract Number:

Date Prepared: November 2021

Prepared by: Don Schwalback, Diving Supervisor

Reviewed by: Scot Wilson, PM

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA will consist of high visibility safety vest (in traffic areas) and hard hat (when working around heavy equipment and/or an overhead safety hazards exist), safety toed boots, safety glasses with side shields, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk** **H = High Risk**
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk** **L = Low Risk**

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
1. Arrival at Location	• Lack of Emergency preparedness and Health and Safety (General) before beginning work	✓ Get to know the location if not familiar. ✓ SSHO to locate the emergency hospital and ensure routes are correct as shown in approved WP. ✓ Conduct site orientation with the crew involved in mobilization tasking including establishment of laydown areas, unpacking and unloading and staging of materials and equipment and haul routes ✓ Review the APP and this AHA, and the Emergency Response Plan and document the training. ✓ Ensure communications are established and working properly among team members. ✓ Develop a plan for mobilization organization and tasking and emphasize communication ✓ Ensure emergency and basic safety equipment and PPE is located and available for use prior to starting site work. ✓ Use buddy system. ✓ SSHO will have site workers fill out medical data sheets that are included in an appendix to the APP ✓ Post the emergency evacuation routes and procedures as well as emergency contact list in a designated location until a permanent location is established at the field office trailer.	L
2. Unloading and initial staging of materials and equipment including set up of site office/shop.	• Vehicle operations from Tt or other tenant operations and delivery vendors could cause injury to personnel or others onsite	✓ Workers operating company or subcontractor vehicles will have a valid state issued driver's license and will be appropriately badged and cleared for entry per Installation requirements prior to entry. ✓ Any Commercial Driver's License (CDL) truck and trailers will be operated by CDL qualified drivers. ✓ Operate at safe speeds and obey local and facility-required traffic speeds (no more than 25 M.P.H.) and additional rules and restrictions to follow while on facility. ✓ Wear seat belt always when vehicle is in operation. ✓ Use chocks when parked on inclines. ✓ When motor vehicle except for auxiliary operation, is left unattended (operator is beyond 25 feet of view of vehicle), turn off the ignition, put the transmission in gear (park) and apply the parking brake. ✓ Yield the right-of-way to any emergency vehicles displaying a flashing light. Pull to right edge of road and stop until the approaching vehicle passes. Obey all signs. Yield to pedestrians. ✓ Use dedicated spotter and standard hand signals for backing operations. ✓ Wear class 2 high visibility vest when working around operating vehicle traffic.	L

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation			
Job Steps	**Hazards**	**Controls**	**RAC**
	• Ergonomic hazards such as sprains, strains, or back injury from lifting or repetitive actions	✓ Use mechanical lifting equipment or team lift when possible rather than by hand and tool methods. ✓ Do not bend at the waist, bend at the knees. ✓ Do not twist and turn while lifting. Keep the load centered and close to body. ✓ Do not lift more than 50 pounds (may be lesser for some workers) alone. ✓ Rotate tasks and take breaks when performing repetitive tasks and try to find the best position possible to perform the task.	
	• Slips, trips, and falls could lead to injuries	✓ Keep work areas free of debris and equipment in work paths. ✓ Follow good housekeeping in work areas. ✓ Correct hazards when seen, such as holes or other trip hazards. ✓ Conspicuously mark trip hazards that cannot be corrected ✓ The site trailer will be cribbed in level position. ✓ Tie down of the trailer will comply with EM 385 1-1, Section 04.A.03 requirements.	**M**
	• Handling sharp objects or using hand tools or knives could cause cuts, punctures, or scrapes	✓ Wear work gloves when handling materials that may be sharp or have sharp edges. ✓ Be familiar with the proper use and limitations of hand tools. ✓ Report even minor injuries to your supervisor for evaluation. ✓ Have a first aid kit available and have a minimum of 2 persons with first aid and CPR training onsite ✓ Ensure knives are folding type or have retractable blades.	**L**
	• Worker exposure to extreme temperatures and sunburn.	✓ Properly dress for the weather. ✓ SSHO to monitor weather and implement heat stress and cold stress controls as specified in the APP. ✓ Provide breaks for personnel to get either into cool (heat stress) or warm (cold stress) environment. ✓ Encourage a steady work pace. ✓ Ensure adequate potable drinking water is available. ✓ Know the signs and symptoms of exposure and keep an eye on your partner. ✓ SSHO to implement EHS 4-6, Temperature Extremes.	**L**
	• Severe weather can cause unsafe working conditions	✓ SSHO will monitor weather forecast at a minimum of two times per day or more. ✓ Outdoor work will cease during extreme weather conditions, such as electrical storms, high wind, heavy rain and extreme temperatures that present unsafe working conditions. ✓ Shut all equipment down when lightning is visible and wait for “all-clear” from the SSHO (30/30 rule). Take cover indoors or in vehicle or heavy equipment cab (fully enclosed cab only).	**L**

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	• Eye injuries from dust or debris or struck by	✓ Wear safety glasses with side shields always when working. ✓ If something enters the eye, do not rub. ✓ Set up portable eyewash for flushing of eye to try to remove object. Notify supervisor so eye can be monitored. ✓ If object still irritates or stays in the eye, seek medical attention as soon as possible. Follow up with eye exam is recommended any time an object gets into an eye since it is necessary to ensure object does not remain, even if it cannot be felt. ✓ To keep dust down, travel at slower speeds on unpaved roads and laydown areas. ✓ If required, water mist can be used to control dust on roads and in laydown areas.	**L**
	• Wind could make materials hard to handle	✓ Avoid handling materials that could respond like a sail (e.g., plywood) in wind. ✓ Position vehicles so that doors do not get caught by the wind when opened. ✓ Hang onto door when opening and closing in high wind. ✓ Open and close doors carefully in the wind and only open one door at a time.	**L**
	• Noise could cause hearing loss and make it hard to communicate	✓ Hearing protection is required when sound levels exceed 84 dBA continuously. ✓ This rule applies to personnel working near or on heavy equipment and any other sources of loud noise. ✓ Generators, if used will be quiet in operation or will be shielded to minimize noise generation in common work areas so that hearing protection is not required to work in the area.	M
	• Lack of proper illumination in work areas could cause hazards to not be recognized or eye strain	✓ During mobilization, if lighting is not yet set up, temporary lighting such as portable bright lumen flashlights may be necessary if ambient lighting is not sufficient, especially within the trailer. ✓ Work during daylight hours or provide adequate lighting source for work areas as specified in the APP Night Operations Lighting Plan (currently limited to daylight hours only) to minimize potential for injuries to occur from lack of visibility.	L
	• Fall hazards (falls from heights of 6 feet or greater)	✓ Utilize fall protection when working at heights 6' or greater. ✓ Ensure ladders are stable and secured appropriately. ✓ Utilize 3 points of contact when ascending/descending ladders, stairs, equipment, etc. ✓ SSHO to identify site fall hazards and ensure appropriate controls are in place if workers could be exposed to a fall.	M
	• Head injuries from struck by or falling objects	✓ Wear hard hat when overhead hazards exist and when working in areas with operating construction equipment. ✓ Do not position under any suspended load at any time.	M

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	• Contact with biting or stinging insects.	✓ Wear long sleeve shirts and long pants in areas where contact with mosquitos may occur. ✓ Use Environmental Protection Agency (EPA)-registered insect repellents with one of the following active ingredients: – DEET, picaridin, IR3535, oil of lemon eucalyptus or para-menthane-diol, or 2-undecanone. – Always follow the product label instructions. ✓ Workers will exercise caution when working in brushy or grassy areas, wood or debris piles, and recessed areas. ✓ Site orientation will include briefing on biological hazards associated with insects as well as local hazardous flora and fauna, signs and symptoms of exposure and precautions to take. ✓ Workers with allergies will let the SSHO know using the medical data sheet and will carry their own prescription medication as applicable. ✓ First aid and medical attention as required. Report any bites, stings, or rashes to the SSHO.	L
	• Electrical hazards could be present during tool use or during hookup of trailer	✓ Ensure that a certified electrician performs all electrical work to hook up office trailer to electrical power source. ✓ Electrician to properly ground systems in accordance with electrical code. ✓ Ensure that power cords are inspected and in good condition for use, that GFCIs are used properly, and portable generators are not overloaded. ✓ Ensure any power tools used are in good working condition and have third prong on cord or are double insulated. ✓ All live work requires arc flash protection. ✓ Contact SHM if there will be any live work so that additional precautions can be identified and incorporated into this AHA.	L
	• Injury from improper use of power and hand tools	✓ Maintain steady pace when using tools and take adequate rest periods. ✓ Use appropriate tools for the task and maintain tools in good condition. ✓ Wear leather work gloves when using tools. ✓ Avoid working too close to other workers. ✓ Inspect all tools for damage before each use, including electrical cords/ pneumatic hoses. ✓ Ensure double insulation on electrical tools. ✓ Train personnel in the proper use of hand tools. ✓ GFCI required for all connections to outdoor use of power tool and other electrical equipment insulation.	M

AHA #1 – Activity/ Work Task: Mobilization and Site Preparation			
Job Steps	**Hazards**	**Controls**	**RAC**
	• Refueling of equipment use could present fire hazards or spills	✓ Only use a UL rated, National Fire Protection Association-approved fuel tanks and fuel transfer hoses. ✓ A minimum 60:BC fire extinguisher will be set up and staged within 50 feet of the fueling area and tank ✓ No smoking at any location unless specifically approved by the SS and SSHO and Installation requirements. ✓ Signage will be posted as flammable and no open flame. ✓ There are no matches or other flame producing materials allowed in the Restricted Area unless specifically permitted. ✓ Spill kit will be available in the refueling area (sorbent pads, kitty litter, gloves, waste bag). Fueling will be done over a secondary containment device to catch incidental fuel in case of overflow or drips. ✓ Operator will be present and have positive control on dispensing of fuel during filling operations at all times and a means to stop the flow of fuel. ✓ Tanks will be able to be monitored to gauge fuel level to prevent overfilling. ✓ Generators, if used will be equipped with mufflers/spark arresters. ✓ If mobile equipment or tools are refueled, the equipment will be turned off and allowed to cool prior to refueling.	L
	• Dry vegetation may be present and presents a potential fire hazard	✓ No smoking at any location except as specifically designated as smoking areas by the SS and as per Installation requirements. ✓ Do not refuel equipment in vegetated areas. ✓ No spark producing tasks or any other open flame tasks in areas of vegetation and not without a Hot Work Permit issued by the SSHO and removal of combustible materials including dry vegetation first. ✓ No spark producing tasks or flame producing equipment allowed in the Restricted Area.	L
3. Backing of boats on boat trailers	• Failure of proper backing can cause struck by and pinch point injuries or property damage.	✓ Use spotters for all backing operations. Ensure spotter stands in line of sight of the person backing the vehicle. All personnel who back a trailer are trained and qualified to do so and are designated by the PjM for such activities. Use boat checklist in APP prior to launching boat. Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. Use parking brake and ensure operator is not moving vehicle before unhitching boat from trailer. Follow EHS 6-6, Boating Procedure. Ground personnel involved in backing operations will wear class 2 high visibility vest.	M

AHA #1 – Activity/ Work Task: Mobilization and Site Setup		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Site vehicles	• Drivers must have current state-issued driver's license.	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO.
- Boats	• Qualified Operators will have USCG approved boater safety qualifications identified in the APP and experience in use of the boats on the project.	✓ Inspect daily, and before use. ✓ Use the boating checklist form. ✓ Follow procedures in EHS 6-6, Boating Procedures
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	✓ Daily inspection by users/operators. ✓ Inspect tools and power cords ✓ Inspect for damage to tool and to cords.
- First aid kit, fire extinguisher, eyewash station	• Use of emergency equipment including first aid kits, fire extinguishers and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO	✓ Fire Extinguisher - initially and at least monthly thereafter by SSHO ✓ First Aid Kit - Weekly and after use for restocking by SSHO ✓ Eye Wash Station - Weekly by SSHO; Potable water changed weekly unless a preservative solution is used
- RTK GPS	• Geo Technician to check each day prior to operations.	✓ Only properly trained operator will use.
- Type II or better PFD to be worn	• User will inspect each day before use.	✓ Boat captain or SSHO will instruct in proper use.
- Personal Protective Equipment	• Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE used	✓ Daily inspection by user before use.

Abbreviations and Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
dBA – decibels, A-scale
CFR – Code of Federal Regulations
DEET – N,N-diethyl-meta-toluamide
EHS – Environmental, Health, and Safety
EM – Engineer Manual
GPS – global positioning system
PFD – personal flotation device
PPE – personal protective equipment
RAC – Risk Assessment Code
RTK – real-time kinematic
SDS – Safety Data Sheet
SSHO – Site Safety and Health Officer
USCG – U.S. Coast Guard

AHA#1 - Mobilization and Site Preparation Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

Activity Hazard Analysis (AHA) #2

Activity/ Work Task: Boat Operations	**Overall Risk Assessment Code (RAC) (Use highest code)** — **M**
Project Location: Congaree River, Columbia, SC	**Risk Assessment Code (RAC) Matrix**
Contract Number:	
Date Prepared: November 2021	
Prepared by: Don Schwalback, Diving Supervisor	
Reviewed by: Scot Wilson, PM	

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA: Safety glasses with side shields (including appropriate tint of lens); sturdy rubber soled deck shoes; work gloves; standard Level "D" work clothes; a Type II or auto-inflatable personal flotation device (PFD) when in transit or on decks without adequate guardrails (exemption to this is a diver who is outfitted in dive-ready diver ensemble, as provided for in the Diving Operations Plan). In addition, sun protection including a hat with a wide brim is recommended onboard vessels if workers do not have immediate access to shade.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	**RAC Chart**
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk** **H = High Risk**
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk** **L = Low Risk**

AHA #2 – Activity/ Work Task: Boat Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Boating	• Failure to meet EM 385-1-1 Section 19F or EHS 06-6 requirements for use of boats could cause injury or death.	✓ Follow the requirements of EM 385-1-1 and EHS 6-6, Boating Procedure, using the inspection checklist provided in the APP. ✓ All boat operators are qualified and trained in boat use and procedures. ✓ Ensure boat passengers have been briefed on the location, use, and inspection of emergency equipment onboard and the procedures to follow in the event of a shipboard emergency. ✓ Practice drills will be done prior to or during first deployment for situations such as man overboard, fires and explosions, and abandon ship.	**M**
	• Fueling of boat – potential for fire, environmental release. Run out of fuel when operating.	✓ No smoking or other sources of ignition when fueling. ✓ Engine must be off. ✓ There must be a fire extinguisher available. ✓ Refuel in a manner to prevent any spills, especially spills into the water. (If there is any sheen in the water the spill must be reported). ✓ Check for fuel leaks in the boat, if fuel lines are in the boat.). ✓ Ensure there is enough fuel supply for the trip and the return to dock plus 1/3 in reserve.	**M**
	• Boat could malfunction and drift into open water if engine does not work.	✓ Ensure communications are working on boat. ✓ Have anchor and enough line to deploy in the event of motor/engine malfunction. Ensure that a Float Plan is filed in accordance with the APP using the example Coast Guard Float Plan in the APP. ✓ File this plan daily with the PjM or designee before leaving the dock and notify them of your return.	
	• Grounding.	✓ Use caution in the shallow areas. ✓ Use depth meter and spotting to avoid striking the bottom or grounding.	
	• Personnel can slip or trip while on the dock and when getting on or off the boat.	✓ Personnel should use appropriate footwear (sturdy leather deck shoes) to ensure that there is enough tread on the soles to minimize slipping. ✓ Look out for trip hazards. Those hazards that cannot be removed must be marked. When climbing up or down or on and off boats, always ensure three points of contact.	
	• Sunburn for personnel in boat.	✓ Use broad spectrum sunscreen SPF 30 or greater as necessary on all exposed skin areas. ✓ Wear a hat with a bill or brim.	

		✓ Suggest wearing of neck protector if neck is exposed to sun or Bimini top on boat is not installed for shade.	
	• Severe weather can cause dangerous seas and hazardous boating conditions.	✓ Monitor the local and national weather service broadcasts prior to mobilization by boat and during the day. ✓ Pay attention to weather advisories and storm warnings, namely hurricanes. ✓ Monitor actual water conditions for dangerous wave or ground swell action. ✓ Follow provisions in the APP for severe weather.	
	• Heat or cold stress may be experienced.	✓ Boat occupants will be monitored for signs and symptoms of heat stress and cold stress (in colder weather, wet weather, or if wind chill is a factor) in accordance with the APP and EHS 4-6, Temperature Extremes. ✓ Hydration and work/rest regimens will be followed. ✓ Survival kits on the boat will include blankets in the event of hypothermia for boat occupants. ✓ Boat occupants will be prepared with raingear and a change of clothing in the event they get wet and chilled. ✓ Boat survival kit, if used, will be restocked with necessary equipment. Adequate drinking water and electrolyte fluids will be available for boaters. ✓ Boat cabin shall have air conditioning or at a minimum, shade for employees to rest in.	
	• Boat could be struck by other boats in area.	✓ Boat Captain oversees situational awareness while on the water. ✓ Boat Captain will not be doing other tasks. ✓ Monitor Channel 16 and U.S. Coast Guard rules for lighting and other vessel operations. ✓ Use air horn in the event of a boat coming close.	
2. Search with divers preselected anomalies, grids and transects as described in the approved work plan. 3. Locate MDAS, MPPEH and MEC under water using divers with underwater navigation and metal detectors to characterize the site.	• Underwater MPPEH / MEC hazards • Uneven and/ or moving working surfaces of the boat – slip, trip, and fall hazards • Muscle strain carrying instruments/equipment • Pinch points/ laceration hazards from boat equipment • Heat Stress	✓ On-site MPPEH and MEC Training ✓ Perform MEC avoidance by avoiding operating the boat in shallow waters in which the boats hull, outdrives or jet-drives impact the sea floor ✓ Boat Operator will ensure that boat is well maintained and in good condition prior to taking on passengers. ✓ Boat Operator will ensure that Captain and vessel are licensed in accordance with local requirements. ✓ Boat Operator will be in communication with Captain and aware of destination, when boat leaves wharf and docks on each trip. ✓ Emergency radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Directions for contacting the Coast Guard and hospital will be posted with each radio and cell phone.	**M**

	• Biological hazards – bees, wasps, mosquitoes, jellyfish, corals, sharks • Noise • Sunburn • Hazardous weather conditions	✓ Personnel will attend daily safety briefing by Captain prior to transport by boat and will obey all directions from the Captain during transport. ✓ Boat will be equipped with rescue equipment to handle a man overboard situation (such as life ring with rope, or similar equipment), and personnel trained in its use. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on the boat and will avoid stepping in wet areas that could be slippery. ✓ Follow appropriate lifting/carrying procedures. Lift with legs, maintain balance, use work gloves, and never lift more than you can safely carry. ✓ Ensure hoisting mechanism is adequate for the load imposed and is securely braced and anchored. ✓ A positive latching device will be used to secure the load and rigging. ✓ Operator of any hoisting equipment will be trained in its use. ✓ Hoisting and rigging equipment will be inspected daily. ✓ Heat stress monitoring, drinking water, work-rest schedule, and cool shelter for breaks. ✓ Training in biological hazards avoidance. ✓ Use PPE in accordance with this AHA. ✓ Use insect repellents as necessary. ✓ Use sunscreen and wear protective clothing. ✓ Fire extinguishers will be readily available. ✓ First Aid Kits will be readily available. ✓ Shark Marine system and underwater cameras will be characterizing levels of underwater MEC contamination and sensitive habitats through videotaping of underwater conditions. ✓ Contact with MEC items is not intended or anticipated. ✓ Personnel will remain seated while boat is in motion, and keep all ✓ extremities inside the boat. ✓ All personnel will wear personal flotation devices while boat is in transit and during inclement weather. At all other times, a personal flotation device should be readily available and accessible. ✓ Good housekeeping standards will be enforced. Cargo will be properly staged on the boat to prevent tripping hazards. ✓ Local weather will be monitored, and boat operations will be terminated during an approaching storm or should sea conditions make it unsafe to continue.	

AHA #2 – Activity/ Work Task: Boat Operations		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
PPE: – Footwear with rubber soles to prevent slipping. Safety toe footwear required near heavy diving equipment (SCUBA cylinders) – Type II or better PFD to be worn in transit – Back braces (optional) – Appropriate clothing and PPE (to include personal flotation device, puncture resistant or leather work gloves, safety sunglasses and cap). Hearing protection will be required if noise from boat engine reaches hazardous levels. – Chemical-resistant gloves for use when handling MPPEH/MEC and in fueling operation	• PPE requirements training	✓ PPE inspected daily prior to use by user with additional random inspections by SSHO.
Boat/s: – RTK systems – HERO Underwater camera – Fuel spill kit – Boat tool kit – Fuel container	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • Current HAZWOPER training • Site-specific training in use of equipment and tools	✓ SSHO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and SSHO. ✓ Daily serviceability check of magnetometers by user and UXOQCS. ✓ Geo Tech or designee to check SM and RTK each day prior to operations.
Emergency gear: – Communications equipment – First Aid Kit – Fire extinguishers – Vessel rescue equipment (hook, rope, life ring) – WBGT monitor	• Emergency response procedures • Heat stress symptoms/first aid • Site-specific biological hazards to include first aid • Equipment familiarity training	✓ Communications equipment checked daily prior to use by SSHO. ✓ First Aid Kits checked daily and inspected weekly by the SSHO. ✓ Fire extinguishers checked daily and inspected weekly by the SSHO. ✓ Equipment inspected daily prior to use by user and SSHO.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
UXOQCS – UXO Quality Control Specialist

AHA#2 – Boat Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

This page intentionally left blank.

Activity Hazard Analysis (AHA) #3

<table>
<tr><td>Activity/ Work Task: Vehicle Operations</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>L</td></tr>
<tr><td>Project Location: Congaree River, Columbia, SC</td><td colspan="6">Risk Assessment Code (RAC) Matrix</td></tr>
<tr><td>Contract Number:</td><td rowspan="2">Severity</td><td colspan="5">Probability</td></tr>
<tr><td>Date Prepared: November 2021</td><td>Frequent</td><td>Likely</td><td>Occasional</td><td>Seldom</td><td>Unlikely</td></tr>
<tr><td rowspan="2">Prepared by: Don Schwalback, Diving Supervisor</td><td>Catastrophic</td><td>E</td><td>E</td><td>H</td><td>H</td><td>M</td></tr>
<tr><td>Critical</td><td>E</td><td>H</td><td>H</td><td>M</td><td>L</td></tr>
<tr><td rowspan="2">Reviewed by: Scot Wilson, PM</td><td>Marginal</td><td>H</td><td>M</td><td>M</td><td>L</td><td>L</td></tr>
<tr><td>Negligible</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td rowspan="6">Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

<u>Personal Protective Equipment for this AHA:</u> High visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (see above).</td></tr>
<tr><td colspan="3">“Probability” is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.</td><td colspan="3">RAC Chart</td></tr>
<tr><td colspan="3" rowspan="2">“Severity” is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.</td><td colspan="3">E = Extremely High Risk</td></tr>
<tr><td colspan="3">H = High Risk</td></tr>
<tr><td colspan="3" rowspan="2">Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on the AHA. Annotate the overall highest RAC at the top of the AHA.</td><td colspan="3">M = Moderate Risk</td></tr>
<tr><td colspan="3">L = Low Risk</td></tr>
</table>

AHA #3 – Activity/ Work Task: Vehicle Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Identify the hazards associated with vehicle operations 2. Inspect vehicle 3. Load cargo onto vehicle	• Slip, trip, and fall hazards • Back strain from carrying equipment • Heat stress • Biological hazards – bees, wasps, mosquitoes, spiders • Sunburn • Weather hazards • Potential for vehicle accidents during field operations • Cargo hazards (MEC/ Explosives) • Fire hazards	✓ Daily vehicle inspections will be performed to ensure a safe operating vehicle. ✓ Operator must have a valid driver's license (permits for transporting explosives). ✓ Use the parking brake if parked on inclines and/or as necessary. ✓ Use spotter when backing ✓ Fire extinguisher and First Aid kit must be with vehicle. If transporting ✓ explosives, two fire extinguishers are required. ✓ Ensure placards are visible on all four sides of vehicle when transporting explosive materials. ✓ Ensure explosives are properly packed and braced in the vehicle. ✓ Fill out DD Form 626 when transporting explosives. ✓ Ensure vehicle is chocked while loading/unloading cargo.	**L**
4. Drive to and from destinations	• Potential for vehicle accidents during field operations • Cargo hazards (MEC/ Explosives) • Fire hazards	✓ Always wear a seat belt. ✓ Use a ground guide when reversing and/or as needed. ✓ Prior to backing or when working alone, drivers will apply the GOAL technique: "Get Out and Look." ✓ Obey the speed limit. ✓ Obey all traffic signs. ✓ Use established roads. ✓ Use the parking brake if parked on inclines and/or as necessary. ✓ Never leave the vehicle running unattended. ✓ Operator must have a valid driver's license (permit for transporting explosives).	**L**

5. Secure vehicle		✓ Fire extinguisher and First Aid kit must be with vehicle. If transporting explosives, two fire extinguishers are required. ✓ Never fuel a vehicle loaded with explosive cargo. ✓ No passengers will be transported in bed of a pick-up truck. All passengers will be in a seat with a seat belt in use during vehicle operation. ✓ There will be no use of cell phones, portable headphones, earphones, or other electronic devices while operating a vehicle. ✓ Silence or turn off all electronic devices prior to operating motor vehicle. ✓ If an electronic device must be used, park the vehicle in an appropriate location and turn engine off prior to turning on and using electronics. ✓ Always lock/ secure vehicle.	

AHA #3 – Activity/ Work Task: Vehicle Operations		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Accident Prevention Plan	• Daily Safety Brief; SUXOS/ Diving Supervisor, UXOSO	✓ All members sign APP acknowledgement. ✓ Sign daily safety brief
- Site vehicles - Placards	• Drivers must have current state-issued driver's license. • UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • All personnel will have MPPEH training • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • All site personnel will have current HAZWOPER training	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO. ✓ UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and UXOSO.
- First Aid kit - Fire extinguisher - Communication equipment	• Knowledge of the Emergency Response and Notification procedures. • Fire extinguisher training. • Equipment familiarity.	✓ Communications equipment checked daily prior to use by UXOSO. ✓ First Aid kits checked daily and inspected weekly by UXOSO. ✓ Fire extinguishers checked daily and inspected weekly by UXOSO.
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task. • Site-specific training in use of tools	✓ Daily inspection by users/operators. ✓ SSHO inspect tools and power cords to ensure they are listed by a NRTL. ✓ Inspect for damage to tool and to cords.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA #3 – Vehicle Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

Activity Hazard Analysis (AHA) #4

Activity/ Work Task: Diving Operations	**Overall Risk Assessment Code (RAC) (Use highest code)**					**H**
Project Location: Congaree River, Columbia, SC	**Risk Assessment Code (RAC) Matrix**					
Contract Number: RTN 4-0000090	**Severity**	**Probability**				
Date Prepared: November 2021		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by: Don Schwalback, Diving Supervisor	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by: Scot Wilson, PM	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.) In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures. **Personal Protective Equipment for this AHA**: PFD (when in transit on boat), appropriate and properly configured diving equipment as outlined in EM385-1-1 Sect 30, high visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).	
	"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	**RAC Chart**
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk** **H = High Risk**
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk** **L = Low Risk**

AHA #4 – Activity/ Work Task: Diving Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Pre-Dive Safety Brief	• Fire hazards on boat • Slips, trips and falls on boat deck • Heat Stress • <u>Biological hazards</u> – hazardous sea life, bees, wasps, centipedes, mosquitoes, spiders, and rodents • Muscle strain carrying equipment • Sunburn • Equipment shifting during boat transit in sea states • Falling overboard/ drowning hazards • Diving related injury	✓ Be observant while walking on decks and docks ✓ Personnel will wear close toed shoes/ boots appropriately soled for working on boat decks ✓ Perform proper stowage and securing of equipment on boat prior to transit ✓ Assure fire extinguishers and first aid kit are available and operational ✓ Assure communications equipment is available and operational ✓ Heat stress monitoring, drinking water, work-rest schedule and cool shelter for breaks ✓ Training in biological hazards avoidance ✓ Use insect repellants as necessary ✓ Use proper lifting/carrying techniques ✓ Use sunscreen and wear cap ✓ Wear personal flotation device always while in transit on boat ✓ Review specific hazards and controls located in the Diving Operations Plan. ✓ Review SOPs as related to current task, assignment, or pre, during, and post dive activities. ✓ Review Diving emergency procedures.	L
	• Submerged Objects • Shallow Water • Non-Secured Ladder • Falling • Pinch Points	✓ Verify water depth prior to entry ✓ Proper entrance ladder or walk-in entry only ✓ Ladder extends minimum of 3 feet below water surface ✓ Maintain three points of contact to ladder ✓ Sweep for submerged objects	L
	• Vessel Traffic	✓ Coordinate Inspection with Port Control ✓ Display Commercial Dive Alpha Flag ✓ Display Recreational Dive Flag ✓ Topside Personnel Aware of Boat Traffic	L
	• Primary Air Supply Failure	✓ <u>Failure of the primary air supply</u> - Diver switch over to the emergency air source. ✓ Dive operations will be terminated**.**	L
	• Loss of Communications	✓ Initiate diver locator system- lost diver buoy ✓ Attempt to establish visual contact ✓ Terminate dive operations ✓ Initiate diver recall system ✓ Dive team surface	L

AHA #4 – Activity/ Work Task: Diving Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
	• Fouled Diver • Entrapped Diver	✓ Diver must always be aware of his surroundings and avoid any hazardous situations if identified. ✓ All hazardous situations will be communicated to the dive supervisor or team leader immediately. ✓ Request Stand-by diver to assist if any problems ✓ Terminate dive operations as necessary	L
	• Carbon Monoxide Poisoning	✓ The primary air source tank to be filled at air fill stations properly tested and within purity standards as outlined in the Dive Operations Plan.	L
	• Minor Diver Injury Sick Diver	✓ Terminate dive operations ✓ Distressed diver assesses conditions ✓ Dive informs topside of condition ✓ Self-transport to medical facilities	L
	• Critical Diver Injury	✓ Terminate dive operations ✓ Distressed diver assesses conditions ✓ Diver informs topside of condition ✓ Topside initiates emergency response ✓ Standby diver deployed if necessary ✓ Stabilize Injured diver ✓ Dive team is extracted	M
	• Unconscious/ Breathing Diver • Lost Diver	✓ Initiated by loss of communications contact procedures ✓ Distressed diver remains submerged ✓ Terminate dive operations ✓ Assess distressed diver condition ✓ Initiate critical diver related injury procedures ✓ Provide Emergency Oxygen	M

AHA #4 – Activity/ Work Task: Diving Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
	• Unconscious/ Non-Breathing Diver	✓ Initiated by loss of Communications contact procedures ✓ Distressed diver remains submerged ✓ Terminate dive operations ✓ Topside initiates emergency response ✓ Locate and recover distressed diver ✓ Initiate critical diver related injury procedures ✓ Provide Emergency Oxygen	M
	• Rapid Accent • Blow Up to Surface	✓ Terminate Dive Operations ✓ Topside Initiates Emergency Response ✓ Deploy Standby Diver if necessary ✓ Recover Diver to Dive Stage ✓ Monitor Distressed Diver and Provide Emergency Oxygen	M
	• Hazardous Marine Life	✓ Wear Protective Outer-Garments (wet/ skin suits or coveralls) ✓ Wear protective gloves ✓ Avoid hazards ✓ Terminate dive operations on any imminent threats (sharks)	L
2. Deploy and recover divers to/ from the water.	• Fire hazards on boat • Falling overboard/ drowning hazards Heat Stress • Biological hazards – hazardous sea life, bees, wasps, centipedes, mosquitoes, spiders, and rodents • Sunburn • Slips, trips, and falls on boat deck. • Stability of divers on dive boat when entering and exiting the water.	✓ Be observant while walking on docks and decks ✓ Personnel will wear close toed shoes/ boots appropriately soled for working on boat decks ✓ Personnel will maintain at least three points of contact with boat during transits ✓ Divers will be paired with tenders always. Tenders will maintain positive control of divers while maneuvering around the dive boat and entering/exiting the water. ✓ All personnel trained in diving distress signals ✓ Wear personal flotation device at all time while on boat ✓ Assure fire extinguishers and first aid kit are available and operational ✓ Assure communications equipment is available and operational ✓ Heat stress monitoring, drinking water, work-rest schedule and cool shelter for breaks ✓ Training in biological hazards avoidance ✓ Use insect repellants as necessary ✓ Use sunscreen and protective clothing	L

AHA #4 – Activity/ Work Task: Diving Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
3. Deploy underwater waypoints, transects and grids	• MEC hazards • Line entanglement • Pinch Points	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques ✓ Ensure lines, buoys and anchors systems are deployed IAW work plan and applicable SOPs.	M
4. Diver(s) perform underwater survey	• MEC hazards • Line entanglement	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques ✓ Anomalies will be investigated using hand tools, without moving the MEC until it can be identified and inspected ✓ Standby diver assigned to the team will be at the ready when diver(s) are in the water ✓ MEC operations will cease if unauthorized watercraft/personnel enter the area and will be asked to leave.	M
5. Diver(s) excavate anomalies	• MEC hazards	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques ✓ Anomalies will be investigated using hand tools, without moving the MEC until it can be identified and inspected ✓ Standby diver assigned to the team will be at the ready when diver(s) are in the water ✓ MEC operations will cease if unauthorized watercraft/personnel enter the area. Personnel will be informed of the site hazards and of the fact that they are not authorized to be near the site operations and will be asked to leave.	H
6. Diver(s) identify and process MEC/ MPPEH	• MEC hazards	✓ On-site MEC Training ✓ Perform MEC operations using approved methods and techniques	M
7. Diver(s) and dive team extraction	• Non-secured ladder • Falling • Pinch points • No-fly safety	✓ Ladder properly secured and extending 3 feet below the water surface. ✓ Walk-in entry only ✓ Maintain three points of contact to ladder ✓ No divers between boats or objects and boats ✓ Do not place hands, feet or legs in between boats or boats and docks ✓ **12-Hour** no-flight after single dive ✓ **24-Hour** no-flight after multi-dive days	L

AHA #4 – Activity/ Work Task: Diving Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
8. Dive Team transit	• Fire • Man overboard • Dehydration • Sun Exposure • Minor Topside Injury Sickness	✓ Locate fire suppressing devices prior to dive operations ✓ Extinguish fire with fire suppressing devices ✓ All personnel don Personal Floatation Devices (PFD's) ✓ Deploy safety tender ✓ Topside exits ✓ Supply appropriate amount of water ✓ Maintain hydration ✓ Supply sunscreen w/ minimum SPF 30 ✓ Apply sunscreen ✓ Assess Injury/illness ✓ Self-transport to medical facilities if necessary	L
9. Equipment transit and maintenance	• Muscle strain • Slips, trips and falls • Heat stress • Muscle strain • Sunburn	✓ Practice safe lifting procedures ✓ Assist Team Members Lifting Heavy Objects ✓ Supply sunscreen w/ minimum SPF 30 ✓ Apply sunscreen ✓ Assess Injury/illness ✓ Self-transport to medical facilities if necessary	L

AHA #4 – Activity/ Work Task: Diving Operations		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Diving Operations Plan	✓ Pre-Dive Safety Brief; SUXOS/ Diving Supervisor, UXOSO	Sign daily safety brief
- Site vehicles	✓ Drivers must have current state-issued driver's license.	Daily vehicle inspection by drivers. Receipt inspection by SSHO.
PPE: - Diving equipment as outlined in the DOP/TtEC DSPM - Footwear with rubber soles to prevent slipping - Safety toe footwear required near lifting operations - Back braces (optional) - Appropriate clothing (to include personal flotation device, canvas or leather work gloves, safety sunglasses and cap). - Hearing protection will be required if noise from boat engine or generator reaches hazardous levels. - Chemical-resistant gloves for use in fueling and MPPEH operations	✓ PPE Training ✓ UXO personnel will meet training and experience requirements outlined in DDESB TP 18. ✓ All divers are certified per EM 385-1-1 sect. 30 ✓ All personnel will demonstrate strong swimming skills. ✓ Training in hazardous tides and currents and how to handle them. ✓ Training in biological hazards. ✓ All dive team members will review and be briefed on the Dive Operations Plan, Dive SOPs, and this AHA. ✓ Site-specific training on slip, trip, and fall hazards. ✓ Site-specific training/lifting techniques. ✓ Site-specific training in use of tools and equipment. ✓ UXO Divers and tenders all emergency procedures. ✓ All site personnel will have current HAZWOPER training.	PPE inspected daily prior to use by user with additional inspections by SSO/ UXOSO. Dive Supervisor will ensure that all personnel have received appropriate training. Dive equipment inspected daily prior to use by user and Dive Supervisor. Dive Supervisor will inspect location to be used for water entry and determine depth. Dive Supervisor will inspect divers for proper tending line attachment (if required). Dive Supervisor inspects lines and floats (if required). Dive Supervisor inspects dive ladder or platform.
- Boats - White's underwater magnetometer - Shark Marine Navigation System - RTK systems - SCUBA equipment - Fuel spill kit - Fuel container	✓ UXO personnel will meet training and experience requirements outlined in DDESB TP 18 ✓ Site specific MEC training will be presented to all site personnel ✓ All personnel will have MPPEH training ✓ Equipment familiarity training ✓ Site-specific training, slip/fall hazards ✓ Site-specific training/lifting and carrying techniques ✓ All site personnel will have current HAZWOPER training ✓ Site-specific training in use oftools	UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. Equipment inspected daily prior to use by user and UXOSO. Daily serviceability check of magnetometers by user and UXOQCS.
- Hand and power tools	✓ Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
- Fire extinguishers	✓ Fire Extinguisher Training including use/limitations.	At least monthly by SSHO or designee.

AHA #4 – Activity/ Work Task: Diving Operations		
- First aid kits and emergency equipment	✓ Use of emergency equipment/first aid kits must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO.	Initially and at least weekly thereafter or after use for restocking. Eyewashes inspected weekly. Potable water changed weekly unless a preservative solution is used.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA#4 – Diving Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

This page intentionally left blank.

Activity Hazard Analysis (AHA) #5

Activity/ Work Task: Surface Air Delivery System (SADS) Operations	**Overall Risk Assessment Code (RAC) (Use highest code)**					**M**
Project Location: Congaree River, Columbia, SC	**Risk Assessment Code (RAC) Matrix**					
Contract Number:	**Severity**	**Probability**				
Date Prepared: November 2021		Frequent	Likely	Occasional	Seldom	Unlikely
Prepared by: Don Schwalback, Diving Supervisor	Catastrophic	**E**	**E**	**H**	**H**	**M**
	Critical	**E**	**H**	**H**	**M**	**L**
Reviewed by: Scot Wilson, PM	Marginal	**H**	**M**	**M**	**L**	**L**
	Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.) In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures. **Personal Protective Equipment for this AHA**: PFD (when in transit on boat), appropriate and properly configured SADS equipment as outlined in EM385-1-1 Sect 30, high visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).	
	"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	**RAC Chart**
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk** **H = High Risk**
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk** **L = Low Risk**

AHA #5 – Activity/ Work Task: SADS Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Pre-operations brief, task assignments, and check equipment.	• Boating hazards • Drowning hazards • Hazardous tides or currents (rip tides, high tide, etc.) • Uneven and/or moving working surfaces of the boat – slip, trip, and fall hazards • Biological hazards – bees, wasps, mosquitoes, spiders • Weather hazards • Sunburn	✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life ring with rope or similar equipment), and personnel trained in its use. ✓ All personnel will be familiar with emergency signal to request assistance. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Training in biological hazards avoidance. ✓ Use sunscreen. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm be approaching or should sea conditions make it unsafe to continue. Snorkelers will return to the boat to evacuate. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Be observant while in water; note, avoid, and report unsafe conditions or activities. Avoid stepping on coral or sharp underwater objects. ✓ Determine types of hazardous aquatic life found in this location from local marine, police or lifeguard headquarters. ✓ Training in biological hazards avoidance. ✓ Use insect repellents as necessary. ✓ Use PPE IAW this AHA. ✓ Local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe to continue. ✓ Determine areas where hazardous tasks, tides, or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. ✓ Wear protective clothing and use sunscreen.	**L**

AHA #5 – Activity/ Work Task: SADS Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
2. Transit boat to SADS operations area.	• Boating hazards • Drowning hazards • Hazardous tides or currents (rip tides, high tide, etc.) • Uneven and/or moving working surfaces of the boat – slip, trip, and fall hazards • Biological hazards (land) – bees, wasps, mosquitoes, spiders • Biological hazards (water) – Box Jellyfish, sharks, barracuda, corals and sting rays • Weather hazards • Sunburn	✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life ring with rope or similar equipment), and personnel trained in its use. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. ✓ All passengers will wear a personal flotation device while on the boat with boat in transit to work station. ✓ Passengers will remain seated while boat is in motion and keep all extremities inside boat. ✓ Use PPE IAW this AHA. ✓ Determine areas where hazardous tasks, tides, or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe to continue. Snorkelers will return to the boat to evacuate. ✓ All personnel will be familiar with emergency signal to request assistance. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Training in biological hazards avoidance. ✓ Use insect repellents as necessary. ✓ Wear protective clothing and use sunscreen.	**M**

3. Perform SADS operations.	• Underwater MEC hazards • Weather hazards • Sunburn • Drowning • Underwater hazards from stepping on coral or other sharp underwater objects • Biological hazards (water) – box jellyfish, sharks, barracudas, sea urchins, corals and stingrays • Hazardous tides or currents (rip tides, high tide, etc.)	✓ On-site MEC Training. ✓ Perform MEC avoidance measures using approved methods and techniques. ✓ Standby safety swimmer assigned to the team will be at the ready when snorkelers are in the water. ✓ All personnel will be familiar with emergency signal to request assistance. ✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life preserver with rope, or similar equipment) ✓ Personal flotation devices will be worn during boat transit and during inclement weather and will be readily available and accessible at all other times while on boat. ✓ The snorkelers must be escorted by a boat. The boat, when in waters deeper than 5 feet, must remain within 50 ft of the snorkelers ✓ Two snorkelers will work as both observer/assistants to each other and will remain within 50 ft of each other ✓ Snorkelers must wear a device providing a minimum of 15.5 pounds (7 kg) of positive buoyancy (Type III personnel flotation device (PFD), fully inflated SADS vest, etc.). ✓ A throw device that can reach out to 70 feet is available on the boat for emergencies ✓ Areas of extreme water velocity and turbulence will be avoided ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Be observant while in water; note, avoid, and report unsafe conditions or activities. Avoid stepping on coral or sharp underwater objects. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. ✓ Training in biological hazards avoidance: If sharks are a hazard in this area, operations will not occur at dawn or at dusk, when they are most likely to be feeding. Personnel will be observant for schools of bait fish on which sharks feed and leave the area immediately if sighted No flashing jewelry will be worn. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe. ✓ Determine areas where hazardous tasks, tides or currents may be present and times of day or conditions likely to cause them from local marine or police or lifeguard headquarters. ✓ Training in how to safely handle these circumstances. ✓ Be observant while walking. ✓ Use dive booties and fins to protect feet. ✓ Use PPE IAW this AHA. ✓ Use sunscreen and protective clothing.	**M**

AHA #5 – Activity/ Work Task: SADS Operations			
Job Steps	**Hazards**	**Controls**	**RAC**
4. Recover operators and return to shop.	• MEC hazards • Boating Hazards • Biological hazards (land) – bees, wasps, mosquitoes, spiders, • Biological Hazards (water) - box jellyfish, sharks, barracudas, sea urchins and stingrays • Hazardous tides or currents (rip tides, high tide, etc.) • Uneven and/or moving working surfaces of the boat – slip, trip, and fall hazards • Sunburn • Weather hazards • Heat stress	✓ Boat will be equipped with rescue equipment to handle a "man ✓ overboard" situation (such as rescue hook, life ring with rope or similar equipment) ✓ Personal flotation devices will be worn during boat transit and during inclement weather and will be readily available and accessible at all other times while on boat. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. Training in biological hazards avoidance. ✓ Determine areas where hazardous tasks, tides. or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. ✓ Training in biological hazards avoidance: If sharks are a hazard in this area, operations will not occur at dawn or at dusk, when they are most likely to be feeding. Personnel will be observant for schools of bait fish on which sharks feed and leave the area immediately if sighted No flashing jewelry will be worn. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Use PPE IAW this AHA. ✓ Use sunscreen. ✓ Weather radio and local weather will be monitored, and boat operations will be terminated should a storm be approaching or should sea conditions make it unsafe to continue. ✓ Heat stress monitoring, drinking water, work-rest schedule, and cool ✓ shelter for breaks.	

AHA #5 – Activity/ Work Task: SADS Operations		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Diving Operations Plan	• Pre-Dive Safety Brief; SUXOS/ Diving Supervisor, UXOSO	✓ Sign daily safety brief
- Site vehicles	• Drivers must have current state-issued driver's license.	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO.
PPE: - SADS equipment as outlined in the DOP/TtEC DSPM - Footwear with rubber soles to prevent slipping - Safety toe footwear required near lifting operations - Back braces (optional) - Appropriate clothing (to include personal flotation device, canvas or leather work gloves, safety sunglasses and cap). - Hearing protection will be required if noise from boat engine or generator reaches hazardous levels. - Chemical-resistant gloves for use in fueling and MPPEH operations	• PPE Training • UXO personnel will meet training and experience requirements outlined in DDESB TP 18. • All divers are certified per EM 385-1-1 sect. 30 • Training in hazardous tides and currents and how to handle them. • Training in biological hazards. • All dive team members will review and be briefed on the Dive Operations Plan, Dive SOPs, and this AHA. • Site-specific training on slip, trip, and fall hazards. • Site-specific training/lifting techniques. • Site-specific training in use of tools and equipment. • All dive team members have training on emergency procedures. • All site personnel will have current HAZWOPER training.	✓ PPE inspected daily prior to use by user with additional inspections by SSO/ UXOSO. ✓ Dive Supervisor will ensure that all personnel have received appropriate training. ✓ Dive equipment inspected daily prior to use by user and Dive Supervisor. ✓ Dive Supervisor will inspect location to be used for water entry and determine depth. ✓ Dive Supervisor will inspect divers for proper tending line attachment (if required). ✓ Dive Supervisor inspects lines and floats (if required). ✓ Dive Supervisor inspects dive ladder or platform.
- Boats - White's underwater magnetometer - RTK systems - SADS equipment - Fuel spill kit - Fuel container	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • All personnel will have MPPEH training • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • All site personnel will have current HAZWOPER training • Site-specific training in use of tools	✓ UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and UXOSO. ✓ Daily serviceability check of magnetometers by user and UXOQCS.
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	✓ Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
- Fire extinguishers	• Fire Extinguisher Training including use/limitations.	✓ At least monthly by SSHO or designee.

AHA #5 – Activity/ Work Task: SADS Operations		
- First aid kits and emergency equipment	• Use of emergency equipment/first aid kits must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO.	✓ Initially and at least weekly thereafter or after use for restocking. Eyewashes inspected weekly. Potable water changed weekly unless a preservative solution is used.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA #5 – SADS Operations Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

Activity Hazard Analysis (AHA) #6

Activity/ Work Task: Underwater Anomaly Reacquisition and Intrusive Investigation	**Overall Risk Assessment Code (RAC) (Use highest code)** — **M**
Project Location: Congaree River, Columbia, SC	
Contract Number:	
Date Prepared: November 2021	
Prepared by: Don Schwalback, Diving Supervisor	
Reviewed by: Scot Wilson, PM	

Risk Assessment Code (RAC) Matrix

Severity	**Probability**				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	**E**	**E**	**H**	**H**	**M**
Critical	**E**	**H**	**H**	**M**	**L**
Marginal	**H**	**M**	**M**	**L**	**L**
Negligible	**M**	**L**	**L**	**L**	**L**

Notes: (Field Notes, Review Comments, etc.)

In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA: PFD (when in transit on boat), appropriate and properly configured diving equipment as outlined in EM385-1-1 Sect 30, high visibility safety vest and hard hat (when working with an overhead safety hazards exist), safety toed boots, safety glasses, standard work uniform (long pants, ¾ length sleeve shirt). Sun protection. Hearing protection (as required). Appropriate work gloves worn when indicated.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (see above).

	RAC Chart
"Probability" is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.	
"Severity" is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.	**E = Extremely High Risk**
	H = High Risk
Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on the AHA. Annotate the overall highest RAC at the top of the AHA.	**M = Moderate Risk**
	L = Low Risk

AHA #6 – Activity/ Work Task: Underwater Anomaly Reacquisition and Intrusive Investigation			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Intrusive anomaly investigation will occur in areas with high anomaly densities. Using underwater man portable magnetometers to reacquire anomalies	• Underwater MEC hazards • Uneven and/or moving working surfaces of the boat • Slip, trip, and fall hazards • Back strain from carrying equipment • Heat stress • Biological hazards – bees, wasps, mosquitoes, spiders • Sunburn • Falling overboard/drowning • Weather hazards	✓ On-site MEC training. ✓ Personnel will wear rubber-soled shoes to prevent slipping while on boat and will avoid stepping in wet areas that could be slippery. ✓ Follow appropriate lifting/carrying procedures: Lift with legs; maintain footing; use gloves for firm grip; never lift more than you can safely handle. ✓ Heat stress monitoring, drinking water, work-rest schedule, and cool shelter for breaks. ✓ Training in biological hazards avoidance. ✓ Use insect repellents as necessary. ✓ Use PPE IAW this AHA. ✓ Use sunscreen and wear protective clothing. ✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as life ring with rope or similar equipment), and personnel trained in its use. ✓ Local weather will be monitored, and boat operations will be terminated should a storm or sea conditions make it unsafe to continue.	**L**
2. SCUBA or SADS will perform an instrument aided survey of the preselected targets and jack stay search patterns. 3. UXO-qualified divers investigate anomalies using hands and hand tools. 4. Non-MEC metal items will be brought to the surface for collection and sent to a qualified recycler at the end of project operations.		✓ On-site MEC Training. ✓ Perform MEC avoidance measures using approved methods and techniques. ✓ All divers are certified per EM 385-1-1. ✓ Review specific hazards and controls located in the Dive Plan. ✓ Review SOPs as related to current task, assignment, or pre-, during, and post-dive activities. ✓ Accurately determine water depth. ✓ If water less than 6 feet, ease diver over side versus roll-off entry. ✓ Check for object on surface or near entry point. ✓ Ensure dive partner is clear of entry point. ✓ Ensure vessel engine is in neutral or turned off. ✓ Standby diver assigned to the team will be at the ready when divers are in the water. Tender will be aware of diver's movement. ✓ Walk line around boat passing line under anchor line. ✓ All personnel trained in diving distress signals.	**M**

5. MPPEH will be inspected by two UXO Technicians and MDAS will be brought to the surface for collection and sent to a qualified recycler at the end of project operations. 6. MEC that is acceptable to move will placed in a designated consolidation area to be further transported to a designated disposal location on shore, where a MEC treatment will occur. 7. MEC that is not acceptable to move will be marked and determination made to which mechanized operation will be performed. (High or low input).	• MEC hazards • Drowning hazards • Boating hazards • Underwater hazards from stepping on coral or other sharp underwater objects • Biological hazards • Hazardous tides or currents (rip tides, high tide, etc.) • Diving-related illnesses • Diver impact with bottom • Impact with unseen objects • Impact with dive partner • Fouled/Entangled diver • Tending line/witness float line fouled in prop • Limited visibility • Lost diver • Loss of air • Decompression sickness and Arterial Gas Embolism	✓ Boat will be equipped with rescue equipment to handle a "man overboard" situation (such as rescue hook, life preserver with rope, or similar equipment). ✓ Dive Supervisor equipped with rescue equipment and First Aid supplies and equipment. ✓ Personal flotation devices will be worn during boat transit and during inclement weather and will be readily available and accessible at all other times while on boat. ✓ Emergency VHF radios will be in operating condition prior to leaving the wharf. There will be a primary and alternate means of communication, and extra batteries will be available. ✓ Be observant while in water; note, avoid, and report unsafe conditions or activities. Avoid stepping on coral or sharp underwater objects. Terminate the dive should conditions warrant. ✓ Determine types of hazardous aquatic life found in this location from local marine or harbor police or lifeguard headquarters. Training in biological hazards avoidance. ✓ Personnel will be observant for schools of bait fish on which sharks feed and leave the area immediately if sighted No flashing jewelry will be worn. ✓ Determine areas where hazardous tasks, tides, or currents may be present and times of day or conditions likely to cause them from local marine or harbor police or lifeguard headquarters. Training in how to safely handle these circumstances. If currents exceed 1 knot, the dive will be terminated until the speed of the current subsides. ✓ If a diver becomes fouled, diver and/or dive partner will assist to free diver. ✓ Standby diver may be deployed if situation warrants. ✓ <u>Topside actions for lost diver:</u> Initiate emergency recall. Identify GPS coordinates of the last known location of the diver. Mark last known location with anchor and buoy. ✓ Divers underwater should look in 360º to look for dive partner. Diver will surface if dive partner cannot be seen. Dive Supervisor will deploy the Standby diver to aid in search of missing diver. ✓ If breathing resistance occurs on the bottom, surface immediately, using controlled ascent. ✓ If out of air completely, go onto emergency air from bail-out bottle. ✓ Divers will surface when primary air reaches 500 PSIG. ✓ Alternative method is to "Buddy Breath" with dive partner. ✓ Adhere to No D tables to prevent decompression sickness. ✓ Divers will be required to remain in sight of each other always, during and after dive. ✓ Divers will not investigate anomalies unless there is suitable visibility.	

AHA #6 – Activity/ Work Task: Underwater Anomaly Reacquisition and Intrusive Investigation			
Job Steps	**Hazards**	**Controls**	**RAC**
		✓ Dive team to maintain neutral buoyancy as much as possible to remain above seabed. ✓ Divers plan to approach anomaly from down-current side to prevent unintended contact. ✓ Divers photograph and video anomaly on surface of sea floor in a manner that equipment does not strike the anomaly. ✓ Diver will perform excavation by hand of anomalies in the sand bottom. Use diver discipline to maintain neutral buoyancy. ✓ Divers will wait at least 12 hours before flying after any dive. This will be extended to 24 hours following multiple days of repetitive dives.	

AHA #6 – Activity/ Work Task: Underwater MEC Investigation		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
- Diving Operations Plan	• Pre-Dive Safety Brief; SUXOS/ Diving Supervisor, UXOSO	✓ Sign daily safety brief
- Site vehicles	• Drivers must have current state-issued driver's license.	✓ Daily vehicle inspection by drivers. Receipt inspection by SSHO.
PPE: - Diving equipment as outlined in the DOP/TMR DSPM - Footwear with rubber soles to prevent slipping - Safety toe footwear required near lifting operations - Back braces (optional) - Appropriate clothing (to include personal flotation device, canvas or leather work gloves, safety sunglasses and cap). - Hearing protection will be required if noise from boat engine or generator reaches hazardous levels. - Chemical-resistant gloves for use in fueling and MEC operations	• PPE Training • UXO personnel will meet training and experience requirements outlined in DDESB TP 18. • All divers are certified per EM 385-1-1 sect. 30 • All personnel will demonstrate strong swimming skills. • Training in hazardous tides and currents and how to handle them. • Training in biological hazards. • All dive team members will review and be briefed on the Dive Operations Plan, Dive SOPs, and this AHA. • Site-specific training on slip, trip, and fall hazards. • Site-specific training/lifting techniques. • Site-specific training in use of tools and equipment. • UXO Divers and tenders all emergency procedures. • All site personnel will have current HAZWOPER training.	✓ PPE inspected daily prior to use by user with additional inspections by SSO/ UXOSO. ✓ Dive Supervisor will ensure that all personnel have received appropriate training. ✓ Dive equipment inspected daily prior to use by user and Dive Supervisor. ✓ Dive Supervisor will inspect location to be used for water entry and determine depth. ✓ Dive Supervisor will inspect divers for proper tending line attachment (if required). ✓ Dive Supervisor inspects lines and floats (if required). ✓ Dive Supervisor inspects dive ladder or platform.
- Boats - Communications equipment - White's underwater magnetometer - Shark Marine Navigation System - RTK systems - SCUBA equipment - Fuel spill kit - Fuel container	• UXO personnel will meet training and experience requirements outlined in DDESB TP 18 • Site specific MEC training will be presented to all site personnel • All personnel will have MPPEH training • Equipment familiarity training • Site-specific training, slip/fall hazards • Site-specific training/lifting and carrying techniques • All site personnel will have current HAZWOPER training • Site-specific training in use of tools	✓ UXOSO will ensure that all controls are being followed, all equipment is being correctly utilized, and all personnel have received appropriate training. ✓ Equipment inspected daily prior to use by user and UXOSO. ✓ Daily serviceability check of magnetometers by user and UXOQCS.
- Hand and power tools	• Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	✓ Daily inspection by users/operators. ✓ SSHO inspect tools and power cords to ensure they are listed by a NRTL. ✓ Inspect for damage to tool and to cords.

Abbreviations and Acronyms:

AOC – Area of Concern
APP – Accident Prevention Plan
CHMM – Certified Hazardous Materials Manager
CIH – Certified Industrial Hygienist
CRL – Corporate Reference Library
CSP – Certified Safety Professional
dBA – decibels, A-scale
EHS – Environmental, Health, and Safety
ESP – Explosive Site Plan
EZ – Exclusion Zone
PPE – Personal Protective Equipment
MDAS – Material Documented As Safe
MEC - Munitions and Explosives of Concern
MPPEH – Material Potentially Possessing an Explosive Hazard
SSHO – Site Safety and Health Officer
SHM – Safety and Health Manager
SUXOS – Senior UXO Supervisor
UXO – Unexploded Ordnance
UXOSO – UXO Safety Officer
UXOQCS – UXO Quality Control Specialist

AHA #6 – Underwater MEC Investigation Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

This page intentionally left blank.

Activity Hazard Analysis (AHA) #7

<table>
<tr><td colspan="2">Activity/ Work Task: Demobilization and Site Restoration (Diving Ops)</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
<tr><td colspan="2">Project Location: Congaree River, Columbia, SC</td><td colspan="6">Risk Assessment Code (RAC) Matrix</td></tr>
<tr><td colspan="2">Contract Number:</td><td rowspan="2">Severity</td><td colspan="5">Probability</td></tr>
<tr><td colspan="2">Date Prepared: November 2021</td><td>Frequent</td><td>Likely</td><td>Occasional</td><td>Seldom</td><td>Unlikely</td></tr>
<tr><td colspan="2" rowspan="2">Prepared by: Don Schwalback, Diving Supervisor</td><td>Catastrophic</td><td>E</td><td>E</td><td>H</td><td>H</td><td>M</td></tr>
<tr><td>Critical</td><td>E</td><td>H</td><td>H</td><td>M</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">Reviewed by: Scot Wilson, PM</td><td>Marginal</td><td>H</td><td>M</td><td>M</td><td>L</td><td>L</td></tr>
<tr><td>Negligible</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td colspan="2" rowspan="5">Notes: (Field Notes, Review Comments, etc.)
In addition to the information listed in this AHA, all field personnel must review and be familiar with all provisions of the approved work plan. EM 385-1-1 and other regulations will also be available on-site for review of specific materials and mitigation measures.

Personal Protective Equipment for this AHA will consist of high visibility safety vest (in traffic areas) and hard hat (when working around heavy equipment and/or an overhead safety hazards exist), safety toed boots, safety glasses with side shields, standard work uniform (long pants, ¾ length sleeve shirt). Hearing protection (as required). Work gloves worn when indicated.</td><td colspan="6">Step 1: Review each “Hazard” with identified safety “Controls” and determine RAC (see above).</td></tr>
<tr><td colspan="3">“Probability” is the likelihood to cause an incident, near miss, or accident and is identified as Frequent, Likely, Occasional, Seldom, or Unlikely.</td><td colspan="3">RAC Chart</td></tr>
<tr><td colspan="3" rowspan="2">“Severity” is the outcome/degree if an incident, near miss, or accident did occur and is identified as Catastrophic, Critical, Marginal, or Negligible.</td><td colspan="3">E = Extremely High Risk</td></tr>
<tr><td colspan="3">H = High Risk</td></tr>
<tr><td colspan="3">Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each “Hazard” on the AHA. Annotate the overall highest RAC at the top of the AHA.</td><td colspan="3">M = Moderate Risk
L = Low Risk</td></tr>
</table>

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)			
Job Steps	**Hazards**	**Controls**	**RAC**
1. Arrival at Location	• Lack of emergency preparedness and health and safety (general) before beginning work	✓ SSHO to locate the emergency hospital and ensure routes are correct as shown in approved WP. ✓ Conduct site orientation with the crew involved in demobilization tasking including establishment of laydown areas, packing, loading and staging of materials and equipment and haul routes ✓ Review the APP and this AHA, and the Emergency Response Plan and document the training. ✓ Ensure communications are established and working properly among team members. ✓ Develop a plan for demobilization organization and tasking and emphasize communication ✓ Ensure emergency and basic safety equipment and PPE is located and available for use prior to starting site work. ✓ Use buddy system. ✓ SSHO will have site workers fill out medical data sheets that are included in an appendix to the APP ✓ Post the emergency evacuation routes and procedures as well as emergency contact list in a designated location until a permanent location is established at the field office trailer.	**L**
2. Loading and staging of materials and equipment for outbound shipment including site office/shop.	• Vehicle operations from TMR or other tenant operations and vendors could cause injury to personnel or others onsite	✓ Workers operating company or subcontractor vehicles will have a valid state issued driver's license and will be appropriately badged and cleared for entry per Installation requirements prior to entry. ✓ Any Commercial Driver's License (CDL) truck and trailers will be operated by CDL qualified drivers. ✓ Operate at safe speeds and obey local and facility-required traffic speeds (no more than 25 M.P.H.) and additional rules and restrictions to follow while on facility. ✓ Wear seat belt always when vehicle is in operation. ✓ Use chocks when parked on inclines. ✓ When motor vehicle except for auxiliary operation, is left unattended (operator is beyond 25 feet of view of vehicle), turn off the ignition, put the transmission in gear (park) and apply the parking brake. ✓ Yield the right-of-way to any emergency vehicles displaying a flashing light. Pull to right edge of road and stop until the approaching vehicle passes. Obey all signs. Yield to pedestrians. ✓ Use dedicated spotter and standard hand signals for backing operations.	**L**

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)			
Job Steps	**Hazards**	**Controls**	**RAC**
		✓ Wear class 2 high visibility vest when working around operating vehicle traffic.	
	• Ergonomic hazards such as sprains, strains, or back injury from lifting or repetitive actions	✓ Use mechanical lifting equipment or team lift when possible rather than by hand and tool methods. ✓ Do not bend at the waist, bend at the knees. ✓ Do not twist and turn while lifting. Keep the load centered and close to body. ✓ Do not lift more than 50 pounds (may be lesser for some workers) alone. ✓ Rotate tasks and take breaks when performing repetitive tasks and try to find the best position possible to perform the task.	
	• Slips, trips, and falls could lead to injuries	✓ Keep work areas free of debris and equipment in work paths. ✓ Follow good housekeeping in work areas. ✓ Correct hazards when seen, such as holes or other trip hazards. ✓ Conspicuously mark trip hazards that cannot be corrected ✓ The site trailer will be cribbed in level position. ✓ Tie down of the trailer will comply with EM 385 1-1, Section 04.A.03 requirements.	**M**
	• Handling sharp objects or using hand tools or knives could cause cuts, punctures, or scrapes	✓ Wear work gloves when handling materials that may be sharp or have sharp edges. ✓ Be familiar with the proper use and limitations of hand tools. ✓ Report even minor injuries to your supervisor for evaluation. ✓ Have a first aid kit available and have a minimum of 2 persons with first aid and CPR training onsite ✓ Ensure knives are folding type or have retractable blades.	**L**
	• Worker exposure to extreme temperatures and sunburn.	✓ Properly dress for the weather. ✓ SSHO to monitor weather and implement heat stress and cold stress controls as specified in the APP. ✓ Provide breaks for personnel to get either into cool (heat stress) or warm (cold stress) environment. ✓ Encourage a steady work pace. ✓ Ensure adequate potable drinking water is available. ✓ Know the signs and symptoms of exposure and keep an eye on your partner. ✓ SSHO to implement EHS 4-6, Temperature Extremes.	**L**
	• Severe weather can cause unsafe working conditions	✓ SSHO will monitor weather forecast at a minimum of two times per day or more.	**L**

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)

Job Steps	Hazards	Controls	RAC
		✓ Outdoor work will cease during extreme weather conditions, such as electrical storms, high wind, heavy rain and extreme temperatures that present unsafe working conditions. ✓ Shut all equipment down when lightning is visible and wait for "all-clear" from the SSHO (30/30 rule). Take cover indoors or in vehicle or heavy equipment cab (fully enclosed cab only).	
	• Eye injuries from dust or debris or struck by	✓ Wear safety glasses with side shields always when working. ✓ If something enters the eye, do not rub. ✓ Set up portable eyewash for flushing of eye to try to remove object. Notify supervisor so eye can be monitored. ✓ If object still irritates or stays in the eye, seek medical attention as soon as possible. Follow up with eye exam is recommended any time an object gets into an eye since it is necessary to ensure object does not remain, even if it cannot be felt. ✓ To keep dust down, travel at slower speeds on unpaved roads and laydown areas. ✓ If required, water mist can be used to control dust on roads and in laydown areas.	**L**
	• Wind could make materials hard to handle	✓ Avoid handling materials that could respond like a sail (e.g., plywood) in wind. ✓ Position vehicles so that doors do not get caught by the wind when opened. ✓ Hang onto door when opening and closing in high wind. ✓ Open and close doors carefully in the wind and only open one door at a time.	**L**
	• Noise could cause hearing loss and make it hard to communicate	✓ Hearing protection is required when sound levels exceed 84 dBA continuously. ✓ This rule applies to personnel working near or on heavy equipment and any other sources of loud noise. ✓ Generators, if used will be quiet in operation or will be shielded to minimize noise generation in common work areas so that hearing protection is not required to work in the area.	M
	• Lack of proper illumination in work areas could cause hazards to not be recognized or eye strain	✓ During demobilization, if lighting is not yet set up, temporary lighting such as portable bright lumen flashlights may be necessary if ambient lighting is not sufficient, especially within the trailer. ✓ Work during daylight hours or provide adequate lighting source for work areas as specified in the APP Night Operations Lighting Plan (currently limited to	L

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)			
Job Steps	**Hazards**	**Controls**	**RAC**
		daylight hours only) to minimize potential for injuries to occur from lack of visibility.	
	• Fall hazards (falls from heights of 6 feet or greater)	✓ Utilize fall protection when working at heights 6' or greater. ✓ Ensure ladders are stable and secured appropriately. ✓ Utilize 3 points of contact when ascending/descending ladders, stairs, equipment, etc. ✓ SSHO to identify site fall hazards and ensure appropriate controls are in place if workers could be exposed to a fall.	M
	• Head injuries from struck by or falling objects	✓ Wear hard hat when overhead hazards exist and when working in areas with operating construction equipment. ✓ Do not position under any suspended load at any time.	M
	• Contact with biting or stinging insects.	✓ Wear long sleeve shirts and long pants in areas where contact with mosquitos may occur. ✓ Use Environmental Protection Agency (EPA)-registered insect repellents with one of the following active ingredients: – DEET, picaridin, IR3535, oil of lemon eucalyptus or para-menthane-diol, or 2-undecanone. – Always follow the product label instructions. ✓ Workers will exercise caution when working in brushy or grassy areas, wood or debris piles, and recessed areas. ✓ Site orientation will include briefing on biological hazards associated with insects as well as local hazardous flora and fauna, signs and symptoms of exposure and precautions to take. ✓ Workers with allergies will let the SSHO know using the medical data sheet and will carry their own prescription medication as applicable. ✓ First aid and medical attention as required. Report any bites, stings, or rashes to the SSHO.	L
	• Electrical hazards could be present during tool use or during hookup of trailer	✓ Ensure that a certified electrician performs all electrical work to hook up office trailer to electrical power source. ✓ Electrician to properly ground systems in accordance with electrical code. ✓ Ensure that power cords are inspected and in good condition for use, that GFCIs are used properly, and portable generators are not overloaded. ✓ Ensure any power tools used are in good working condition and have third prong on cord or are double insulated.	L

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)			
Job Steps	**Hazards**	**Controls**	**RAC**
		✓ All live work requires arc flash protection. ✓ Contact SHM if there will be any live work so that additional precautions can be identified and incorporated into this AHA.	
	• Injury from improper use of power and hand tools	✓ Maintain steady pace when using tools and take adequate rest periods. ✓ Use appropriate tools for the task and maintain tools in good condition. ✓ Wear leather work gloves when using tools. ✓ Avoid working too close to other workers. ✓ Inspect all tools for damage before each use, including electrical cords/ pneumatic hoses. ✓ Ensure double insulation on electrical tools. ✓ Train personnel in the proper use of hand tools. ✓ GFCI required for all connections to outdoor use of power tool and other electrical equipment insulation.	M
	• Refueling of equipment use could present fire hazards or spills	✓ Only use a UL rated, National Fire Protection Association-approved fuel tanks and fuel transfer hoses. ✓ A minimum 60:BC fire extinguisher will be set up and staged within 50 feet of the fueling area and tank ✓ No smoking at any location unless specifically approved by the SS and SSHO and Installation requirements. ✓ Signage will be posted as flammable and no open flame. ✓ There are no matches or other flame producing materials allowed in the Restricted Area unless specifically permitted. ✓ Spill kit will be available in the refueling area (sorbent pads, kitty litter, gloves, waste bag). Fueling will be done over a secondary containment device to catch incidental fuel in case of overflow or drips. ✓ Operator will be present and have positive control on dispensing of fuel during filling operations at all times and a means to stop the flow of fuel. ✓ Tanks will be able to be monitored to gauge fuel level to prevent overfilling. ✓ Generators, if used will be equipped with mufflers/spark arresters. ✓ If mobile equipment or tools are refueled, the equipment will be turned off and allowed to cool prior to refueling.	L
	• Dry vegetation may be present and presents a potential fire hazard	✓ No smoking at any location except as specifically designated as smoking areas by the SS and as per Installation requirements. ✓ Do not refuel equipment in vegetated areas.	L

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)			
Job Steps	**Hazards**	**Controls**	**RAC**
		✓ No spark producing tasks or any other open flame tasks in areas of vegetation and not without a Hot Work Permit issued by the SSHO and removal of combustible materials including dry vegetation first. ✓ No spark producing tasks or flame producing equipment allowed in the Restricted Area.	
3. Backing of vehicles	• Failure of proper backing can cause struck by and pinch point injuries or property damage.	✓ Use spotters for all backing operations. ✓ Ensure spotter stands in line of sight of the person backing the vehicle. ✓ All personnel who back a trailer are trained and qualified to do so and are designated by the PM for such activities. ✓ Use boat checklist in APP prior to launching boat. ✓ Verify understanding of hand signals used for backing, going forward, stopping, and turning left or right. ✓ Use parking brake and ensure operator is not moving vehicle before unhitching boat from trailer. ✓ Follow EHS 6-6, Boating Procedure. ✓ Ground personnel involved in backing operations will wear class 2 high visibility vest.	M

AHA #7 – Activity/ Work Task: Demobilization and Site Restoration (Dive Ops)		
Equipment to be Used	**Training Requirements/Competent or Qualified Personnel Name(s)**	**Inspection Requirements**
Site vehicles	Drivers must have current state-issued driver's license.	Daily vehicle inspection by drivers. Receipt inspection by SSHO.
Boats	Qualified Operators will have USCG approved boater safety qualifications identified in the APP and experience in use of the boats on the project.	Inspect daily, and before use. Use the boating checklist form. Follow procedures in EHS 6-6, Boating Procedure
Hand and power tools	Training in use of hand and power tools by the SSHO or designee and review of operating manual. Use proper hand tool for the task.	Daily inspection by users/operators. Inspect tools and power cords to ensure they are listed by a NRTL. Inspect for damage to tool and to cords.
First aid kit, fire extinguisher, eyewash station	Use of emergency equipment including first aid kits, fire extinguishers and eyewash must be done by personnel familiar with this plan; use and inspection criteria of the equipment, and what the equipment is used for, are by or under direction of the SSHO	Fire Extinguisher – Initially and at least monthly thereafter by SSHO First Aid Kit – Weekly and after use for restocking by SSHO Eye Wash Station – Weekly by SSHO – Potable water changed weekly unless a preservative solution is used
Personal Protective Equipment	Users must be trained in the proper use of, limitations of, inspection of, donning and doffing of, and replacement of PPE used	Daily inspection by user before use.

Abbreviations and Acronyms:

AHA – Activity Hazard Analysis
APP – Accident Prevention Plan
dBA – decibels, A-scale
CFR – Code of Federal Regulations
DEET – N,N-diethyl-meta-toluamide
EHS – Environmental, Health, and Safety
EM – Engineer Manual
GPS – global positioning system
PFD – personal flotation device
PPE – personal protective equipment
RAC – Risk Assessment Code
RTK – real-time kinematic
SDS – Safety Data Sheet
SSHO – Site Safety and Health Officer
USCG – U.S. Coast Guard

AHA#7 - Demobilization and Site Restoration (Dive Ops) Signature Sheet

I have reviewed the above AHA and acknowledge the hazards involved with this work task and the controls that will help to minimize illness or injury during the tasks.

NAME	SIGNATURE	TITLE	DATE

This page intentionally left blank.

ATTACHMENT C

TETRA TECH STANDARD OPERATING PROCEDURES

This page intentionally left blank.

Status:	Approved	**Approved By:**	M.W.D. Mark W. Dollar, President
Version Date:	09/08/2021	**Title:**	HSE 1-10, Boating
Revision #:	Rev. 2	**Original Issue Date:**	03/31/2020
Category:	Procedure	**Sections:**	Safety
Reference Driver:	CFR 33/EM 385-1-1	**Document Type:**	Procedure
Keyword Index:	Boating/Health, Safety and Environmental	**Document Owner:**	Scot Wilson

1.0 PURPOSE AND SCOPE

The purpose of this procedure is to establish the minimum requirements for boating safety. This procedure applies to all Tetra Tech Munitions Response (TMR) project sites and activities, including subcontractor activities.

2.0 DEFINITIONS

Definitions are provided to understand their intent as they pertain to a procedure and projects requiring quality program planning.

A Master List of Definitions is located in the Corporate Reference Library on the intranet (https://tetratechinc.sharepoint.com/sites/OU-TMR). In addition, the following definitions are specific to this procedure.

Inshore/Nearshore- For the purposes of TMR boating operations, inshore operations typically consist of the use of a boat less than 26 feet (Class A or Class I) that will not operate more than 1 mile from the nearest land.

Offshore- For the purposes of TMR boating operations, offshore operations typically consist of the use of a boat greater than 26 feet (Class II, Class III, or greater) that will operate more than 1 mile from the nearest land.

Boat – Any powered or non-powered watercraft utilized for the transport of personnel on a body of water.

Class	**Description**
Class A	Less than 16 feet (4.8 meters) length overall
Class I	16 feet (4.8 meters) to less than 26 feet (8 meters) length overall
Class II	26 feet (8 meters) to less than 40 feet (12 meters) length overall
Class III	40 to 65 feet (12 to 20 meters) length overall
Small Research Vessel (SRV)	Greater than 65 feet (20 meters) length overall but less than 300 gross tons
Diving Support Vessel (DSV)	Greater than 65 feet (20 meters) length overall but less than 300 gross tons

3.0 PROCEDURE

3.1 Responsibilities

3.1.1 Line Management

Project manager (PM) is responsible for coordinating with the dive program safety officer to implement the requirements of this procedure. The PM shall provide the necessary management support and allocate enough project resources to enable project personnel to operate boats in a safe manner.

Site managers (SMs) and supervisors are responsible for implementation of this boating safety program in the field.

3.1.2 HSE Personnel

The Health, Safety, and Environmental (HSE) director shall ensure that the requirements of this program are incorporated into site HSE plans.

3.1.3 Boat Captain

The captain of the boat is responsible for the overall health and safety of those on the boat. The boat captain shall ensure that all persons on the boat are given a safety orientation regarding emergency procedures. The boat captain shall also ensure that safety requirements in the applicable safety plan governing the work, such as the use of personal protective equipment, are implemented. The captain is also responsible for the inspection of the boat being used and for having the proper safety equipment, in good working order, on the boat. The captain of the boat will have the final say concerning safety, specifically concerning that of the personnel and craft during operations.

3.2 General Requirements

3.2.1 Boating Towing and Launching

Those TMR personnel who will tow a boat on a trailer to the launching site will be experienced in this capacity and be responsible for reviewing the Boat Pre-Operation Checklist prior to departure. This person will ensure that the boat is not loaded with project equipment, which will overload the bearings and axle weight capacity. Overweight equipment should be carried in another vehicle or the towing vehicle.

The PM must designate a person experienced in towing a boat, launching, or piloting a vessel. This person must have attended a nationally recognized boating safety class (i.e., United States Coast Guard [USCG] Auxiliary or Power Squad). Pre-launch checks will be done before the boat is backed into the water. This includes checking the engine oil and/or fuel mixtures in the tanks. Any mixing of fuel and oil will be done in a separate Underwriters Laboratory (UL) approved flammable liquid storage container prior to filling the vessel tanks. This will ensure the gas/oil mixture is correct.

Whenever possible, perform fuel mixing and transfer in an environmentally safe area where spills can be easily cleaned.

To launch the vessel, back part of the way down the boat ramp, remove the rear tie down straps to the trailer, ensure the boat plug is installed, and continue backing into the water's edge. Place the fenders/bumpers on the side that will be in contact with the pier, to prevent damage. Ensure that the bow and stern lines are being handled by personnel on the pier as the vessel is backed further into the water—until the vessel is floating freely. An alternative plan is to have the coxswain in the boat lower the engine and start it when the rear is in the water and floating free from the trailer. Carefully back the boat with the engine clear of the trailer. Pull the truck and trailer forward and park and secure. Secure the bow and stern lines to the dock and load additional equipment. Lower the engine/out drive, if applicable, and start the engine. Once warm, check all indicators and gauges to ensure that the motor is working properly.

For vessel recovery, reverse the process listed above. Back the truck and trailer down the ramp and place the truck in park with the emergency brake on. Keep the bow winch connected to the vessel until the vessel is out of the water and onto the trailer. Raise the motor/outdrive and secure in the up position. Once the vessel is trailered, remove additional equipment as necessary to reduce weight; and secure the vessel to the trailer with bow and stern straps and the safety chain near the winch. The vessel is not to be towed with a person in the vessel.

3.2.2 Boat Operators

Only designated TMR personnel who meet appropriate Federal, State or local training requirements shall operate a boat during a project. These requirements are a valid USCG license for vessels over 40 feet (12 meters) or any USCG recognized training such as the USCG Auxiliary Boating Skills and Seamanship Training for vessels less than 40 feet (12 meters).

Boat operators must possess basic knowledge to troubleshoot common mechanical problems that can occur on the boat. The boat operator shall be responsible for all personnel's safety on board the boat and for the integrity of all boat and safety equipment.

Each designated boat operator shall give a safety briefing to boat occupants prior to leaving shore. **Boats are to be occupied during use by not less than one qualified operator plus one additional person.** If the "additional person" is not a qualified operator, a basic safety and operations demonstration will be conducted before launching.

3.3 Logbook

Boat captains shall maintain a logbook for each vessel. The logbook will be used to note weather, tides, maintenance issues, equipment status, and to record completion of the safety orientation given to each day’s passengers. Captains will make notes of any additional observations regarding the boat and its safe operation. This logbook will be kept with the vessel.

3.4 Float Plan

A Float Plan shall be filled out by the boat captain, unexploded ordnance (UXO) safety officer (UXOSO) or field operations lead (FOL) for all trips made by boat using the USCG Float Plan (Attachment 2). The UXOSO or FOL shall always be aware of the location of all project boats and designated use personnel. If several boats and crews are involved in the work or are traveling to remote areas, each designated boat operator shall file a written USCG Float Plan or equivalent with the UXOSO or SM/FOL. This plan can be filed electronically, via email or text message, if necessary. The Float Plan shall include the following:

- The names of the boat operator and passengers.
- A description and registration numbers of the boat.
- Radio call sign or cellular telephone number if boat is so equipped.
- A trip itinerary with expected time and location of return.
- Steps the UXOSO or SM/FOL will take to initiate a search response if the expected time of return is exceeded.

A Float Plan shall be prepared by each designated boat operator and approved by the PM, UXOSO, and/or qualified person prior to the activity. For boats that are operated with one crew, the Float Plan shall be developed that ensures the boat returns to the dock in no more than 12 hours.

3.5 Boat Registration and Numbering

The UXOSO or SM/FOL shall ensure that all project boats meet USCG or state boat registration and numbering requirements. The USCG requires that all motorized boats be numbered in the state of principal use. Many states also require that certain non-motorized boats be numbered (sailboats, rafts, and dinghies). A valid certificate or number showing the numbers issued to the boat is required to be on board the boat whenever the boat is in use. Boat registration numbers are required to be painted or permanently attached to the outside of each side of the forward half of the boat. Boat registration must be updated annually or as required by the registering state.

3.6 USCG -Approved Equipment

All TMR project boats will meet or exceed USCG requirements for safety equipment. These requirements are summarized below for small craft (less than 40 feet or 12 meters in length). The UXOSO or SM/FOL shall consult with the HSE director if larger craft are required.

3.6.1 Flame Arresters

All gasoline engines, except outboard motors, installed in a boat must have an approved flame arrestor (backfire preventer) fitted to the carburetor/intake.

3.6.2 Sound Signaling Devices

Although not required for small craft, all TMR boats shall carry at least one air horn or similar sound-signaling device.

3.6.3 Personal Flotation Devices

All TMR personnel and passengers shall always wear an approved personal flotation device (PFD) when operating or being transported in a boat. A positively buoyant wet suit may be substituted for a PFD. PFDs shall be Type III or higher (capable of turning its wearer in a vertical or slightly backward position in the water). Automatic inflating PFDs can be used providing that they are approved in the HSE Plan, and Activity Hazards Analysis addresses its use. For persons less than 90 pounds, a child PDF must be used. PDFs shall be inspected, maintained, and stored in accordance with the manufacturer's instruction. In addition, each boat up to 26 feet (8 meters) in length shall be equipped with at least one Type IV PFD ring buoy, 24 inches (6 meters) in diameter with 90 feet (27 meters) of buoyant line attached, designed to be thrown to a person in the water, grasped and held by the user until rescued.

A buoyant boat cushion equipped with straps and a float ring are two common examples of additional types of life rings that can qualify as a Type IV PFD and help in a rescue.

For boat operations in cold water environments, immersion/exposure suits will be required for each person on board based on the location of boat operations listed below.

AREA OF OPERATION	VSL TYPE	DEVICE
Seaward of the Boundary Line, north of 32ºN, or south of 32ºS, and Lake Superior.	Documented	Immersion Suit/Exposure Suit
Coastal Waters on the West Coast of the U.S. north of Pt. Reyes, CA; Beyond coastal waters, cold waters; and Lake Superior	All	Immersion Suit/Exposure Suit

3.6.4 Fire Extinguishers

Each boat used by TMR personnel less than 26 feet (8 meters) shall carry at least one Type 1-A:10-B:C fire extinguisher (for use in gasoline, oil, and grease fires) approved by UL. Motorboats or skiffs over 26 feet (8 meters) will have a minimum of two 1-A:10BC fire extinguishers available. Larger craft will have additional requirements. Each fire extinguisher shall be inspected by the UXOSO or SM/FOL at least once every week to ensure that it is sufficiently charged and that the nozzles are free and clear. Discharged fire extinguishers shall be replaced or recharged immediately. The number and sizes of extinguishers required will depend on the vessel size and applicable regulations.

3.6.5 Navigation Lights

All TMR project boats shall be equipped with navigation lights. These lights shall always be utilized when operating between sunset and sunrise. Navigational lighting shall meet all USCG requirements. Boats shall be operated at reduced speeds at night and when visibility is reduced.

3.6.6 Visual Distress Signals

All TMR boats shall carry a selection of pyrotechnic and non-pyrotechnic visual distress signals. Pyrotechnic visual distress signals include red flares, orange smoke (day use only), and aerial red meteor or parachute flares. No pyrotechnic visual distress signals include an orange distress flag (day use only) and a flashlight or other electric distress light (night use only). No single signaling device is ideal under all conditions and for all purposes. Pyrotechnic visual distress signals shall not be used past the expiration date.

3.6.7 Pollution Control

The Refuse Act of 1899 prohibits the throwing, discharging, or depositing of any refuse matter of any kind (including trash, garbage, oil, and other liquid pollutants) into the waters of the United States (U.S.). The Federal Water Pollution Control Act prohibits the discharge of oil or hazardous substances in quantities that may be harmful into U.S. navigable waters. No person may intentionally drain oil or oily wastes from any source into the bilge of any vessel. Vessels 26 feet (8 meters) and greater in length, with machinery spaces, must display a placard fixed in a conspicuous place in the machinery spaces, or at the bilge pump control station stating the rules of the Federal Water Pollution Control Act governing the discharge of oil or oily waste to the water (see Reference No. 3). Pumping of bilge water without using an oily-water separator should be undertaken with caution. Any vessels equipped with toilet facilities must be equipped with a USCG-approved marine sanitation device and shall observe all no-discharge areas shown on National Oceanic and Atmospheric Administration (NOAA) charts.

TMR employees shall report any significant oil spills to water to the HSE director who must report the spill to the USCG or other applicable regulatory agency. The procedure for incident reporting and investigation shall be followed when reporting the spill. (See Tetra Tech Safety Manual, DCN 02-02, Incident Reporting & Investigation Program)

3.7 Weather

A daily weather check shall be conducted prior to any boating operation. If severe weather is forecast, work should be delayed or cancelled. All HSE plans covering boating operations shall address the hazards that weather poses to boating operations, and specific actions to be taken to avoid these hazards. The field supervisor in consultation with the boat captain, site safety and health officer and PM shall establish maximum sea state or go/no-go criteria, ensuring compliance with the applicable project safety plans, prior to the beginning of operations.

3.8 Load Capacity

Boats less than 20 feet shall not be loaded (passengers and gear) beyond the weight capacity printed on the USCG capacity plate attached to the stern. For boats without capacity plates, the licensed captain/trained operator shall evaluate the safe loading of crew, cargo, and equipment on a trip-by-trip basis. Several factors must be considered when loading a boat: distribute the load evenly; keep the load low; do not stand up in a small boat or canoe; and do not overload the boat.

3.9 Tool Kit

All TMR motorized boats shall carry a tool kit with enough tools for the boat operator to troubleshoot common mechanical problems such as fouled spark plugs, flooded carburetor, electrical shorts, etc. Boats operated in remote areas shall also carry appropriate spare parts (e.g., propellers, shear pins, patch kits, air pumps). The tool kit shall be maintained by the boat operator, with supplies replaced immediately upon use.

3.10 Survival Kit/Ditch Bag

All TMR boats utilized in remote areas shall carry a survival kit. The survival kit shall contain, at a minimum: a first aid kit; high-energy canned or preserved foods; drinking water; blankets; a heat source; signaling devices; waterproof matches; and other items as necessary to ensure survival for a minimum of 24 hours for the entire crew. For offshore work, a “ditch bag” consisting of an Emergency Position-Indicating Radio Beacon (EPIRB); handheld very high frequency (submersible) signaling devices – visual and audible; and/or strobe light or light stick may be required. The ditch bag should be waterproof, float and preferably be high visibility in color. Survival suits may be required by the HSE plans for operations in cold environments.

3.11 Communications

All TMR boats operated in remote areas shall carry a two-way radio or cellular telephone that enables communication back to the field camp or other pre-established location. Exceptions to this requirement must be negotiated with the HSE director. Additional communication and locating methods may be utilized such as SPOT Messenger, global positioning system, EPIRB, and satellite telephones.

3.12 Boating Accident Report

The USCG requires filing a boating accident report within 24 hours of an accident (death, disappearance overboard, medical treatment beyond first aid, property damage > $2000, or if the boat is destroyed).

TMR personnel involved in a boating accident shall follow the procedure outlined in HSE plans and Tetra Tech's Safety Manual, Incident Reporting and Investigation Program (DCN 02-02), for accident and injury reporting. This procedure will provide for proper notification of the USCG.

3.13 Good Housekeeping

TMR personnel using a boat shall properly stow and secure all gear and equipment against unexpected shifts when underway. Decks and open spaces must be kept clear and free from clutter and trash to minimize slip, trip, and fall hazards.

3.14 Fuel Management

TMR personnel shall utilize the "one-third rule" in boating fuel management. Use one-third of the fuel to get to the destination, one-third to return, and keep one-third in reserve.

3.15 Training

Boat operators shall be trained on, and pass the test of, a nationally recognized boating safety organization such as the USCG Auxiliary or Power Squadron. All operators and passengers shall be trained on the requirements of this program. Training records shall be maintained in accordance with the Tetra Tech Safety Manual, DCN 01-04, Recordkeeping and Reporting Requirements.

3.16 Operations

Operations of motorboats/skiffs can be hazardous to personnel considering other boaters, weather conditions, the task assigned, and the condition of the boat/skiff you are operating. Ensure Boat Pre-Operation Checklist is completed before departing the launch area. The boat captain or designee must utilize and fill out the checklist each day the vessel is used (use is defined as being launched from the trailer or departing the dock or moorage) and submit it to the UXOSO or FOL. This checklist can be filed electronically, via email or text message, if necessary.

When operating in restricted waters, near shipping channels, in rough fast flowing water, or near obstacles that could damage or capsize the boat, plan for emergency rescue in case the boat motor fails, or you become incapacitated from operating the boat and you are in personal danger. Consideration would be for a second motor or a safety boat operating in the area or other rescue capability available.

4.0 REFERENCES

CFR Title 33, Navigation and Navigable Waters, Chapter I - Coast Guard, Department of Homeland Security (Parts 1-199), Subchapter S, Boating Safety (Parts 173-199), Retrieved from https://www.gpo.gov/fdsys/granule/CFR-2010-title33-vol2/CFR-2010-title33-vol2-chapI-subchapS

USACE EM 385-1-1 (November 30, 2014), Safety and Health Requirements Manual. Retrieved from https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf

Title 33 USC. Chapter 9 Protection of Navigable Waters and of Harbor and River Improvements. Subchapter I - In General. 407 - Deposit of refuse in navigable waters generally. (pp. 46). Retrieved from https://www.gpo.gov/fdsys/pkg/USCODE-2011-title33/pdf/USCODE-2011-title33-chap9-subchapI.pdf

Tetra Tech Safety Manual, Incident Reporting and Investigation Program, DCN 02-02.[1]

Tetra Tech Safety Manual, Recordkeeping and Reporting Requirements, DCN 01-04.[2]

U.S Department of Homeland Security. United States Coast Guard Auxiliary (2015 v.10.2). USCG Float Plan. Retrieved from http://www.floatplancentral.org

DOC NOAA. Office of Marine & Aviation Operations. NOAA Small Boat Standards and Procedures Manual (April 30, 2018, 4.1 Edition), Retrieved from https://www.omao.noaa.gov/sites/default/files/documents/2018%200430%20SBS%26PM%204.1.pdf.

5.0 RECORDS

Records associated with the awareness and recognition programs will be retained in the appropriate project or office files.

6.0 GUIDELINES

HSE-25 Boat Pre-Operation Checklist

HSE-26 Float Plan Template

7.0 APPLICABLE ISO17025 CLAUSES

None.

[1] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/02_General%20Health%20and%20Safety%20Programs/DCN%2002-02%20Incident%20Reporting%20and%20Investigation%20Program.pdf

[2] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/01_Health%20and%20Safety%20Program%20Administration/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

TETRA TECH

UXO SOP for MEC Management and Disposal

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct MEC Management and Disposal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman	P. Tatman	Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP MEC Management and Disposal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

This Standard Operating Procedures (SOP) provides Munitions and Explosive Concern (MEC) management and basic explosive demolition procedures for the treatment of MEC and material potentially presenting material potentially posing an explosive hazard (MPPEH) found during the MEC activities on Munitions Response Site (MRSs). These procedures will be conducted in accordance with the Quality Assurance Project Plan (QAPP) or equivalent planning documents.

This SOP provides the detailed information needed to safely configure, conduct demolition procedures, and perform post demolition inspection and area restoration. These operations include:

- Documenting the recovery, accountability, and management of MEC/MPPEH
- Conducting disposal operations involving MEC/MPPEH
- Post disposal operations

All training on equipment or software will be either formal or on-the-job training (OJT). Training will be documented by site personnel and subject to review for accuracy and completeness. The Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) will verify training is completed and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 PERSONNEL REQUIREMENTS

Explosive demolition operations require specific organizational roles and personnel assignments, specifically:

- Senior Unexploded Ordnance Supervisor (SUXOS), to oversee all demolition operations.
- Demolition Supervisor (DS), an Unexploded Ordnance (UXO) Technician Level III or above, designated by the SUXOS. The DS is responsible for planning, directing, and executing all demolition operations. The SUXOS may perform duties of the DS based on the project manning.
- Unexploded Ordnance Safety Officer (UXOSO), ensures that all demolition operations are performed safely and following the approved site-specific plans.
- Two Unexploded Ordnance Technicians Level II or I, designated to assist the DS.

2.2 EQUIPMENT

The Demolition teams conducting MEC management and disposal tasks will be equipped with the following:

- Analog Geophysical Sensor
- Disposal equipment
- Donor explosives
- Logbook and/or personal digital assistant (PDA) for recording data
- Camera

3.0 PROCEDURES AND GUIDELINES

3.1 MEC/MPPEH MANAGEMENT

When MEC and MPPEH are discovered, they are inspected and positively identified using a three-tiered inspection process while the munitions are left in place.

1. Inspected first by the UXO technician discovering the munition(s) to determine if it is MEC or MPPEH,
2. Second by a UXO Tech II to independently classify the munitions(s), and
3. Third by the UXO Tech III, Team Leader.

For MEC/MPPEH, the SUXOS and UXOSO must assess and agree that the risk associated with the movement of MEC or suspected munition is acceptable and necessary. They will document the decision in writing. If necessary, the Director of Technical Operations and Explosives Safety will be consulted and concur with the decision to move the ordnance. Based on knowledge of the site, this may be accomplished before field operations beginning.

If MEC/MPPEH are determined by the SUXOS and UXOSO to be unacceptable to move, they will be conspicuously marked, secured, and scheduled for Blow-in-Place (BIP) treatment by a demolition team.

All MEC shall be secured or guarded by a UXO technician or approved security personnel until demolition operations.

All MEC will be photographed, and as much information as possible will recorded on the dig sheet or PDA. Recorded data to include nomenclature (if known), type (projectile, mortar, rocket, mine, etc.), size, physical condition, fuzed or unfuzed, fuze type by function (e.g., point detonating, mechanical time, etc.), condition (e.g., fired or unfired, armed or unarmed), filler if known, Global Positioning System (GPS) coordinates (if different from the relocated position) and depth.

3.2 NOTIFICATIONS

The SUXOS will ensure that the agencies responsible for emergency response are notified as far in advance as possible that demolition activities will be taking place. The notifications should address scheduling, evacuations, road closures, exclusion zones (EZs), and any other required support. Table 1 provides a list of emergency telephone numbers and contacts.

Table 1: Emergency Contact Numbers

Contact	Phone Number
Fire Department	
EMS	
Police	
FAA	
Base Operations	
Anyone else not listed….	

3.3 EXCLUSION ZONES, ENGINEERING CONTROLS, AND ROAD CLOSURES

Engineering controls should be employed whenever possible to minimize the damage from demolition operations. These controls may consist of sandbags, ecology blocks, trenching, buttressing, taping of glass, mounding, flooding and/or venting to reduce the effects of detonations.

The SUXOS will ensure EZ barricades are set up with signs at all access roads and marked appropriately: Danger, UXO Remediation Project in Progress, DO NOT ENTER, and list contact information on the barricade sign.

3.4 WEATHER AND ENVIRONMENTAL CONSIDERATIONS

Before commencing demolition operations, the SUXOS or UXOSO will obtain a local weather report.

Demolition operations will not be conducted if electrical storms are within 10 miles of the demolition site or during severe weather conditions that would impact safety.

The SUXOS and UXOSO will decide on whether wind speed and visibility will hamper the safe execution of demolition operations.

3.5 FIRE SUPPORT

The telephone number of the responding fire departments will be posted in plain sight at the site office and the disposal site.

The Fire Department nearest the disposal site location will be notified of disposal operations each day.

When the fire hazard is high due to dry conditions, disposal operations will not be conducted unless mobile fire-fighting equipment is standing by and the fire department is capable of responding within five (5) minutes.

Fire extinguishers, portable water tanks, and shovels will be on-site to fight small fires. Evacuate the area if the fire approaches ordnance or explosives. Do not fight grass fires in areas where there may be ordnance or kick-outs.

Conduct a fire risk assessment before conducting disposal operations to consider the type of ordnance to be disposed of, environmental conditions on the site, and appropriate preventative measures to be employed before initiation of explosive procedures.

Consider preventative measures to include: Movement of the MEC to a prepared site, if possible, ground preparation to include scraping and vegetation removal, wetting of the site just before the commencement of operations, and tamping of the shot with sand, or water.

3.6 DEMOLITION OPERATIONS

3.6.1 Demolition Briefing

The DS will brief all personnel involved in range operations in the following areas:

- General Safety Precautions
- Type of MEC or MPPEH being destroyed
- Type, placement, and quantity of demolition material being used

- Method of initiation (electric or Nonel)
- Team assignments
- Equipment being used (e.g., Remote Firing Device [RFD], galvanometer, blasting machine, firing wire, etc.)
- Misfire procedures
- Post-shot cleanup of range procedures
- Emergency procedures

3.6.2 Preparing Donor Charges for Initiation

One Pound Pentolite Booster

1. Insert the 80-grain detonating cord into the detonator well. Insert all the way through the first hole and back through the second hole, then tie an overhand knot to secure it.
2. When using more than one booster, insert the detonating cord through each of the booster's detonator wells and secure to keep it from sliding along the detonating cord.
3. Place the booster on the MEC/material documented as an explosive hazard (MDEH) using tape or other suitable material to prevent it from moving.

Jet Perforator

1. Using tape or detonating cord clips secure the detonating cord to the jet perforator.
2. Place the jet perforator on the MEC/MPPEH using tape or other suitable material to prevent it from moving.

Binary Explosives

1. Obtain part A and part B.
2. Mix per manufacturer requirements and the site where the operation will be conducted.
3. Place on item in same manner as booster and as discussed during demolition briefing.

3.6.3 Initiation Set-ups

The UXOSO will act as a safety observer during demolition set-ups and will depart the range/demolition area before the demo team priming the donor charge. He/she will maintain communications with the team, the SUXOS, and Site Field Office at all times.

A maximum of 2 people will prime the shot. All others will be located outside the EZ.

Electric Blasting Cap

- Prior to making a connection with the electric blasting cap, the firing circuit will be continuity tested.
- All parts of the firing circuit will be kept insulated from the ground or other conductors such as bare wires, rails, pipes, or other paths of stray current.
- The shunt will not be removed from the wires until the individual performing the operation has been grounded. Electric blasting caps will be connected to the firing circuit before connection to the main initiation charge.
- Electric blasting caps of different manufacturers or types will not be used in the same system.
- The electric blasting caps will be tested for continuity with a galvanometer at least 50-ft (15.2-m) downwind from any explosives before connecting them to the firing circuit. After the testing is completed, the lead

wires will be short-circuited by twisting the bare ends of the wires together. The wires will remain shunted until ready to connect to the firing circuit.

- The electrical lead wires of electric blasting caps, detonators, or other electro-explosive devices should not be pulled; detonation may occur.
- The legs should be unrolled so that the cap is as far as possible from the operator and pointing away from him before testing.
- The blasting cap will be placed in a hole, behind a barricade, or under a sandbag before removing the shunt and testing for continuity. The cap should not point toward other personnel or explosives. Always test at the extent of lead wires with ones back towards the blasting cap.
- Only authorized and serviceable testing equipment will be used.
- The remote receiver will not be connected to the firing wires until all pre-firing tests have been completed, and all preparations have been made to fire the charge.

Nonel Blasting Cap

- No testing required
- Blasting cap should be placed in a hole, behind a barricade, or under a sandbag before priming.
- The blasting cap should not point towards other personnel or explosives.

Nonel Lead Line Splicing

- Care should be taken to keep moisture from the cut end of the shock tube.
- The DS or designated UXO Technician will perform the following procedures to cut and splice the shock tube.
- Minimize the number of splices in a shock tube line to as few as possible.
- Lead Line splicing procedure as follows:
    1. Use a sharp knife or razor blade to squarely cut (at a 90-degree angle) approximately 12 inches from a new roll or the cut-off end of a partial roll.
    2. Loosely tie the two-shock tube ends to be spliced together. Leave at least 2 inches free at the end of each shock tube beyond the knot.
    3. Pull the shock tube lightly to tighten the knot, but not so tight as to significantly deform the shock tube in the knot.
    4. Use only the splicing tubes provided to make splices. Taping the two cut ends of the shock tubes together does not make a reliable splice.
    5. Push one of the free shock tubes, to be spliced, firmly into one of the pre-cut splicing tubes at least 1/4 inch.
    6. Push the other shock tube end firmly into the other end of the splicing tube at least 1/4 inch. Attempt to push the two ends up against each other or get as close as possible.

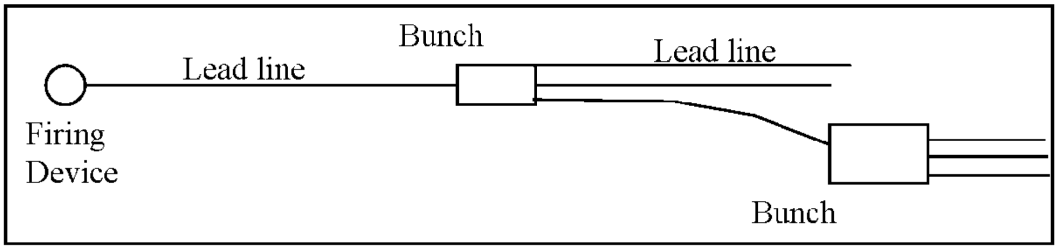
Nonel Lead Line Preparation

The DS or designated UXO Technician will perform the following procedures to set up the lead line.

1. Layout the required length of lead line from the demolition area back to the firing point.
2. Attach an EZTL 30 Bunch Block (or equivalent method) to the lead line at the demolition site using the supplied splicing tube.
3. Secure the bunch block or immobilize with sandbags.
4. Run additional lead line(s) from the bunch block to the MEC/MPPEH (see Figure 3-1).

Note: Only attach a maximum of six additional leads per bunch block. Use additional bunch blocks, if necessary.

Figure 3-1 Nonel Lead Line Setup



3.6.4 Initiation Systems

The firing system will use RFD with Nonel or electric blasting caps. As a back-up to the RFD, the Scorpion Electronic Blasting Machine with electric caps or Nonel will be used.

Remote Firing Device Preparation

1. Perform system pre-operational test and set up using the operator's manual. Remove key from controller unit until ready to fire.
2. Place the remote near the detonation site with the antenna in the vertical position. If using electric caps, the remote should be within 100 feet of the shot. Using the unit blast shield, sandbags, or natural cover to protect the remote.
3. Ensure the remote indicates a READY condition for the selected initiation method (green READY LED on steady, red ARMED LEG off).
4. If using Nonel, connect the shock tube to the igniter tip. The tube should be wrapped around through holes in the tip's molded casing to keep it from falling out. Prime the shot and return to the safe area.
5. If using electric caps, cut off a length of firing wire that will reach between the remote and the charges (100' or less).
6. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
7. Test each electric blasting cap 50 feet downwind of other explosives with a galvanometer.
8. Place blasting caps in a hole, behind a barricade or under a sandbag before removing the shunt and testing for continuity.
9. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
10. Secure the leg wires to prevent the cap from moving during the test.
11. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
12. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
13. For dual priming connect blasting caps in a parallel circuit to the extension wires.
14. Test the circuit with the Galvanometer, and then connect extension wires to the remote.
15. Retrieve caps from barricade, prime shot, and return to safe area.

Scorpion Electronic Blasting Machine Preparation

1. Perform pre-operational check as per instructions on blasting machine.
2. Layout firing wire or Nonel.
3. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
4. Test each blasting cap with a galvanometer 50 feet downward of other explosives.
5. Place blasting caps in a hole, behind a barricade or under a sandbag before removing the shunt and testing for continuity.
6. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
7. Secure the leg wires to prevent the cap from moving during the test.
8. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
9. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
10. For dual priming connect blasting caps in a parallel circuit to the firing wire.
11. Retrieve caps from barricade, prime shot, and return to safe area.

Initiation Sequence

The SUXOS or DS will ensure that the actions taken before initiating a demolition shot are completed as follows.

1. Ensure all required notifications have been made.
2. Set up EZ and post guards at the barricades.
3. Visually inspect EZ and surrounding area for unauthorized personnel.
4. **Five-minute warning**. The DS will give the five-minute warning on the radio, followed by a one-minute series of long blasts on the air-horn.
5. **One-minute warning**. The DS will give the one-minute warning on the radio, followed by a one-minute series of short blasts on the air-horn before the shot. At this time, the arming of the RFD or Blasting Machine will occur.
6. Before initiating the shot, the DS will give three loud "*Fire in the Hole!*" warnings and then give the “fire” command on the radio.

Firing the Remote Firing Device

1. Install the key and engage the "POWER" switch on the controller to the right until the BATTERY LED illuminates.
2. Momentarily depress the controller STATUS button. The yellow TRANSMIT LED will flash for approximately one second. At the end of this time, a green READY LED will come on steady, indicating that the remote is on and in the standby mode. The steady green LED also means the remote is within range of the controller.
3. Push the ARM/DISARM switch to the left and hold for one second. The red ARMED LED will flash for approximately 18 seconds then come on steady. The remote is now armed.
4. The SUXOS or DS gives three loud "Fire-in-the-Hole" warnings.
5. Then the SUXOS gives permission to fire the shot.
6. Lift the safety cover on the FIRE switch and push the FIRE switch forward.

Firing the Scorpion Electronic Blasting Machine

1. Connect the firing leads to the terminal posts of the blasting machine.
2. For Nonel plug in the shock tube adapter and attach Nonel.
3. SUXOS or DS gives three loud "Fire-in-the-Hole" warnings.
4. Then the SUXOS gives permission to fire the shot.
5. Degrees and hold CHARGE button (keep depressed throughout sequence).
6. Press DETONATE button when green ready light comes on. For non-electric shots hold DETONATE button down for one second and release.

3.6.5 Misfires

If a misfire does occur, it must be cleared with extreme caution. The responsible technician will investigate and correct the situation using the steps outlined below.

Misfire Procedures for the Remote Firing Device

1. Make three successive attempts to fire.
2. Turn off the controller and remove the key.
3. Wait 1 hour from the last initiation attempt.
4. After the wait time has elapsed, the SUXOS or DS and one other UXO technician will proceed downrange to inspect the firing system.
5. Disconnecting from RFD:
   - 5.1 If Nonel was used, do not remove the caps from the charge. Disconnect Nonel from the igniter tip on the remote firing device.
   - 5.2 If electric caps were used, remove the old blasting caps from charge and disconnect from extension wires. Shunt cap leg wires.
6. Set up new firing system.

Misfire Procedures for the Scorpion Electronic Blasting Machine

1. Make three successive attempts to fire.
2. If using firing wire and still unsuccessful disconnect wires and check continuity.
3. If continuity is good, reconnect to blasting machine and make three more attempts to fire.
4. If still unsuccessful check connections of firing wires to terminals and make three more attempts to fire.
5. Change blasting machine after third unsuccessful attempt.
6. If unsuccessful with new blasting machine disconnect and shunt firing leads.
7. If using Nonel disconnect from blasting machine.
8. Wait 1 hour from the last initiation attempt.
9. After the wait time has elapsed, the SUXOS or DS and one other UXO technician will proceed downrange to inspect the firing system.
10. Clearing the primed shot:
    - 10.1 If electric caps were used, remove the old blasting caps from charge and disconnect from firing wire. Shunt cap leg wires.
    - 10.2 If detonating cord was used cut detonating cord between cap and charge, disconnect cap from fire wire. Shunt cap leg wires.
    - 10.3 If Nonel was used, do not remove the caps from the charge. Place a new, primed explosive charge next to the misfired charge.
11. Set up new firing system.

3.6.6 Post Demolition Procedures

1. Wait the designated wait times specified by the SOP. A minimum of 5 minutes after a single shot or after a series of shots that can be counted. A minimum of 30 minutes after multiple shots that could not be counted.
2. The SUXOS or DS and one other UXO technician will return to the detonation site and check the results of the shot. If the procedure was successful, the demo supervisor will call in additional personnel to clean up the site. UXO personnel will conduct a visual sweep of the detonation site and the immediate area to gather fragments and explosive residue if present.
   - 2.1 Metal fragments will be examined to ensure complete consumption of explosive material.
   - 2.2 Explosive residue will be collected and detonated.
   - 2.3 Intact MEC items will be disposed of if they fail to detonate.
3. After the area is swept and cleared, the SUXOS or DS will notify the remaining personnel over the radio that the "All Clear" is given.
4. Backfill hole, as necessary.
5. Recover all equipment.

3.7 DOCUMENTATION

Forms and checklists should be generated and/or modified to meet site-specific requirements. The forms provided in this SOP may be used, or alternate forms containing the same information may be used. The SUXOS will make this determination. For disposal operations, the SUXOS or the UXO DS will, as a minimum, complete the following.

- General Safety Precautions
- Disposal Operations Checklist
- Explosive Disposal Log

4.0 QUALITY CONTROL

The MEC Management and Disposal operations will meet the quality control (QC) performance objectives identified in the QAPP or equivalent planning document and the attached quality control inspection checklist.

The QC team will verify the quality of the task through the three phases of the control process and document the results as described in the QAPP or equivalent planning document. Any tasks the QC team determines do not meet the quality control metrics, will be considered deficient or non-conforming. If a deficiency or nonconformance occurs, the UXOQCS will prepare a Deficiency Report or Nonconformance Report.

ATTACHMENTS

ATTACHMENT 1

DEMOLITION EQUIPMENT CHECKLIST

TETRA TECH

DEMOLITION EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Explosive Vehicle(s)		
Personnel Vehicle(s)		
Digital Camera		
Air Horn		
Hand-held Radios		
Cellular Telephone(s)		
Remote Firing Device		
White XLT all-metals detector		
Shovel, round point, long handle		
Shovel, round point, short handle		
Blasting Machine		
Tape, duct		
Tape, measuring, 50- or 100-meter		
Tape, electricians, plastic		
Toolbox, general hand tools		
Galvanometer		
IME-22 container		
Knife		
Initiating explosives		
Donor explosives		
Fire Extinguishers, 20B:C		
Wheel Chocks		

Checklist Verification

Disposal Supervisor Signature:	Date:

ATTACHMENT 2

HEALTH AND SAFETY EQUIPMENT CHECKLIST

TETRA TECH

HEALTH AND SAFETY EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Air Horn, emergency		
Burn Blanket		
Burn Kit		
Emergency Eye Wash		
Hand-held Radio and Satellite Phone		
Lightning Detector		
Fire Extinguisher, 20-pound ABC		
Bloodborne Pathogen Kit		
First Aid Kit		
Gloves, leather		
Goggles		
Face Shield(s)		
Fire Retardant Gloves		
Fire Retardant Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, drinking -- 1 liter per person		

Checklist Verification

Disposal Supervisor Signature:	Date:

ATTACHMENT 3

GENERAL SAFETY PRECAUTIONS

TETRA TECH

GENERAL SAFETY PRECAUTIONS

1. Carry blasting caps in approved containers and keep them out of the direct rays of the sun. Keep the caps located at least 25 feet from other explosives until they are needed for priming.
2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity such as nylon, silk, synthetic hair, etc.
3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.
4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.
5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.
6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.
7. Do not use improvised methods for initiating blasting caps.
8. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps, on the surface, to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, which could lead to premature firing or misfires.
9. Test electric-blasting caps for continuity at least 50 feet from any other explosives before connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the bare ends of the wires together. The wires will remain shunted until ready to be connected to the firing circuit.
10. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 60 minutes after the expected detonation time, when firing electrically.
11. Items with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.
12. Consideration should be given to tamping the UXO to control fragments if the situation warrants. Fragments will be minimized not only to protect personnel but also property, such as buildings, trees, etc.
13. Avoid inhaling the smoke, dust, or fumes of burning pyrotechnic or incendiary materials. The smoke, dust, and fumes from many of these materials are irritating and/or toxic if inhaled.
14. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.
15. Anticipate a high order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based upon this possibility.
16. Inert ordnance will not be disposed of, or sold for scrap, until the internal fillers have been exposed and unconfined. The heat generated during a reclamation operation can cause the inert filler, moisture, or air to expand and burst the sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to pressure from being confined. All requirements of the UXO Procedure for the Management and Disposition of MPPEH will be met before releasing any inert ordnance material.
17. Maintain minimum safe distances between electromagnetic-radiating sources and electro-explosive devices (IAW EODB/TM-TO 60A-1-1-12).
18. Do not conduct blasting or demolition operations during an electrical, dust, sand, or snowstorm severe enough to produce atmospheric static electrical charges, or when such a storm is nearby (within 6 miles). Under such conditions, all operations will be suspended or terminated, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet.
19. Loose initiating explosives: lead azide, mercury fulminate, lead styphnate, and tetracene, these explosives manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling

these types of explosives. Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. The sensitivity of these explosives is significantly increased when dry.

20. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, or friction.
21. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
22. Photo flash bombs must be handled with the same care as black powder-filled munitions.
23. MEC containing white phosphorous will not be detonated into the ground. White phosphorous munitions will be counter-charged on the bottom centerline (CCBC) when possible.
24. A search of the detonation site, after the demo operation, will be conducted to assure complete disposal was accomplished.
25. Do not abandon any explosives.
26. Do not leave explosives, empty cartridges, boxes, liners, or other materials used in the packing of explosives lying around where children, unauthorized persons or livestock can get at them.
27. Do not allow any wood, paper, or other materials used in packing explosives to be burned in a stove, fireplace, or other confined space, or be re-used for any other purpose. Such materials will be destroyed by burning at an isolated location out of doors, with no one allowed within 100 feet of the burning operation.
28. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.
29. Know and observe international, federal, state, and local laws/regulations that apply to the transportation, storage, and use of explosives.
30. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
31. Do not transport metal, flammable, or corrosive substances with explosives.
32. Do not allow smoking, or the presence of unauthorized personnel, in vehicles transporting explosives.
33. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
34. Assure the load is blocked and braced to prevent it from movement and displacement.
35. Do not drive vehicles containing explosives over public highways until all permits and certifications have been obtained from the state enforcement agencies.
36. All routes must be approved in writing before transporting explosive materials over public highways.
37. Licensed commercial carriers will conduct the shipment of explosive materials over public highways unless Tetra Tech UXO personnel have been specifically licensed and certified to make the shipment.
38. Never leave a vehicle that is loaded with explosives unattended.
39. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box, container, or magazine with other explosives.
40. Store explosive materials in military or ATF-approved magazines only. Ensure the magazines used for the storage comply with quantity distance requirements, for the class of explosive material they contain. Reference documents include: NAVSEA OP-5, TM 9-1300-206, AMCR 385-100, ATF - Explosives Law and Regulation, ATF P 5400.7, and 49 CFR.
41. Do not store spark-producing metal/tools in an explosive magazine.
42. Do not permit smoking, matches, or any source of fire or flame within 100 feet of an explosive magazine.
43. Do not allow leaves, grass, brush, or debris to accumulate within 50 feet of an explosive magazine.
44. Do not permit the discharge of firearms within 300 feet of an explosive magazine.

TETRA TECH

GENERAL SAFETY PRECAUTIONS

45. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.
46. Do not permit smoking, matches, or other sources of fire or flame within 100 feet of an area in which explosives are being handled.
47. Do not expose explosives or devices containing explosive to prolonged exposure to direct sunlight. Such exposure can increase sensitivity and deterioration.
48. Ensure all unused explosives are returned to their proper containers, and the container closed after use.
49. Do not carry explosives or explosive components in pockets or on the body.
50. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator, or other explosive initiating device. A detonation may occur.
51. Do not pull on the electrical lead wires of electric blasting caps, detonators, or their electro-explosive devices. A detonation may occur.
52. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.
53. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.
54. Do not use pull rings or safety pins to lift or handle explosive devices.

ATTACHMENT 4

DISPOSAL OPERATIONS CHECKLIST

TETRA TECH

DISPOSAL OPERATIONS CHECKLIST

FUNCTION	DATE/TIME	SIGNATURE
SUXOS		
Assign Disposal Team		
Brief Disposal Team Review emergency procedures Discuss MEC/MPPEH to be disposed Describe Disposal procedures and method		
Inspect Range/Exclusion Zone upon completion of operations		
Disposal Supervisor		
Assign demolition task to team members		
Verify Not Later Than (NLT) disposal time includes wait time for misfire procedures		
Verify roads are closed		
Verify Exclusion Zone boundaries in place		
Complete health and safety and equipment checklists		
Ensure Field Site Office has completed the verification checklist Responsible activity Medical Facility Fire Department Security/Police Department		
Disposal Supervisor tailgate safety brief: Designate emergency vehicles Designate emergency evacuation route Review emergency response procedures		
Verify daily equipment inspection		
Verify detonators are separated from explosives		
Verify area has been evacuated		
Verify engineering controls are correct		
Notify Field Site Office that operations are commencing		
Start disposal activities		
Inspect shot after designated wait time		
Collect all metal fragments for later disposal		
QC check performed		
QA check (if required)		
Tetra Tech to notify upon completion: Client Responsible Activity Medical Facility Fire Department Security/Police Department		
Complete MEC/MPPEH Accountability Log and record data in Explosive Disposal Log		
Demolition Supervisor signature:		Date:

ATTACHMENT 5

EXPLOSIVE DISPOSAL LOG

TETRA TECH

EXPLOSIVE DISPOSAL LOG

Project Information

Project Name: ______________________ Start Time: ____________

Project Location: Stop Time:

MEC Disposed of This Date (List items and quantity of each item)

QTY	NOMENCLATURE	GRID	MEC	MDAS	DATE LOCATED	DATE DISPOSAL

Donor Explosive Used (List types and quantity)

QTY	TYPE
	ELECTRIC DETONATORS
	DETONATNG CORD
	COMMERCIAL SHAPED CHARGES

Remarks

Approval

Demolition Supervisor (Signature):

Print Name ______________________

Date:

ATTACHMENT 6

QUALITY CONTROL INSPECTION CHECKLIST

MEC MANAGEMENT AND DISPOSAL

TEAM INFORMATION		
Team:	**Location:**	**Date:**
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

ITEM	REF.	INSPECTION POINT	YES	NO	N/A	COMMENTS
1	**Workers' Statement**	Have all MEC Management and Disposal Team Members read this SOP?				
2	**QAPP**	Have assigned disposal team members received training on and demonstrated proficiency with the RFD?				
3	**SOP**	Did all personnel attending the morning safety/operational briefing sign-in?				
4	**SOP**	Did the Team Leader conduct and document the Tailgate Safety Briefing before beginning operations?				
5	**SOP**	Did all recovered MPPEH undergo the three-tiered inspection process?				
6	**SOP**	Did the SUXOS and UXOSO assess all MEC and agree that the risk associated with movement is acceptable or not?				
7	**SOP**	Was the decision to move MEC documented in writing before movement or transporting the items to the storage magazines for temporary storage?				
8	**SOP**	Were MPPEH items further classified as or MDAS, as appropriate?				
9	**SOP**	Were all MEC items photographed?				
10	**SOP**	Did the Demolitions Supervisor conduct and document the demolitions briefing?				
11	**SOP**	Was the EZ established and observed?				
12	**SOP**	Was the demolition sequence observed?				
13	**SOP**	Were donor charges properly prepared?				
14	**SOP**	Were post-demolition operations conducted?				

FINDINGS

Item	Comments

Conducted By: ____________________ **Reviewed By:** ____________________

TETRA TECH

UXO SOP MPPEH and MDAS Management and Disposal

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct MPPEH and MDAS management and disposal operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Director, Health, Safety, & Environmental Jim Streib, CSP, SMS, CQA, CHST		Date:	
Director, Technical Operations & Explosives Safety Patrick Tatman		Date:	6/23/2020

Review Date	Reviewer	Next Review

WORKER'S STATEMENT

I have read UXO SOP – MPPEH and MDAS Management and Disposal and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE

The purpose of this standard operating procedure (SOP) is to provide procedures and technical guidance for material potentially presenting an explosive hazard (MPPEH) inspection, management, safety, security and chain of custody (CoC) certification during munitions response activities. This applies to all Tetra Tech Unexploded Ordnance (UXO) Technicians involved in the inspection and management process for certifying MPPEH as material documented as safe (MDAS) before transfer within or release from U.S. Department of Defense (DOD) control.

This SOP is not a stand-alone document and should be used together with the Quality Assurance Project Plan (QAPP) or equivalent planning documents, other Tetra Tech SOPs, applicable Federal, State, local regulations, and contract restrictions and guidance.

All training on equipment or software will be either formal or on-the-job training (OJT). Training will be documented by site personnel and subject to review for accuracy and completeness. The UXO Quality Control Specialist (UXOQCS) will verify training is completed and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials required to implement this SOP.

2.1 PERSONNEL

The following individuals may be involved in MPPEH and MDAS Management and Disposal activities:

- Senior Unexploded Ordnance Supervisor (SUXOS)
- UXOQCS
- Unexploded Ordnance Safety Officer (UXOSO)
- UXO Technicians, Levels III, II, and I
- Government or third-party Quality Assurance personnel

2.2 EQUIPMENT

- MDAS containers (e.g., 55-gallon drums, 20yd roll-off, etc.)
- Unique Numbered Seals
- Expray Kit
- Logbook and/or PDA for recording data
- Bottled water
- Camera
- Communications equipment
- First-aid kit
- Level D personal protective equipment (PPE)
- Fire extinguisher

3.0 PROCEDURES AND GUIDELINES

3.1 UXO TECHNICIAN RESPONSIBILITIES AND PROCEDURES

The objective of the following procedures is to ensure that an inspection of the exterior and interior surfaces of all recovered MPPEH is safely conducted to ensure these items do not present an explosive hazard and are not transferred from DOD or Tetra Tech custody.

3.1.1 Unexploded Ordnance Sweep Personnel (UXOSP)

Will only mark suspected MPPEH and will not be allowed to perform any assessment of a suspect MPPEH to determine its status.

3.1.2 UXO Technician I

Can tentatively identify a located material as MPPEH confirmation by a UXO Technician II or III.

3.1.3 UXO Technician II

Will perform a 100 percent inspection of each piece of MPPEH as it is recovered and determine the following:

a. Is the MPPEH MEC, munitions debris (MD), range-related debris (RRD) or is non-munition related debris (NMRD)?

b. Does the MPPEH contain explosives hazards or other dangerous fillers?

c. Does the MPPEH/MEC require detonation?

d. Does the MPPEH/MEC require demilitarization or venting to expose dangerous fillers of cavities not inspectable?

e. Does the MPPEH require removal of batteries, mercury seals, or switches; the draining of engine fluids, illuminating dials, and other visible liquid hazardous, toxic, or radiological waste (HTRW) materials?

Will segregate material MPPEH requiring demilitarization or venting procedures from those items ready for certification.

Will process any MPPEH found to contain explosives hazards or other dangerous fillers following applicable UXO SOP – MEC Management and Disposal.

3.1.4 UXO Technician III:

Will perform a 100 percent re-inspection of all reclassified MPPEH to determine if free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW materials.

Will supervise detonation of MEC/MPPEH found to contain explosive hazards or other dangerous fillers and venting/demil procedures.

Will supervise the consolidation of inspected MPPEH for containerization and sealing. MD and RRD or NMRD will be segregated.

3.1.5 UXO Quality Control Specialist (UXOQCS)

Will conduct daily audits of the procedures used by UXO teams and individuals for processing MPPEH.

Will perform and document random sampling (by pieces, volume, or area) of all MPPEH collected from the various teams to ensure no MD, RRD, or NMRD contains and explosive hazard, engine fluids, illuminating dials, and other visible liquid HTRW.

The UXOQCS will sign as the verifier on the DD Form 1348-1 in the absence of a government representative.

3.1.6 UXO Site Safety Officer (UXOSO)

Will ensure the specific procedures and responsibilities for processing MPPEH for certification as MD or RRD specified in the work plan are being followed.

Will ensure all procedures for processing MPPEH are being performed safely and consistent with applicable regulations.

3.1.7 SUXOS:

Will be responsible for ensuring work and Quality Control (QC) plans specify the procedures and responsibilities for processing MPPEH for final disposition as MD or RRD.

Will ensure a Requisition and Turn-in Document DD Form 1348–1A is completed for all MD and RRD to be transferred for final disposition.

Will perform a final 100 percent re-inspection of all recovered MPPEH to certify that they are free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials, and other visible liquid HTRW material necessary to complete the DD Form 1348–1A.

Will be responsible for ensuring that inspected debris is secured in a closed, labeled, and sealed container and documented as follows:

a. The container will be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that will start with the applicable DOD component/Installation Name/Tetra Tech/0001/Seal’s unique identification and continue sequentially.

b. The container will be closed in such a manner that a seal must be broken to open the container. A seal will bear the same unique identification number as the container, or the container will be clearly marked with the seal’s identification if different from the container.

c. Tetra Tech will provide a documented description of the container with the following information for each container: contents, weight of the container, location where munitions or RRD was obtained, name of the contractor, names of certifying and verifying individuals, unique container identification, and seal identification, if required.

Will establish a secure location for the collection, processing, and storage of MD, RRD, and NMRD until transferred off-site.

All acceptable to move MEC or MPPEH will be stored in a magazine or secured until disposal.

3.2 MD CERTIFICATION AND CONTAINERIZATION

MPPEH procedures will be per DOD Instruction 4140.62, EM 385-1-97 or OP-5. All MPPEH will be assessed and its explosive safety status determined and documented before transfer within the DOD or release from DOD control. Before release to the public, MPPEH will be documented by personnel who are authorized in writing and technically qualified to certify or verify MDAS after a 100 percent inspection, and an independent 100 percent re-inspection to ensure that it is safe from an explosive perspective. The following certification and verification procedures will be followed for material suspected or determined as MPPEH:

- The SUXOS will certify that the debris is free of explosives hazards.
- The UXOQCS or similarly trained individual in the absence of a government representative will verify that the debris is free of explosive hazards.

- DD Form 1348–1A Issue Release/Receipt Document will be used as the certification/verification documentation. The DD Form 1348–1A must clearly show the names and contact numbers of the SUXOS and the UXOQCS, similarly trained UXO-qualified individual or Government representative and will be completed with the following information:

  Block 2: Site Address

  Block 3: Address where the MDAS will be shipped to

  Block 5: Document date

  Block 8: Cargo type (MDAS or NMRD – non-munitions related debris)

  Block 9: Mandatory Entry - Enter "U" if Unclassified material. For more Controlled Inventory Item Codes (CIIC) see DOD 4100.39-M, Volume 10, Chapter 4, Table 61.

  Block 10: Actual quantity received. Entered by Receiver

  Block 11: Number of items for this unit. Enter "1" if only one container is listed on the form.

  Block 12: Enter the weight of the container listed on the form

  Block 15: Mandatory Entry – Enter "0" for No Shelf-life. For more codes see DOD 4100.39-M Volume 10, Chapter 4, Table 50

  Block 16: Leave blank for the transport company

  Block 17: Basic material content such as Material Documented as Safe or Non-Munitions Related Debris with the type of metal (steel or mixed)

  Block 18: Type of container

  Block 19: Number of containers that make up the shipment

  Block 20: Total weight of all containers that make up the shipment

  Block 22: Signature of receiver

  Block 23: Date received

  Block 24:

  - Site Name
  - Site Location
  - Company name
  - Contract Number

  Block 25: Container number - DOD component/Installation Name/Tetra Tech/0001/Seal's unique identification

Block 26:

- The following certification/verification will be entered on each DD Form 1348–1A for MD or RRD transferred within or release from DOD control and will be signed by the SUXOS and the UXOQCS, a similarly trained UXO-qualified individual or Government representative. This statement will be used on any ranges where range related debris is to be processed along with MD:

  "This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials, and other visible liquid HTRW materials."

- The following certification/verification will be entered on each DD Form 1348–1A for turnover of MD and will be signed by the SUXOS and the UXOQCS, similarly trained UXO-qualified individual or Government representative where only munitions debris is being processed:

  "This certifies and verifies that the material listed has been 100 percent inspected and, to the best of our knowledge and belief, are inert and/or free of explosives or related materials."

Block 27: Signature Block for both the SUXOS and UXOQCS containing:

- Certified by: SUXOS Name / Verified by: UXOQCS Name or other verifier
  Tetra Tech (OU Name Here), Munitions Response Services
  Applicable OU Address
  Home Office: XXX-XXX-XXXX
  SUXOS phone number / UXOQCS phone number or other verifier
  Signature of SUXOS / Signature of UXOQCS or other verifier

Upon receipt of the material identified on the DD Form 1348–1A, the PM is responsible for ensuring the following blocks are completed by the qualified recycler:

- Block 10: Quantity of material receive;
- Block 22: Signature; and
- Block 23: Date.

3.3 MAINTAINING CHAIN OF CUSTODY AND FINAL DISPOSITION

Tetra Tech will arrange for maintaining the chain of custody and final disposition of the certified and verified materials. The certified and verified material will be released only to an organization that will:

A. ***Upon receiving the unopened labeled containers, each with its uniquely identified and unbroken seal ensuring a continued chained of custody, and after reviewing and concurring with all the provided supporting documentation, the receiving vendor will sign for having received and agreeing with the provided documentation that the sealed containers contained no explosive hazards upon receipt. This will be signed on company letterhead that states the contents of these sealed containers will not be sold, traded, or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.***

B. Send notification and supporting documentation to the sealed container-generating contractor documenting the contents of the sealed containers have been smelted and are now only identifiable by their basic content.

C. If the chain of custody is broken, the affected shipment must undergo a 100 percent inspection, a second 100 percent re-inspection, and be documented to verify its explosives safety status.

MDAS is no longer considered MPPEH as long as the chain of custody remains intact. A legible copy of the inspection, re-inspection, and documentation must accompany the material through final disposition and be maintained thereafter for three years.

4.0 QUALITY CONTROL

The MPPEH and MDAS Management and Disposal operations will meet the QC metrics outlined within the QAPP or equivalent planning document and the Compliance Checklist in this SOP.

The UXOQCS will verify the quality of the task through the three-phase of control and document the results as described in the QAPP or equivalent planning documents. Any tasks the UXOQCS determines not to meet the QC metrics will be considered deficient or non-conforming. If a deficiency or nonconformance occurs, the UXOQCS will prepare a Deficiency Report or Nonconformance Report.

4.1 QC CHECKLIST: MPPEH/MDAS MANAGEMENT AND DISPOSAL

TEAM INFORMATION		
Team:	**Location:**	**Date:**
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	SOP	Have all personnel read and signed the workers' statement?				
2	SOP	Do all personnel performing this DFW meet the minimum qualifications required?				
3	SOP	Have all personnel performing this DFW been trained on this SOP, and is it documented?				
4	SOP	Have the teams been provided maps of the overall project site and evacuation routes?				
5	SOP	Are all equipment and materials required to perform the DFW inspected, available on-site, and is it documented?				
6	SOP	Was each received container marked as MPPEH or MDAS, sealed and contained in a cleared area?				
7	SOP	Is the PPE serviceable and worn properly?				

FINDINGS

Item	Comments

Conducted By: ______________________ **Reviewed By:** ______________________

UXO SOP for Removal of MEC in a Marine Environment

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct the removal of Munitions and Explosives of Concern (MEC) in a marine environment for munitions response projects. This SOP covers high and low input mechanized and underwater demolition operations. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Diving Program Manger Scot Wilson, PMP	Scot M Wilson	Date:	May 19, 2021
Diving Safety Officer Patrick Tatman	P. Tatman	Date:	May 19, 2021

Review Date	Reviewer	Next Review

SUPERVISOR'S STATEMENT

I have read and understood this SOP. To the best of my knowledge, the procedures described in this SOP can be performed in a safe, healthful, and environmentally sound manner. I have confirmed that all persons assigned to this process are qualified, have read and understood the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure the SOP contains current procedures. If a major change to the SOP is necessary, I will ensure active processes are suspended until the SOP is revised and approved. If unexpected safety, health, or environmental hazards are identified, I will make sure the process is stopped until the hazards have been eliminated.

SUXOS/Diving Supervisor

Date

WORKER'S STATEMENT

I have read UXO SOP Removal of MEC in a Marine Environment and have received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

Appendices

ACRONYMS AND ABBREVIATIONS

APP	accident prevention plan
BEM	buried explosion module
BIP	blow-in-place
DDESB	Department of Defense Explosives Safety Board
DOD	U.S. Department of Defense
DS	diving supervisor
DSPM	diving safe practices manual
ESA	Endangered Species Act
ESP	explosives site plan
EZ	exclusion zone
LED	light-emitting diode
MEC	munitions and explosives of concern
MFD	maximum fragment distance
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MRB	master reference buoy
MRDB	master reference disposal buoy
MSD	minimum separation distance
PM	project manager
QC	quality control
RFD	remote firing device
RTB	raise, tow, and beach
SM	shark marine dive tablet
SOP	standard operating procedure
SUXOS	senior unexploded ordnance supervisor
TL	team leader
TP	technical paper
U.S.	United States
USCG	U.S. Coast Guard
UXO	unexploded ordnance
UXOQCS	UXO quality control specialist
UXOSO	UXO safety officer

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This standard operating procedure (SOP) provides basic procedures specific to the recovery of munitions and explosives of concern (MEC) in a marine environment identified during a target intrusive investigation. Mechanized MEC processing operations outlined in explosive safety planning are often referred to as raise, tow, and beach (RTB) operations in the field. Phases of this SOP include the following:

- Target reacquisition and recovery of the MEC using unexploded ordnance (UXO) dive teams
- Mechanized operations - RTB MEC for disposition
- Disposition/ treatment of the MEC using demolition procedures

The procedures above will be conducted following a project-specific Work Plan (of which this SOP will be a part), Accident Prevention Plan (APP), and applicable United States (U.S.) Department of Defense (DOD) guidance, including EM 385-1-1, EM 200-1-15, DOD 6055.09-M, EM 385-1-97, Explosives Site Plan or Submission, and DOD Explosives Safety Board (DDESB) Technical Papers (TP)16 and TP18. In addition, underwater explosive detonation (blow-in-place [BIP], consolidated shot, or deep-water disposal) is not allowed unless coordination to address concerns of endangered marine life has been completed with the appropriate authorities. All mitigation requirements shall be coordinated and in place for this activity. This coordination will take place with the understanding that underwater detonation would take place as a last resort and only if avoidance/minimization measures can be implemented in a way that avoids jeopardy of listed species or destruction and adverse modification of designated critical habitat. This procedure's diving aspects will be per our corporate Diving Safe Practices Manual (DSPM), EM 385-1-1, and the project work plan.

1.2 SCOPE

This SOP provides the detailed information needed to safely perform the procedures above and protect the environment, particularly Endangered Species Act (ESA) resources. Specific requirements are defined in the approved work plan for notification procedures, personnel, training, equipment/ material, field procedures, and documentation. This SOP will be used in conjunction with applicable DOD guidance. This document's procedures apply to Tetra Tech UXO employees who conduct recovery and disposition of MEC.

The senior UXO supervisor (SUXOS)/UXO diving supervisor (DS), in collaboration with the project manager (PM), is responsible for the execution of this procedure. The final approval authority for changes ultimately rests with the Tetra Tech director of technical operations and explosives safety.

2.0 PERSONNEL, TRAINING, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

All field personnel will meet the requirements of DDESB TP 18, including those UXO technicians selected to perform diving operations. It is expected that all target investigations will occur in a marine environment or have a marine component; thus, field operations will be planned and conducted by the following personnel:

- SUXOS / UXO DS

- UXO Quality Control (QC) Specialist (UXOQCS)
- UXO Safety Officer (UXOSO)
- UXO Dive Team (minimum of four personnel)

Note: High input mechanized operations for MECs not acceptable to move and to require remote removal may need additional support personnel to conduct simultaneous operations and coordination as required.

A complete dive team with assigned and qualified demolition members will conduct any underwater demolition operations. An underwater explosive detonation (BIP, consolidated shot, or deep-water disposal) is not allowed unless coordination to address endangered marine life concerns has been completed with the appropriate authorities. All mitigation requirements are coordinated and in place for this activity. A BIP would be performed as in an emergency, as a last resort, and only if avoidance/minimization measures can be implemented in a way that avoids jeopardy of listed species or destruction and adverse modification of designated critical habitat.

The SUXOS/DS will be responsible for planning, directing, and executing all field operations. The SUXOS/DS may designate the UXO technician III/team leader (TL) as the Demolition Supervisor. An assigned demolition team will assist the TL as required during the demolition operations. The SUXOS/DS may designate an alternate UXO Dive Supervisor to assist with the mechanized operations in the MEC recovery phase.

The UXOSO will be stationed on-site and will maintain visual contact to the best extent possible with the dive and demolition teams downrange during field operations. The UXOSO will maintain communications with the team and the Tetra Tech site office.

The UXOQCS will ensure all operations are performed correctly in accordance with this SOP, the QC plan, and all other applicable guidelines of the approved project work plan. He will also assist the UXOSO as an on-site safety observer.

2.2 TRAINING

All Tetra Tech UXO technicians will meet the qualification and professional training requirements presented in the DDESB TP-18 and the approved project work plan. Before conducting field operations, project-specific training will be provided to all involved personnel. The topics to be covered include, but will not be limited to, the following:

- Project summary and approach – Work Plan review
- APP review
- Dive Plan and SOP review
- Demolition notifications
- Exclusion zone (EZ) management
- Type and condition of potential MEC
- MEC accountability
- Material potentially presenting an explosive hazard (MPPEH) management/handling/inspection procedures
- Review of donor charge placement
- Documentation and recordkeeping
- Logbook/personal digital assistants
- Demolition/dive team staffing (team assignments)
- Subcontractor management (same day explosives delivery procedures) if applicable
- Equipment training
- RTB Materials (Mechanized Operations Equipment Checklist, Appendix 1)

- Demolition Equipment Checklist (Appendix 3)
- All-metals Detector
- Shark Marine Dive Tablet II
- Daily health and safety briefing
- Emergency equipment review
- Talk through/walk-through of emergency procedures
- First aid/cardiopulmonary resuscitation
- Daily site-specific munitions training

Other pertinent guidance documents, including the various MEC that may be encountered, will also be reviewed, as required. A practical training exercise (rehearsal) with all team members will be conducted before any RTB operations.

2.3 EQUIPMENT

The SUXOS/DS will be responsible for ensuring all required equipment and materials are on site. At a minimum, the following will be checked daily before commencing field operations:

- Mechanized operations equipment (Appendix 1)
- Health and safety equipment per Boat Pre-Operation Checklist (project work plan)
- Support vessels, small boats/inflatables as required
- Diving equipment per the project work plan and DSPM
- Demolition operations equipment (Appendix 3)
- Health and Safety equipment (Appendix 4)

3.0 PLANNING

The task-specific procedures for conducting each of the major field operations listed for removal of ordnance in a marine environment are as follows:

3.1 GENERAL SAFETY

MEC removal activities will not be conducted until the required training and proper equipment checks have been completed, documented, and the appropriate EZ is established, marked, and secured.

If applicable, all utilities will be marked by the appropriate authorities before the intrusive operation.

As a rule, when a MEC is determined as unacceptable to move, one tended UXO technician diver will attach any lifting system or explosive charge. The SUXOS/DS will have the discretion to use additional divers (as needed) if additional divers are determined to be less hazardous to perform all required tasks.

Non-UXO personnel must always be escorted by UXO-trained personnel, after receiving site orientation and 3R training, in areas potentially containing MEC.

- Do not expose MEC to radio, cell phone, or satellite phone transmissions within 25 feet.
- Do not smoke except in designated areas.
- Prohibit non-essential personnel from encroaching upon the site.

- Suspend all operations immediately upon the approach of an electrical storm within 10-miles.

Additional and specific safety precautions will be further outlined in Appendix 5 and the project work plan.

3.2 NOTIFICATION AND COORDINATION

Coordination regarding activities at the worksite with the agencies and personnel listed below will be required for the safe conduct of all field operations, including any additional requirements that must be met as determined by the appropriate authorities after completion of the environmental/endangered species coordination process. Prior to conducting demolition operations, the disposition of individual targets will be coordinated with the resource agencies. The coordination will include determining the method and location of disposal. The SUXOS/DS will act as the coordinator for personnel and equipment to safely conduct all field operations. Specific notifications, described below, will be required to be made before commencing RTB operations. Notices are coordinated through the SUXOS/DS and the regulating authorities, which may include, but are not limited to:

- Local Police Department
- Local Fire Department
- U.S. Coast Guard (USCG) or applicable local organization
- Federal Aviation Administration or applicable local organization
- U.S. Fish and Wildlife Service or applicable local organization
- U.S. Environmental Protection Agency or applicable local organization
- National Oceanic and Atmospheric Administration or applicable local organization
- Local municipality
- Tetra Tech PM or the SUXOS/DS will notify the regulating authorities before disposal operations (per the approved work plan)

Prior to the initial on-site field operations, a coordination meeting will be conducted to establish roles and responsibilities, and meeting minutes will be prepared and submitted for approval. The meeting will address specific planning and organizational responsibilities, communication pathways, coordination and notification processes, and reporting requirements. Topics will include:

- Target reacquisition and recovery diving team makeup and assignments
- Demolition team makeup and assignments
- Explosive handling, storage, and transportation
- Required support services, fire, medical, security, etc.
- Emergency procedures
- Maintenance of EZs
- Community impact
- Identification of project reporting requirements during all phases of project planning, execution, and closeout (e.g., Work Plans, Production Reports, Project Status Reports, Daily Quality Reports)
- Endangered species/critical habitat impact and mitigation requirements
- Notification process to stakeholders and regulating authorities

3.3 COMMUNICATIONS

Two methods of communication will be used during field operations. A designated cell phone will be the primary means of notifying emergency responders (i.e., dialing 911). If available, Tetra Tech site office landlines will be the secondary means of off-site communication. As the operation will be conducted on the water, a marine Very High Frequency handheld radio will be on-site and available to communicate with the USCG (or local authorities). Communication (via radio) among the field team members. Communication checks between the security teams, TLs, UXOSO, UXOQCS, and the SUXOS/DS will be verified before commencing operations.

3.4 EXCLUSION ZONES

Mechanized MEC processing operations may be considered high or low input operations per DOD 6055.09-M, Volume 7, depending on the risk assessment. If MEC is deemed to be unacceptable to move, and it may be relocated remotely using a lifting mechanism, this will be viewed as a high input operation due to a higher level of risk. If MEC is deemed acceptable to move and on-site transport using a lifting balloon is performed, this will be considered a low input operation. The Maximum Fragment Distance (MFD) will be used while towing a munition underwater for high and low input operations. The MFD will be calculated by the Buried Explosion Module (BEM) using the depth of water the MEC is being suspended while under tow. MEC must remain submerged at a water depth allowing the MEC to clear any obstructions on the bottom, but also provide enough tamping to be protective to the UXO team conducting the lift and tow operations. A witness buoy will be attached to the MEC to provide visibility if the MEC becomes separated from the lifting mechanism during the lift and tow procedures.

For the MEC requiring mechanized MEC processing operations, net explosive weight, depth of water, and burial depth for planned detonation will be used to calculate the appropriate EZ using the U.S. Army Munitions Response Actions – Minimum Separation Distances (Relative to Impulse Water Pressure) from Underwater Detonations (Safe Separation Distance for Swimmers and Divers) SAIE-ESOH Memorandum, dated 16 Sep 2013 and the most recent BEM model. EZs will be calculated and may be adjusted for the following situations:

- Initial EZs will be calculated for the specific MEC and will be observed during the mechanized operations.
- During tow operations, EZs will be adjusted on the surface using the BEM for the appropriate depth of tow. Underwater EZ will also be adjusted and maintained along the entire tow route considering the depth of tow.
- A support boat of adequate size to support operations will remain outside the exclusion zone and be prepared to support the UXO dive team as required.
- Before the beaching operations, the SUXOS/DS shall ensure the predetermined surface EZ is established and maintained for the MEC. This exclusion zone will be enforced until the MEC is buried (if using the BEM), which can then be further adjusted for the calculated BEM used.

MEC will be towed only on the approved routes based on the factors outlined above. This information will be provided to the regulating authorities for confirmation and approval. The EZ will remain intact until the SUXOS/DS has verified the site is safe and all field operations are complete. If EZ cannot be secured, guards will be posted, and work halted if non-essential personnel enter the minimum separation distance (MSD). Mechanized MEC operations will not resume until non-essential personnel has exited the MSD.

3.5 WEATHER AND ENVIRONMENTAL CONSIDERATIONS

Prior to commencing field operations, the SUXOS/DS will obtain a local weather report. Operations will not be conducted above sea state 1 or if small craft warnings are forecasted. Demolition operations will not be conducted if electrical storms are within 10 miles of the demolition site or during any severe weather conditions, including electrical storms or small craft warnings that might impact safety.

Any biological monitoring will be conducted following the project work plan. Reconnaissance by the regulatory agencies, project biologists, Marine Mammal Observer (if assigned), and the SUXOS/DS of the primary and alternate tow routes and the approved beaching sites will be conducted to ensure that:

- Minimum habitat impact to the landing area on the beach.
- Proper depth of tow and the tow route selected provide enough area to conduct the task safely and will not adversely impact or damage any habitat before RTB operations. Use of a floating line for the primary tow and beaching lines to minimize impact to habitat.
- The routes and beach landing areas will be marked physically using visible markers, buoys, and line of sight and/or electronically using a global positioning system (GPS) when required.

3.6 MEDICAL

Specific medical support requirements are identified in the project work plan APP. A medically qualified person will be on-site for all demolition shots and will have equipment capable of treating traumatic injuries resulting from an explosion unless adequate medical support is within 5 minutes of the operation site.

3.7 FIRE

All project support vessels and vehicles will have at least one fire extinguisher onboard. Additional firefighting equipment will be provided as outlined in appendix 3, 4, and 6 and following the project work plan.

3.8 PERSONAL PROTECTIVE EQUIPMENT

Unless otherwise directed, all land-based field operations will be conducted in Level "D" personal protective attire. The SUXOS/DS may modify the PPE level as required. Divers will be dressed following the project work plan and the DSPM.

3.9 RECORDKEEPING

For field operations, the SUXOS will ensure, at a minimum, complete the following:

- Field Team Logs (maintained by UXO technician III/TL)
- MEC Accountability Log
- Appropriate MPPEH Inspection Certifications
- Dive logs as required in the project work plan and DSPM

4.0 EQUIPMENT SETUP

4.1 RECEIPT ON-SITE

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements. Photos will be taken and filed with the daily QC reports or the Quality Receiving Inspection Report.

Handheld geophysical sensors will be tested. If applicable, search programs uploaded and verified in the applicable Functional Check Area or Instrument Verification Strip for functionality, following the approved project work plan and manufacturer's operator's manual.

Handheld or other GPS devises for use during these operations will be checked for the correct project and coordinate upload.

All cameras will have video cards and batteries checked.

Vessels, utility, or passenger vehicles will be inspected for damage and verified as operational. Photos will be taken and given to the site safety officer.

4.2 DAILY - PRIOR TO OPERATIONS

Electronic equipment will be tested prior to beginning operations each day, and the results recorded in the team logbook or on forms. All tests will be reported to the lead on-site quality representative for inclusion in the daily report.

GPS devices will be checked against know points before use to ensure accuracy during use.

Handheld geophysical sensors will be checked in an established test strip or against a piece of metal on the surface before daily operations begin.

Vessels, utility, or passenger vehicles will be inspected daily for damage and operability. Inspection forms will be submitted to the site safety officer weekly.

5.0 OPERATIONS

5.1 PROJECT BRIEFS

The following briefs will be given and documented before conducting mechanized and/or underwater demolition operations:

- Operation overview
- Team assignments
- Type and condition of expected MEC
- Dive Plan
- Demolition Plan
- Emergency procedures

In addition, a briefing by the project biologist and/or client regulatory representative may be required based on the requirements identified after completion of the ESA coordination process.

5.2 TARGET REACQUISITION

Targets will be reacquired by navigating to the target site using the Shark Marine Navigation system or a GPS unit and deploying a master reference buoy (MRB) offset by 10 feet down current from the location of the target. The anchor will be a soft anchor, such as a sandbag or soft dive weight, and lowered by hand to the bottom. The diver will deploy on this MRB. If the target is buried or in case of low visibility, the diver should utilize search equipment. The diver will then navigate to the last known position indicated by the Shark Marine Dive Tablet (SM) (if used) to reacquire the MEC. If GPS is used, the diver will conduct a circle line search around the MRB to reacquire the MEC. Once the MEC is reacquired, the diver will affix a marker float directly to the target. The diver will then proceed with RTB procedures (described in 5.3) or underwater detonation procedures (described in 5.4).

5.3 RECOVERY USING HIGH AND LOW INPUT MECHANIZED PROCEDURES

Where an underwater detonation is not permitted, land demolition operations must be carried out. MEC determined as unacceptable to move, or any MEC that is of a size and weight that are acceptable to move but cannot be lifted and recovered by the UXO diver (or manually/ mechanically hoisted by dive boat personnel), will be remotely raised, towed to beach site, and remotely beached for follow-on disposal by detonation. Appropriate earthworks and earthen tamping will be employed to reduce the blast and fragmentation distances for the specific munition involved. It should be noted that the EZ for the munition involved must be observed during the RTB operations, as there is a possibility of the MEC detonating during such activities. Once beached, the MEC will be disposed of as outlined in the Tetra Tech UXO SOP MEC Management and Disposal, including the placement of donor explosives for the MEC encountered. Utilizing a main charge, detonating cord, and remote positive control initiation (using NONEL detonators as the primary and electric detonators as the secondary, in conjunction with the radio-controlled firing device).

The general process for mechanized operations using RTB are as follows:

- Lifts for MEC that are determined as unacceptable to move will involve the use of a remotely operated lifting device (e.g., Reverse cam or SUBSALV Orca remote lifting balloon)
- Lifts for MEC determined as acceptable to move can be manually transported to the designated disposal site using commonly used commercial salvage techniques. (e.g., commercial lifting balloons)
- Diver/s will reacquire the MEC using the SM or GPS described in paragraph 5.2.
- Diver/s will affix a lifting bridle, cargo net, or a mesh bag to the MEC if not part of the lifting system.
- Diver/s will attach the remote lifting system if not part of the bridle to the MEC.
- Diver/s will attach the tow line to the MEC.
- Diver/s surfaces and attaches the tow line to a preplaced transfer float (MRB used in reacquisition).
- After the dive team has recovered the diver, the tow vessel will transit to the transfer buoy and connect the tow line to the towboat bridal or bollard if equipped.
- After the tow vessel verifies that the EZs are clear of other vessel traffic and non-essential personnel, the tow vessel captain will request permission from the SUXOS to actuate the remote lifting device or remotely lift the MEC.

When the remote lift device reaches the surface, the tow vessel will ensure the MEC has been lifted, no unintentional detonation occurred, and MEC is stable. The towboat then slowly (headway speed) begins to tow the MEC on the approved route to the selected beaching site and transfer the tow line using another preplaced transfer buoy to the beach recovery team.

5.3.1 Upon Target Reacquisition

Upon target reacquisition, the diver/s will configure the selected attachment system (mesh bag, cargo net, or bridle) outlined in the project work plan.

5.3.2 Attach Remote Lifting Device (Reverse Cam/ MK V Orca/ Commercial Lift Bag)

If using the SUBSALV Orca Lift balloon set up using procedures outlined in the MK V Orca Operations and Maintenance Manual. For large MEC, Diver/s deploys on marker float carrying the lift balloon (with transfer line attached). A buoy will be clipped to the end of the transfer line. Diver attaches a lift balloon and opens the balloon air supply bottle. Diver/s ensures there are no obstructions to the valve release mechanism and returns to the surface following the transfer line.

When used, diver/s will rig commercial lift bags to MEC using approved methods outlined in the project work plan and the corporate DSPM.

For small MEC, diver/s will rig MEC using a reverse cam system. The reverse cam system consists of the tow rope, adequately sized tow buoy (Formula = 1 square feet for every 64 pounds), and a traxion pulley. This system will be attached to the bridle or other attachment system. The MEC will then be remotely pulled (by towboat) up to a designated depth using a stop knot, and the tow will commence using guidelines established in 5.3.3. ***Safety note: UXO Diver/s must return to the surface and be recovered before continuing operations.***

5.3.3 Actuate Remote Lifting Device/ Commence Tow

Towboat personnel will consist of: Coxswain, who drives the boat, Tender to handle lines, and Safety Observer, who continuously watches the balloon/load. The Safety Observer must be ready to jettison the tow line in the event of an emergency.

Towboat personnel (an assigned tender) will attach a tow line to the transfer line. The buoy will be disconnected from the transfer line and clipped to the end of the tow line if the line must be jettisoned. When the SUXOS gives permission, the towboat will execute the remote lifting method. Once on the surface, and if authorized by the SUXOS, a support boat may be used to verify the load is secured, undertow, and at the proper depth of tow. The MEC's depth will be selected for the tow depending upon the size and explosive weight of the MEC. This method is used to reduce the hazards of fouling, unintentional detonation, and damage to habitat. This also takes advantage of the DDESB-TP-16 BEM model using the water tamp to reduce the EZ during the tow as outlined in the Explosives Site Plan (ESP). The EZ will return to the MFD-Horizontal outlined in the ESP when the beaching phase of the MEC is outlined in 5.3.4.

Only the pre-approved and planned route to the beaching site will be used; alteration of the route is not authorized. Towboat should proceed only fast enough to maintain steerage. The towboat will initiate the tracking feature on the GPS if so equipped. The towboat will shorten the tow as required for safe navigation and maneuverability through restricted areas. Proper signals will be displayed to alert nearby mariners of restricted movement. Safety boats will provide security from any approaching vessels and observers for ESA species.

5.3.4 Beaching Operation

A basic beaching operation site setup is outlined in Appendix 2.

The towboat will connect the MEC being towed to the beaching line at the Transition Buoy. Lines will be attached using a shackle. The towboat will then move toward the second buoy and attach to the beaching line. A buoy will be clipped to the end of the beaching line if the line must be jettisoned. Resume the tow until the balloon/load is on the beach at the preselected location. The towboat will then slacken the line and disconnect from the tow. Refer to the project work plan and the UXO SOP MEC Management and Disposal for disposal procedures.

5.4 UNDERWATER MEC DISPOSAL

This section addresses identified/recovered MEC that will be disposed of using BIP or consolidated underwater shots. However, no underwater explosive detonations (BIP, consolidated shots, or deep-water disposal) are allowed unless coordination with appropriate authorities has been completed to address endangered marine life concerns. All mitigation requirements shall be coordinated and in place for this activity. This coordination will take place with the understanding that underwater detonation would take place only if avoidance/minimization measures can be implemented in a way that avoids jeopardy of listed species or destruction and adverse modification of designated critical habitat. It is expected the field team will encounter the need for one or all the options listed below.

5.4.1 Blow-in-Place

MEC/MPPEH to be disposed of via explosive demolition using the BIP technology on the bottom of the water where located. Formal approval must be obtained from the local regulatory agency for this activity. This procedure will require a diver to deliver an explosive charge consisting of donor explosives (amount and placement depending on the MEC encountered), primed with a shockwave transmission method (e.g., detonating cord). Shockwave transmitter shall be 1 ½ to 3 times the anticipated depth of water. This will provide an adequate scope to the surface and secured with a flotation device/buoy. The charge will be secured to the MEC, and a strain relief will be provided for the detonating cord. The detonating cord will not be secured to the marker anchor but will have its own anchor (dog stake, sandbag, etc.) offset from the MEC location to provide adequate strain relief. When ready for detonation, the explosive supply vessel will approach the detonating cord float and attach the NONEL detonators for initiation.

5.4.2 Consolidated Shots

For MEC located in sensitive areas where BIP is not an option, one of two options, depending on individual circumstances, will be employed for disposal.

5.4.2.1 Shallow Water Disposal Area

A bottom survey will identify an underwater disposal area free of coral formations or other sensitive flora/fauna that cannot withstand an underwater detonation. This area should have a hard sand bottom, be between 30 and 50 feet of seawater, and protected from high-sea states, if possible. Once found and identified, this area will have a master reference buoy installed to mark the area's center. An EZ will be established based on the worst-case munition and depth of water per the Buried Explosive Module DDESB TP 16, or as provided by the remedial PM. The munition will be raised, towed, and allowed to rest on the bottom within this disposal area. The disposal will then be conducted in accordance with Section 5.5.

5.4.2.2 Deep Water Disposal Area

For deep-water disposal, the MEC will be recovered remotely and towed to the designated deep-water disposal area, estimated to be in excess of 100 feet in depth. This area will include a semi-permanent master reference disposal buoy (MRDB), located in the center of the disposal area. From the MRDB, disposable buoys will be attached to the MRDB with 100 feet of line. The MEC will be suspended below these buoys at appropriate depths, depending on the MEC and water depth necessary to reduce the EZ to an acceptable level. This is assumed to be 30 to 50 feet in depth. Depending on the MEC, the donor charge can be placed on the MEC after being recovered into the explosive vessel. Then it can be lowered to the appropriate depth and suspended from the disposable buoys via a suspension line, not the detonating cord, which will be 3 times the depth of suspension, with the initiating end attached to a flotation device. If the MEC is not safe to move, it will not be recovered into the boat but towed and secured to the disposable buoy. A diver will then attach the donor charge, as described above. Depending on the MEC size, a substantial flotation device may be required to support it in the water column (e.g., large bombs may require several 55-gallon drums to provide adequate buoyancy for detonation).

5.5 UNDERWATER MEC DISPOSAL PROCEDURES

5.5.1 Disposal Shot Initiation

Initiation will be performed for in-water scenarios by placing and protecting the receiver of the radio-controlled firing device (RFD) in an improvised waterproof float assembly consisting of an inner tube or appropriate floatation device.

The NONEL or electrical leads connected to the receiver, and with adequate strain relief via small lines, so the NONEL or electric detonators are adequately protected when connected to the detonating cord. The RFD receiver must also be protected from the water environment, and a suitable separation provided from the detonating cord and RFD, when initiated, to protect the RFD receiver. The receiver is not an expendable item. All initiation components will be waterproofed using an appropriate sealant before deployment.

5.5.2 Shockwave Transmission Methods

The selected donor explosives are initiated by standard shockwave transmission methods using either a NONEL shock tube or a detonation cord. Detonation cord used for underwater demolition shall be reinforced and contain an explosive charge of at least 80 grams per foot. Shock tube and detonating cord components will be waterproofed using an appropriate sealant and reinforced with a strain relief method before deployment. Shock tube or detonating cord shall be 1 ½ to 3 times the anticipated depth of the donor explosive charge/ MEC. Longer lengths should be considered for deeper water depths if higher current or difficult sea conditions are anticipated.

5.5.3 Main Charge - Donor Explosives

The donor explosives used for MEC disposal are anticipated to include an appropriate main charge, detonating cord or shock tube, NONEL detonators as primary, electric detonators as primary, and a non-electric cap fuse as an alternative. A designated UXO technician/diver will perform all setup procedures as outlined in the project work plan, explosive safety plan or submission, and applicable Tetra Tech UXO SOPs. All donor explosive main charges will be waterproofed before deployment as required. All donor explosives will be stored following the project explosives site plan or submission.

5.5.4 Operation of the RFD

5.5.4.1 Preparation

Perform system preoperational tests and setup procedures using the operator's manual. **Do not insert the RFD key from the controller unit until ready to fire.** The SUXOS/DS will maintain custody of the key until the demolition shot is ready for initiation.

- Place the receiver in the flotation device and ensure it is watertight. Ensure there is enough standoff to protect the receiver.
- Ensure the receiver indicates a READY condition for the selected initiation method (***GREEN READY*** light-emitting diode [LED] on steady, ***RED ARMED LED*** off).
- When using electric blasting caps, cut off a firing wire length that will reach between the receiver and the detonating cord.
- Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
- Test each electric blasting cap 50 feet downwind of other explosives with a galvanometer.
- Place blasting caps behind a barricade or under a sandbag before removing the shunt and testing for continuity.
- Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
- Secure the leg wires to prevent the cap from moving during the test.
- Use only a special silver-chloride dry cell battery in the galvanometer. (Other types of batteries may provide enough voltage to fire the blasting cap.)

- Upon completion of testing, shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
- Retrieve caps from the barricade, ensure there is a strain relief on the firing wire.
- Approach the detonating cord float and connect the blasting caps to the detonating cord's priming loop and the strain relief to the float, so the caps cannot be pulled out of the priming loop of the detonating cord.
- For dual priming, connect blasting caps in a parallel circuit to the firing wire.
- Test the circuit with the galvanometer, and then connect the firing wire to the receiver.
- Allow the receiver float to trail downwind/current of the detonating cord float.
- Withdraw to the safe area outside of the EZ and prepare to fire the RFD.

5.5.4.2 Firing the RFD

The SUXOS will verify the EZ is clear, then give the pre-blast warnings. After sounding the 5- and 1-minute warnings on the air horn/siren and radio, the SUXOS/DS will insert the RFD key, turn the POWER switch on the controller to the right until the BATTERY LED illuminates, and perform the following procedures:

- Momentarily depress the controller STATUS button. The ***YELLOW TRANSMIT LED*** will flash for approximately 1 second. At the end of that time, a ***GREEN READY LED*** will become steady, indicating that the remote is on and in standby mode. The steady ***GREEN LED*** also indicates the remote is within range of the controller.
- Push the ARM/DISARM switch to the left and hold for 1 second. The ***RED ARMED LED*** will flash for approximately 18 seconds and then become steady. The remote is now armed.
- The SUXOS/DS will request permission to fire from the UXO Safety.
- The SUXOS/DS will then give three loud “Fire-in-the-Hole” warnings.
- The SUXOS/DS will give the command to fire the shot.
- The SUXOS/DS will then lift the safety cover on the FIRE switch and push the FIRE switch forward.

5.5.4.3 Misfire Procedures for the RFD

The SUXOS/DS will perform the following if there is a misfire:

- Make three successive attempts to fire.
- Turn off the controller and remove the key.
- Wait 60 minutes from the last initiation attempt if using NONEL or an electric firing train.
- After the wait time has elapsed, the SUXOS/DS and a safety observer will proceed via a small boat to inspect the float's firing system.
- If NONEL was used, do not remove the detonators from the detonating cord. Disconnect NONEL from the igniter tip on the receiver. Place a new NONEL detonator with lead on the igniter tip and attach it to the detonating cord priming loop.
- If electric caps were used, do not remove the old blasting caps from the detonating cord, but disconnect the firing wire from the receiver and shunt the firing wire.
- Prepare a new firing wire with dual caps. Attach to the detonating cord, as described above.

5.5.5 Non-Electric Blasting Cap and Time/ Safety Fuse

If the RFD is inoperable or not available, the secondary means of initiating the explosives will be a non-electric cap and time fuse. The SUXOS/DS will adhere to the following setup, firing, and misfire procedures.

5.5.5.1 Preparation

- Prior to each daily use, the time/safety fuse's burn rate must be tested to ensure the accurate determination of the length of time/safety fuse needed to achieve the minimum burn time of 5 minutes required to conduct demolition operations.
- Using approved crimpers, cut 6 inches off the end of the roll of time/safety fuse.
- Cut a 6-foot length of fuse from the roll and attach an igniter.
- In a safe location, ignite the fuse and measure the ignition time to spit at the 6-foot fuse end. Note this time in seconds. Divide by 6, which will give you the burn rate per foot of fuse.
- The minimum time to be used on any demolition shot will be no shorter than 5 minutes burn time, or, in this case, the minimum time required to travel outside the EZ from the time the igniters are pulled.
- Dual priming will be used. Cut two lengths of time/safety fuse from the same roll as needed to provide the required escape time. Attach igniters to one end of each length.
- Using an approved crimper, attach one No. 8 or equivalent non-electric blasting cap to the other end of each length of time/safety fuse.
- Tape the two systems together and add flotation along the length (bubble wrap works well for this). The firing system is now ready for priming.
- Cushion and protect the blasting caps for transit in the boat to the detonating cord priming loop.

5.5.5.2 Priming and Firing the Non-Electric Blasting Cap and Time/Safety Fuse System

- The SUXOS/DS will verify the EZ is clear with the UXOSO.
- The SUXOS/DS and one UXO technician/diver will approach the detonating cord float and attach the blasting caps to the detonating cord priming loop.
- The SUXOS/DS will request permission to fire from the UXOSO on the support vessel.
- The UXOSO will sound the 5- and 1-minute warnings on the air horn/siren and radio.
- The SUXOS/DS, when permission is granted, will provide three loud “Fire in the Hole” commands verbally and one via the radio, and then pull the igniters, noting the time when pulled.

5.5.5.3 Misfire Procedures for the Non-Electric Blasting Cap and Time/Safety Fuse System

The SUXOS/DS will perform the following misfire procedures:

- Observe a wait time of 60 minutes from the expected time of detonation.
- Prepare another firing system, as described above.
- After the wait time has elapsed, the SUXOS/DS and one UXO technician/diver will proceed to the detonating cord float to inspect the firing system.
- Leave the old caps and firing system in place. Attach the new system to a clean area on the detonating cord priming loop.
- Follow the procedures above for initiation.

5.5.6 Post-Demolition Procedures

Upon completion of the demolition operation, the procedures described below will be followed by all personnel or the designated UXO technicians, as appropriate:

- Wait a minimum of 5 minutes after a single shot or after a series of shots in which all detonations are accounted for. Wait a minimum of 30 minutes after shots that could not be counted.

- A confirmation dive may be required to confirm the MEC was successfully detonated depending on the MEC's size and depth of detonation, and whether the MEC was detonated on the bottom or in the water column. For larger MEC, this may be obvious from the detonation plume, but smaller MEC may not break the water's surface, again depending on the depth of water and position in the water column.
- The inspection dive will determine the MEC condition, a high order detonation, a low order detonation, or possibly mechanical damage. The inspection dive will also ascertain any damage to the bottom or surrounding area.
- If the MEC was low ordered, all pieces will be collected at the site, and a second attempt will be performed.
- The dive team will recover munitions debris after the disposal shot and will process the recovered metal following the material documented as safe screening process.

6.0 QUALITY CONTROL (QC)

QC for this SOP will be achieved through visual checks of the definable feature of work, completing the QC Checklist for removal of MEC in a marine environment, and performance metrics identified in the plans are met. The checklist will be filled out and signed by the on-site quality lead or designee upon completing the mechanized operations.

6.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for removing MEC in a marine environment are presented in the project plans. Results will be documented in the team logbooks and the daily field management team's reporting.

6.2 REPORTING

The SUXOS/DS will provide input and updates to the project MEC Accountability Log, the SUXOS/DS, UXOQCS, and UXOSO will provide input and updates using reporting procedures from this SOP and as outlined in the project work plan.

6.3 QC CHECKLIST FOR REMOVAL OF MEC IN A MARINE ENVIRONMENT

TEAM INFORMATION		
Team:	**Location:**	**Date:**
Team Leader:		
Personnel Present:		
Contract #:		
Task Order #:		

QC CHECKLIST POINTS

Item	Ref.	Inspection Points	Yes	No	N/A	Comments
1	**UXO SOP X**	Have personnel read and signed the workers' statement?				
2	**UXO SOP X**	Has the equipment been checked out, and is it documented correctly?				
3	**UXO SOP X**	Are daily position checks within specified tolerances if the GPS is used?				
4	**UXO SOP X**	Have the appropriate MQOs been achieved for removal of MEC in a marine environment?				
5						

FINDINGS

Item	Comments

Signature:

UXOQCS or Designee: ______________________________ **Date:** ____________

APPENDIX 1 MECHANIZED OPERATIONS EQUIPMENT CHECKLIST

TETRA TECH

MECHANIZED OPERATIONS EQUIPMENT CHECKLIST

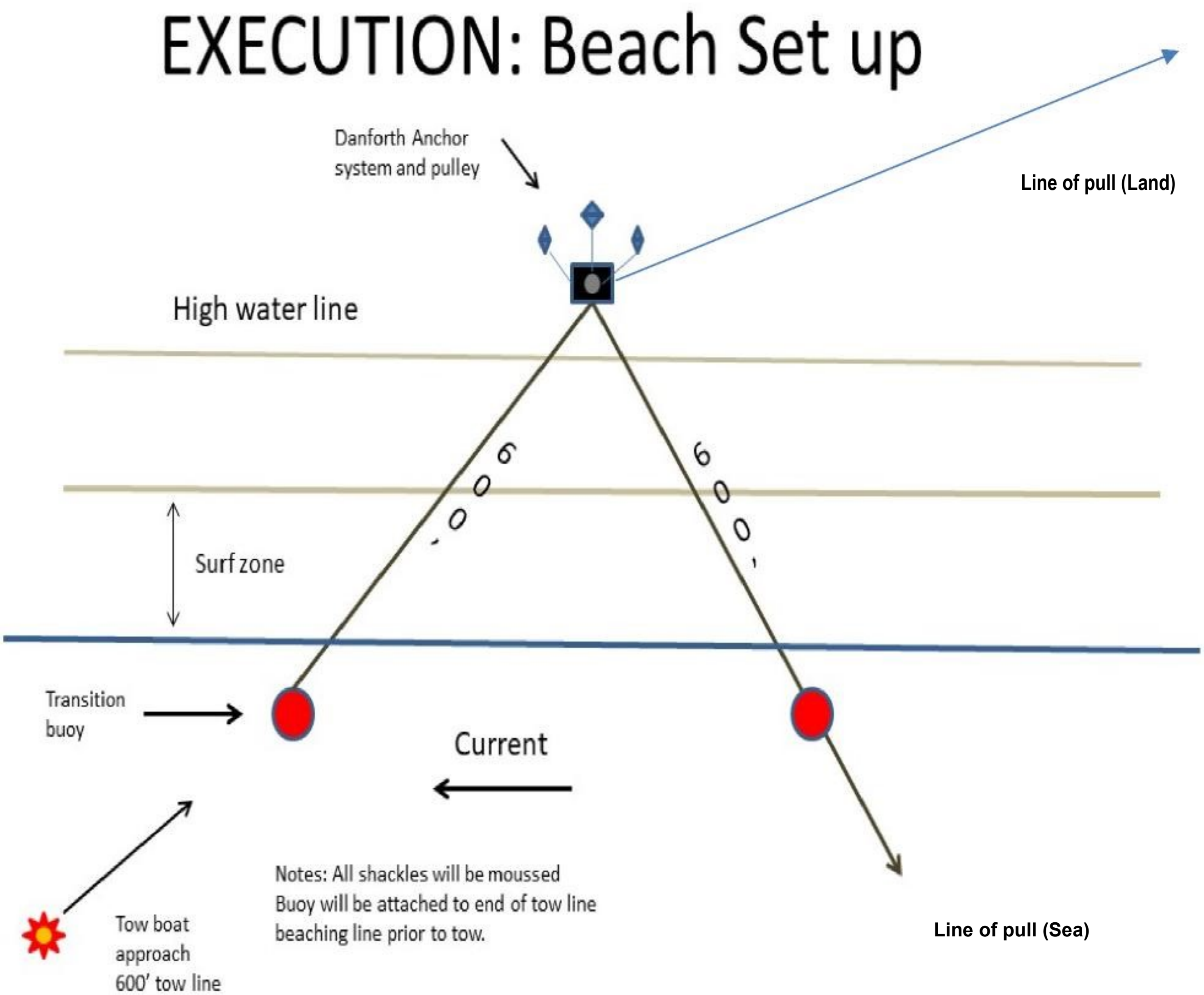
Equipment List

Equipment	Quantity	Comments
Dive Support Boat		
Tow – Transport Boat		
Towing Day Shape (Ball/Diamond/Ball)		
Support Vessel(s)		
Handheld Radios (Marine Band)		
Cellular Telephones		
GPS		
Lift System (MK V Orca)		
Towline - AMSTEEL FLOATING		
Beaching Line - AMSTEEL FLOATING		
Transition Buoy System		
Sandbags		
Shackles (assorted sizes)		
Fairlead/Pully		
3-Anchor System/ Deadman		
3’ Augers		
Shovel		
Buoys (small)		
Quick-release System/Pelican hook		
Load Attachment System (Bridle/Cargo		
Binoculars		
Knife		
U/W Locator		
Traxion Pulley/ (Reverse) Cam		

Checklist Verification

SUXOS Signature:	Date:

APPENDIX 2 MECHANIZED OPERATIONS BEACHING SETUP



EXECUTION: Beach Set up
Danforth Anchor system and pulley
Line of pull (Land)
High water line
600'
600'
Surf zone
Transition buoy
Current
Notes: All shackles will be moussed
Buoy will be attached to end of tow line beaching line prior to tow.
Tow boat approach 600' tow line
Line of pull (Sea)

APPENDIX 3 DEMOLITION EQUIPMENT CHECKLIST

TETRA TECH

DEMOLITION EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Explosive Vessel(s)		
Support vessel(s)		
Camcorder/Digital Camera		
Siren		
Air Horn		
Handheld Radios		
Cellular Telephone(s)		
Electronic Firing Device		
Radio Controlled Firing Device		
Ruler, 24-inch		
Fisher U/W Locator		
Shovel, round point, long handle		
Shovel, round point, short handle		
Blasting Machine		
Tape, duct		
Tape, measuring, 50- or 100-meter		
Tape, plastic		
Toolbox, general hand tools		
Galvanometer		
Firing Wire		
Demolition Kit without Donor Explosives		
Knife		
Floats/buoys		
600’ ¼ inch nylon line		
Zip Ties		

Checklist Verification

Demolition Supervisor Signature:	Date:

APPENDIX 4 HEALTH AND SAFETY EQUIPMENT CHECKLIST

TETRA TECH

HEALTH AND SAFETY EQUIPMENT CHECKLIST

Equipment List

Equipment	Quantity	Comments
Air Horn, emergency		
Burn Blanket		
Burn Kit		
Emergency Eye Wash		
Fire Blanket		
Fire Extinguisher, 10-pound ABC		
Bloodborne Pathogen Kit		
First Aid Kit		
Gloves, leather		
Goggles		
Face Shield(s)		
Welders' Gloves		
Welders' Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, drinking - 1 liter per person		
Personal Flotation Devices		
Other:		

Checklist Verification

Demolition Supervisor Signature:	Date:

APPENDIX 5 GENERAL SAFETY PRECAUTIONS

TETRA TECH

GENERAL SAFETY PRECAUTIONS

General and Pre-Detonation

1. Carry blasting caps in approved containers and keep them out of the direct rays of the sun. Keep the caps located at least 25 feet from other explosives until they are needed for priming.
2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity (e.g., nylon, silk, synthetic hair).
3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.
4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.
5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.
6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.
7. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps, on the surface, to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, leading to premature firing or misfires.
8. Test electric blasting caps for continuity at least 50 feet from any other explosives before connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the wires' bare ends together. The wires will remain shunted until ready to be connected to the firing circuit.
9. MECs with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.
10. Consideration should be given to tamping the MEC to control fragments if the situation warrants. Fragments will be minimized to protect personnel and property, such as buildings, trees, etc.
11. Loose initiating explosives (tetracene, lead styphnate, mercury fulminate, and lead azide) manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling these types of explosives. Always keep initiating explosives in a water-wet condition until ready for final preparation for detonation. The sensitivity of these explosives is significantly increased when dry.
12. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, or friction.
13. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
14. Photo flash bombs must be handled with the same care as black powder-filled munitions.
15. Know and observe federal, state, and local laws/regulations, which apply to the transportation, storage, and use of explosives.
16. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
17. Do not transport metal, flammable, or corrosive substances with explosives.

TETRA TECH

GENERAL SAFETY PRECAUTIONS

18. Do not allow smoking or unauthorized personnel in vehicles transporting explosives.
19. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
20. Ensure the load is blocked and braced to prevent it from movement and displacement.
21. Do not drive vehicles containing explosives over public highways until all permits and certifications have been obtained from state enforcement agencies.
22. All routes must be approved in writing before transporting explosive materials over public highways.
23. Licensed commercial carriers will conduct the shipment of explosive materials over public highways.
24. Never leave a vehicle loaded with explosives unattended.
25. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box or container with other explosives.
26. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.
27. Do not permit smoking, matches, or other fire or flame sources within 100 feet of an area in which explosives are being handled.
28. Do not expose explosives or devices containing explosives to direct sunlight. Prolonged exposure can increase sensitivity and deterioration.
29. Do not carry explosives or explosive components in pockets or on the body.
30. Do not use pull rings or safety pins to lift or handle explosive devices.

Detonation

31. Do not use improvised methods for initiating blasting caps.
32. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 30 minutes after the expected detonation time when firing electrically. When conducting non-electric procedures, the wait time will be at least one hour from the expected time of detonation.
33. Anticipate a high-order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based on this possibility.
34. Maintain minimum safe distances between electromagnetic-radiating sources and electro-explosive devices in accordance with EODB/TM-TO 60A-1-1-12.
35. Do not conduct blasting or demolition operations during an electrical, dust, sand, or a snowstorm severe enough to produce atmospheric static electrical charges or when such a storm is nearby (within 10 miles). All operations will be suspended or terminated under such conditions, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet.
36. MEC containing white phosphorous will not be detonated into the ground. White phosphorous munitions will be counter-charged on the bottom centerline (CCBC) when possible.

TETRA TECH	GENERAL SAFETY PRECAUTIONS

37. Do not allow any wood, paper, or other materials used in packing explosives to be burned in a stove, fireplace, or other confined space or to be re-used for any other purpose. The donor explosives delivery subcontractor will remove such materials.
38. Do not insert anything but a time fuse or detonating cord into the open end of a blasting cap.
39. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator, or other explosive initiating devices. A detonation may occur.
40. Do not pull on the electrical lead wires of electric blasting caps, detonators, or electro-explosive devices. A detonation may occur.
41. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.
42. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.
43. Always point the explosive end of blasting caps, detonators, and other explosive devices away from the body.

Post-Detonation

44. Avoid inhaling the smoke, dust, or fumes of burning pyrotechnic or incendiary materials. The smoke, dust, and fumes from many of these materials are irritating and/or toxic if inhaled.
45. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.
46. After the demolition operation, a search of the detonation site will be conducted to ensure complete disposal was accomplished.
47. Do not abandon any explosives.
48. Do not leave explosives, empty cartridges, boxes, liners, or other materials used in the packing of explosives lying where children, unauthorized persons, or livestock can approach them.
49. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.
50. Ensure all unused explosives are returned to their proper containers and ensure the container is closed after use.

APPENDIX 6 DEMOLITION OPERATIONS CHECKLIST

TETRA TECH

DEMOLITION OPERATIONS CHECKLIST

FUNCTION	DATE/TIME	SIGNATURE
Senior UXO Supervisor		
Assign Demolition Team		
Brief Demolition Team: - Review emergency procedures - Discuss MEC to be disposed - Describe disposal procedures		
Inspect range/EZ upon completion of operations		
Disposal Supervisor		
Verify roads are closed		
Verify EZ boundaries are in place		
Complete health and safety and equipment checklists		
Ensure the command center has completed the verification checklist: - Range Control - Medical Facility, - Fire Department, - Security/Police Department		
Demolition Supervisor tailgate safety brief: - Designate emergency vehicles - Designate emergency evacuation route - Review emergency-response		
Verify daily equipment inspection		
Verify detonators are separated from explosives		
Verify area has been evacuated		
Notify command center when operations are commencing		
Start demolition activities		
Inspect shot after the designated wait time		
Collect all metal fragments for later disposal		
Quality Control (QC) check performed		
Stop demolition activities		
QA check (if required)		
Tetra Tech notifications upon completion: - Notify client - Responsible activity - Medical facility - Fire department - Security/Police department		
Complete MEC Accountability Log		
Demobilize		
Record data in Explosive Demolition Log		
Approval		
Demolition supervisor signature:		Date:

APPENDIX 7 EXPLOSIVE DEMOLITION LOG

TETRA TECH

EXPLOSIVE DEMOLITION LOG

Project Information

Project Name: Start Time:

Project Location: Stop time:

MEC/MDEH Disposed of This Date (List items and quantity of each item.)

Donor Explosive Used (List types and quantity.)

Remarks

Approval

Demolition Supervisor:	Date:

TETRA TECH

UXO SOP for Underwater Intrusive Investigation Operations

RECORD OF DEVELOPMENT, REVIEW, VALIDATION, AND APPROVAL

This Standard Operating Procedure (SOP) contains the procedures by which Tetra Tech, Inc will conduct Intrusive Investigation Operations for munitions response projects. Any changes or deviations will be included in the project plans and approved by the Director of Technical Operations and Explosives Safety. SOPs will be reviewed annually.

Diving Program Manger Scot Wilson, PMP	Scot M Wilson	Date:	May 19, 2021
Diving Safety Officer Patrick Tatman	P. Tatman	Date:	May 19, 2021

Review Date	Reviewer	Next Review

SUPERVISOR'S STATEMENT

I have read and understood this SOP. To the best of my knowledge, the procedures described in this SOP can be performed in a safe, healthful, and environmentally sound manner. I have confirmed that all persons assigned to this process are qualified, have read and understood the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure the SOP contains current procedures. If a major change to the SOP is necessary, I will ensure active processes are suspended until the SOP is revised and approved. If unexpected safety, health, or environmental hazards are identified, I will make sure the process is stopped until the hazards have been eliminated.

________________________________ ________________

SUXOS/ Diving Supervisor Date

WORKER'S STATEMENT

I have read UXO SOP – Underwater Intrusive Investigation Operations and received the training necessary to demonstrate my capability to perform the procedures addressed in this SOP. If I identify a hazard not addressed in this SOP or encounter an operation I cannot perform in accordance with this SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

AHA	activity hazard analysis
AOI	areas of interest
BEM	buried explosion module
DDESB	Department of Defense Explosives Safety Board
DGM	digital geophysical mapping
DMM	discarded military munitions
DS	diving supervisor
ESP	explosives site plan
ESS	explosive safety submission
ETA	equipment test area
EZ	exclusion zone
GPS	global positioning system
JSA	job safety analysis
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objective
MSD	minimum separation distance
NMRD	non-munition related debris
PDA	personal digital assistant
RRD	radiological dispersal device
SM	shark marine dive tablet
SOP	standard operating procedure
SUXOS	senior UXO supervisor
TL	team leader
TP	technical paper
U.S.	United States
UXO	unexploded ordnance
UXOQCS	UXO quality control specialist
UXOSO	UXO safety officer

1.0 PURPOSE AND SCOPE

The purpose of this Standard Operating Procedure (SOP) is to provide procedures and technical guidance for the Underwater Intrusive Investigation Operations at designated munitions response sites. These operations include:

- Mag and Dig Operations
- Target Investigation of Targets and Areas of Interest (AOI) as a result of geophysical data collection

All training on equipment or software will be either formal or on-the-job training. This training will be documented by site personnel and subject to review for accuracy and completeness. The Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) will verify training is complete and documented.

2.0 PERSONNEL, EQUIPMENT, AND MATERIALS

This section describes the personnel, equipment, and materials that may be required to implement this activity.

2.1 PERSONNEL

The following individuals or vendors may be involved in Underwater Investigation activities:

- UXO divers qualified in accordance with the United States (U.S.) Department of Defense Explosives Safety Board (DDESB) technical paper (TP) 18, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities (DDESB 2015).
  - Senior UXO supervisor/diving supervisor (SUXOS/DS). Responsible for planning, directing, and executing all field operations.
  - Field UXOQCS. Responsible for all aspects of project quality.
  - Project UXO safety officer (UXOSO)/site safety and health officer. Responsible for all aspects of health and safety on the project site.
  - UXO divers. Responsible for performing the intrusive investigation operations under the guidance and direction of the SUXOS/DS.
  - Geophysical personnel as required by the project work plan.
- Subcontractors (Marine/Boat services, biologist/marine mammal observer, geophysics technicians, Security support, etc.)
- Visitors or other site personnel

2.2 EQUIPMENT

- Personal protective equipment outlined in the Activity Hazard Analysis (AHA)/Job Safety Analysis (JSA)
- Hand-held geophysical instruments - underwater all metals detectors.
- Global Positioning System (GPS) Unit / Shark Marine Dive Tablet (SM).
- Underwater capable cameras.
- Operations support vehicles.
- Marker floats or buoys with appropriate anchoring as authorized in the project work plan.

- Support vessels, small boats as required.
- Health and safety equipment per Pre-Operation Checklists.
- Diving equipment as outlined in the project work plan and the Diving Safe Practices Manual.

3.0 PROCEDURES AND GUIDELINES

The SUXOS, UXOSO, and UXO Team Leader (TL) will review the site terrain and determine the best approach available in the project work plan for intrusive investigation operations. Any inaccessible locations will be documented in the field logbook. Any changes to the procedures will be made by a field change request as outlined in the project work plan.

3.1 EQUIPMENT SET-UP

Materials or equipment received at the site will be inspected for serviceability and against purchase order requirements or operations manuals. Photos will be taken and filed with the daily quality control reports, the quality receipt inspection report, or equivalent record.

Analog metal detector sensors will be assembled with fully charged batteries and tested for functionality at an Equipment Test Area (ETA) prepared under the direction of the UXOQCS. The test strips will include a collection of Industry Standard Objects buried at depths and orientations defined in the Quality Assurance Project Plan or equivalent planning document. This will simulate the size and depth of the targets expected at the project site. Sensors will be tested at the ETA before beginning operations each day, and the results recorded in the team logbook or on forms. All tests will be reported to the UXOQCS for inclusion in the daily report.

GPS or Robotic Total Station positioning systems will be assembled and operated following the appropriate civil survey SOP. This includes daily equipment checks and data recordings as appropriate to their use in support of Underwater Intrusive Investigations.

Cameras, when used, will have video cards and batteries checked as applicable.

All tests will be reported to the SUXOS/DS and the UXOQCS for inclusion in the daily reporting.

3.2 EXCLUSION ZONES, ENGINEERING CONTROLS, AND ROAD CLOSURES

Engineering controls should be employed whenever possible to minimize the damage from demolition operations. These controls may consist of sandbags, ecology blocks, trenching, buttressing, taping of glass, mounding, flooding and/or venting to reduce the effects of detonations.

During underwater intrusive activities (*designated as unintentional detonation operations*), the open-air exclusion zone for vessels and non-essential personnel will be the hazardous fragment distance for the munitions with the greatest fragmentation distance of the approved project Explosive Safety Submission (ESS) or Explosives Site Plan (ESP) as appropriate. Underwater minimum separation distances (MSDs) will be provided by the U.S. Army using the U.S. Army Munitions Response Actions – Minimum Separation Distances (Relative to Impulse Water Pressure) from Underwater Detonations (Safe Separation Distance for Swimmers and Divers) SAIE-ESOH Memorandum, dated 16 Sep 2013 and the most recent buried explosion module (BEM) model. All vessels and personnel at the water surface will be outside of the Blast Withdrawal Distance or the Maximum Fragment Distance, whichever is greater, as calculated using the BEM. If an underwater intentional detonation is permitted, then depth of water will be factored into the BEM and used as an engineering control.

The SUXOS will ensure exclusion zone (EZ) barricades are set up with signs at all access roads and marked appropriately: Danger, UXO Remediation Project in Progress, DO NOT ENTER, and list contact information on the barricade sign. If roads/water areas cannot be blocked, guards will be posted, and work halted if non-essential personnel enter the MSD. The explosives of concern (MEC) intrusive operations will not resume until non-essential personnel have exited the MSD.

4.0 OPERATIONS

4.1 GENERAL SAFETY

The most pertinent rules for handling munitions and MEC are summarized below:

- Underwater Investigation activities will not be conducted until the required training and proper equipment checks have been completed, documented, and the appropriate EZ is established, marked, and secured.
- A designated DS with a dive team consisting of a minimum of four personnel will perform MEC investigation, reacquisition, and recovery operations.
- The UXOSO will be stationed on-site and will maintain visual contact to the best extent possible with the dive and demolition teams downrange during field operations. The UXOSO will maintain communications with the team and the Tetra Tech site office.
- The appropriate authorities will identify all utilities prior to intrusive operation.
- Appropriate supervisors will be notified immediately of all MEC or suspected MEC finds as outlined in the project work plan.
- Non-UXO personnel must always be escorted by UXO-trained personnel after receiving a site safety briefing and 3R training in areas potentially containing MEC.
- If MEC is encountered that presents an immediate threat to life or property, it will be marked and secured until a plan for the item's safe disposition has been made and approved.
- UXO personnel must always remain on site when non-UXO personnel are conducting intrusive operations.
- Personnel will not collect souvenirs under any circumstances.
- If non-essential personnel are encroaching upon the site, all intrusive operations will be suspended immediately until resolved.
- Suspend all operations immediately upon the approach of an electrical storm (within 10-miles). All personnel will shelter as identified in the project work plan or as directed by the UXOSO.
- Assume munitions contain a live charge and are ready to fire until determined otherwise.
- Make every effort to identify the munitions. Carefully examine the munition for markings and other identifying features such as shape, size, and external fittings. Do not move the suspected munition until it is identified and confirmed acceptable to move by the SUXOS and UXOSO.
- Plan for, provide, and know the measures to be taken in the event of an accident.
- Provide a designated emergency vehicle (if applicable) in the area in case of an accident or an emergency.
- Always base operations on minimum exposure consistent with efficient operations.

- Do not rely on the color-coding of MEC for positive identification of contents. Munitions having non-existent, incomplete, or improper color codes may be present.
- Avoid the area forward of the ammunition's nose until it can be determined that the item is not a shape-charge or high-explosive anti-tank round. The explosive jet can be fatal to great distances forward of the item's longitudinal axis. Assume any shape-charge munitions contain a piezoelectric fuzing system until the fuzing is otherwise identified. Piezoelectric fuzes are extremely sensitive, can fire at the slightest physical change, and may remain hazardous for an indefinite period.

4.2 DAILY BRIEFING

After arriving at the worksite, the SUXOS/DS or designee will conduct a field operation brief at the work location. The UXOSO or designee will conduct a safety brief to all team members on potential hazards in the area and the operations conducted during the shift and review the AHA/JSA for the task. The following briefings will be given:

- Operation overview
- Team assignments
- Type and condition of expected MEC
- Dive Plan
- Emergency procedures

The TL will ensure hand-held instruments, GPS, communications equipment, safety gear, or other equipment are function checked and serviceable before beginning field operations. All daily meetings, briefs, and equipment checks will be documented in team logs and project forms outlined in the work plan.

4.3 INTRUSIVE OPERATIONS

4.3.1 Underwater Intrusive Investigation of Targets and AOI

Reacquisition of specific targets will be made using the SM or GPS to navigate the known anomaly location. The vertices of grid locations will be provided to the field teams. In general, grids will be systematically investigated, starting in the deeper, lower density areas and moving toward the shallower depths and high-density areas. The following are general descriptions of the options available to investigate underwater mini-grids and discrete anomalies using the SM or manual search methods, based on depth, bottom type, and the local environment:

4.3.2 Rectangular Mini grids

For rectangular mini-grids in water 3 to 4 feet or deeper, the investigation team will conduct a mini-grid lane search using a SCUBA diver(s) tethered to the SM. The diver(s) will utilize the SM, including self-contained navigation and underwater imaging system, providing the diver(s) with location, navigation, and situational awareness. The diver(s) will use the SM to descend to the entrance point (grid corner). Guided by the SM, the diver(s) will then swim and search each lane within the mini-grid, performing an analog instrument-assisted visual search.

As the diver(s) encounter anomalies, they will note the item's location, status, and condition and take a photograph using the SM underwater camera. At the completion of the search, the population of MEC and munitions debris (MD) within the mini-grid will be recorded. For areas with coral, rock, or another hard substrate, the diver(s) will conduct an analog instrument-assisted visual search. In areas with soft substrate or seagrass, the diver(s) will use the SM for navigation and a hand-held metal detector to help locate anomalies.

If an anomaly is buried in a soft substrate, the diver(s) will use their hands or small hand tools to excavate down to the anomaly until an identification can be made. If the diver(s) have not reached the anomaly after excavating to a predetermined depth or the depth of refusal, the anomaly will be labeled accordingly in the Access database Intrusive Results table.

If the SM cannot be used, a manual jackstay search pattern (two marker buoys with sandbag anchors placed by GPS location and a highway line between them on the bottom) may be used.

4.3.3 Circular Mini-Grids

For circular grids in water 3 to 4 feet or deeper, the investigation team will conduct diving operations using a SCUBA diver(s) tethered to the SM. The diver(s) will use the SM to descend to the center of the grid. Guided by the SM, the diver(s) will perform a search pattern expanding around the center point until the entire circular grid is investigated. As the diver(s) encounter anomalies, they will note the item's location, status, and condition and take a photograph using the SM underwater camera. At the completion of the search, the population of MEC and MD within the mini-grid will be recorded. If an anomaly is buried in a soft substrate, the diver(s) will use their hands or small hand tools to excavate down to the anomaly until an identification can be made. If the diver(s) have not reached the anomaly after excavating to a predetermined depth or the depth of refusal, the anomaly will be labeled accordingly in the Access database Intrusive Results table.

If the SM cannot be used, a manual circle line search pattern (one marker buoys with sandbag anchor placed by GPS location and a manual circle line search pattern attached) may be used.

4.3.4 Shallow Water

For anomalies that are located in water shallower than 3 to 4 feet, the investigation team will use either snorkeler(s) or technician(s) on a paddleboard(s) (lying down or seated in a position to ensure legs are not dangling in the water) who can investigate the anomaly from the surface, or technician(s) wading in shallow non-coral areas where contact with the bottom is feasible. A preliminary identification will be made, the item's location, status, and condition will be recorded, and a photograph will be taken using the SM camera. For either option, the snorkeler(s)/technician(s) will be equipped with a GPS capable of recording the target's location.

For AOIs in water shallower than 3 to 4 feet, the investigation team will conduct mini-grid searches over areas delineated with GPS boundaries. The geometric shapes of these areas will be selected to correspond to the shapes of the AOIs. To investigate these areas, UXO snorkeler(s) or technician(s) will use a paddleboard to investigate the target from the surface, or technician(s) wading in shallow non-coral areas where contact with the bottom is feasible. A preliminary identification will be made, the item's location, status, and condition will be recorded, and a photograph will be taken. For either option, the snorkeler(s)/technician(s) will be equipped with a GPS capable of recording the target's location. At the completion of the search, the population of MEC and MD within the mini-grid and its status and condition will be recorded.

If MEC is found, it will be left in place, documented as outlined in the project work plan, and clearly marked. The UXO diver will notify via a post-dive debrief the TL, SUXOS, and UXOSO or their findings.

4.3.5 Underwater Mag and Dig Operations

The general intrusive investigation procedures for mag and dig operations are:

- For mag and dig operations, establish a search area within the grid or transect as outlined above;
- If SM navigated pattern is used; diver/s will guide the SM operator while swimming forward slowly down the search lane sweeping the head of the analog sensor smoothly from side to side;

- If the manual search pattern is used; diver/s will guide on the lines while swimming forward slowly down the search lane sweeping the head of the analog sensor smoothly from side to side;
- Ensure the sensor head exceeds the width of the search lane to slightly overlap the adjacent lane;
- A wide-head electromagnetic analog sensor requires an overlap of one-half the head's width to perform an effective search. The sensor head must be parallel to the ground surface. Keep the head close to the ground;
- The sensor head must be kept at a constant height throughout the sweep;
- Each pass across a search lane should take 2-3 seconds;
- Investigate every anomaly detected that is consistent with the smallest munition anticipated at the site;
- Do not be deceived by a dull or low volume signal from a sensor. Deep targets do not necessarily produce a loud or sharp signal;
- Define the extent of the anomaly using the analog sensor;
- Technicians may use hand tools if sediment conditions permit;
- Using a shovel, trowel, or other suitable tools, remove sediment in small amounts from the side of the anomaly and work inward toward the anomaly;
- Once the anomaly is uncovered, characterize it as described in this SOP;
- Recheck the excavation with the analog sensor and continue clearing the anomaly if necessary;
- When restarting the sweeping activity, back up a foot and begin sweeping. This should ensure that no residual target is present in the excavation;
- Backfill any excavation after completing documentation unless otherwise instructed; and
- Continue the process until the assigned area/lane is complete.
- TLs will verify dig sheets/personal digital assistant (PDA) are filled out correctly, are complete, correct, standardized nomenclature is used, and no-finds are listed. MEC requires positive identification on the dig sheet. The gross weight of material documented as safe (MDAS) per grid is documented separately. Location and depth of item are recorded.
- Blind seed items must be recovered and correctly identified/documented.

4.3.6 Underwater DGM Target Investigation

The specific intrusive investigation procedures for digital geophysical mapping (DGM) target investigations are:

- The selected targets from the DGM data are marked with target buoys using the appropriate positioning system/s;
- Each target will be investigated to the radius and depth defined in the work plan bypassing the analog sensor over the ground's surface and then investigating all contacts identified within the search radius. The search radius may be extended by the geophysical data processor and noted in the dig sheet.
- After prosecution of the target to the extent required, the analog metal detector will verify any remaining signature is less than the threshold criteria selected for the project. Once complete, the target buoy may be recovered and documented to indicate a completed target.

- If the target investigation results in a “no find”, the target marker will be removed and repositioned. A second UXO diver will investigate the target and record the results. The TL will follow all procedures for documentation, as outlined in the project work plan.

Upon completion of the target clearance, all MD, range related debris (RRD), and non-munition related debris (NMRD) will be 100% inspected by a UXO technician II and a UXO technician III, before it is removed from the grid to ensure it is free of explosive hazards. If MEC/ material potentially presenting an explosive hazard (MPPEH) is found, it will be left in place, clearly marked, and the UXO Technician III will notify the SUXOS and UXOSO.

The TL will photograph all MEC/MPPEH and record as much information as possible in the TL’s logbook or the PDA. Recorded data includes nomenclature (if known), type (projectile, mortar, rocket, etc.), size, physical condition, fuzed or unfuzed and fuze type by function (point detonating, mechanical time, etc.), condition (fired or unfired, armed or unarmed), filler if known, GPS coordinates.

All MD, RRD, and NMRD will be brought to the central collection point for SUXOS and UXOQCS or government representative inspection as outlined in the project work plan. See SOP for MPPEH and MDAS Management.

All project records will be returned to the SUXOS or project data manager at the end of the day.

4.4 COLLECTION POINTS

Collection points allow for temporary accumulation of recovered and classified MEC and MPPEH that are acceptable to move to another area for storage or destruction. Collection points must be authorized by the project work plan and the associated ESP/ESS. A bottom survey will identify an underwater disposal area free of coral formations or other sensitive flora/fauna. This area should have a hard sand bottom, be between 30 and 50 feet of seawater, and protected from high-sea states, if possible. Once identified, this area will be marked using GPS. An EZ will be established based on the worst-case munition item and depth of water per the BEM TP 16, or as provided by the Remedial Project Manager. The munition item will be raised, towed, and allowed to rest on the bottom within this area. MEC and MPPEH will not be transported from one munition response site to another within the Munitions Response Area unless authorized in the project work plan and applicable ESS/ESP.

4.5 FIELD COMMUNICATION

Two methods of communication will be used during field operations. Marine hand-held radios will be used for communication among the team during any routine field operations. A designated cell phone will be the primary means of notifying emergency responders (e.g., dialing 911). As the operation will be conducted on the water, a marine Very High Frequency hand-held radio will be on-site and be capable of communicating with the U.S. Coast Guard via channel 16 (or designated channel for local authorities). If available, Tetra Tech site office landlines can be used for off-site communication.

Communication (via hand-held radio) among the field teams, the UXOSO, UXOQCS, and the SUXOS/DS will be verified before commencing operations. Applicable telephone numbers will be found in the project work plan. Additionally, these will be posted in the site office and placed in all site vehicles and vessels. If necessary, a radio base station or repeaters will ensure reliable communications across the site.

4.6 MPPEH CHARACTERIZATION

Refer to the specific SOP for full details on MPPEH characterization.

- As the diver(s) encounter anomalies, they will note the item’s location, status, and condition and take a photograph using the SM underwater camera. The first UXO Technician who discovers the suspected MPPEH will conduct the initial classification as MEC: UXO, discarded military munitions (DMM) or Munitions

Constituents (MC); Or if the target is not MPPEH (e.g., MD, RRD, NMRD). If a UXO Tech I, the suspected target, will have to have a UXO Tech II or higher verify the classification before further action is taken.

- A UXO Tech III will inspect all MEC, MD, RRD, and NMRD before leaving the Area of Interest (i.e., target, grid, or transect).
- The UXO TL will determine whether the MPPEH, once visible, is MEC and notify the SUXOS and UXOSO. Note: Suspected MPPEH that is not inspectable will be treated as MEC.
- The SUXOS will make the final identification of any suspected MEC.
- The SUXOS and UXOSO will make a joint decision on the acceptable to move determination. The two must agree with the decision and it will be documented.
- If MEC and MPPEH are determined by the SUXOS and UXOSO to be unsafe to move, it will be blown-in-place (BIP) or may be moved remotely using mechanized operations after all appropriate precautions have been taken. MEC or MPPEH will not be left unsecured in the field at any time. Notifications to the client, Ordnance and Explosives Safety Specialist or equivalent, and PM will be made as outlined in the Work Plan.
- Protective works will be implemented as described in the explosive safety documents for BIPs
- If MEC is not intact upon discovery (e.g., has exposed high explosive or filler), this will be noted on the Investigation Data Sheet and the MEC Accountability Log. If the MEC or MPPEH is judged to be safe to transport, it will be destroyed by detonation at a location identified in the ESP or ESS.
- Any suspected hazardous material (not munitions-related related) identified will be assessed on a case-by-case basis by the SUXOS and PM in consultation with the client. Hazardous material will be suspected to be hazardous if it emits a chemical odor, has caused soil staining, or is contained in a drum or other container commonly used (or marked) to store hazardous materials. If any doubt, materials will be reported for further investigation.

4.7 MEC, MPPEH, AND MDAS

Refer to the specific SOP for full details on MEC/MPPEH and MDAS disposal.

Targets identified as MEC or MPPEH (e.g., UXO, DMM, recovered bulk explosive, or MC) will be demolished by explosive detonation in-situ or relocated to a collection point. MEC and MPPEH will be demolished individually or as part of a consolidated shot. The day they are found, using a same-day donor explosives delivery service, placed at an approved unmarked underwater collection point, or guarded until disposal can be conducted. MEC and MPPEH will be documented from discovery to final disposal in the MEC accountability log.

Materials that cannot be certified and verified during the initial inspection as explosive free will have demolition or demilitarization activities performed on them in accordance with the project work plan.

Materials that cannot be certified and verified as inert (either following demolition disposal or otherwise) will have demolition activities performed on them again. MEC and MPPEH certified as explosive-free will be further classified as MDAS (materials documented as safe) then managed and recycled as scrap metal following the MPPEH and MDAS Management SOP and project work plan.

5.0 DATA MANAGEMENT

The following sections describe the data that is needed to perform this SOP and the resulting data.

5.1 INPUT DATA REQUIRED

No data other than sensor user manuals and target location Geographic Information Systems files must perform intrusive operations.

5.2 OUTPUT DATA

The primary output from this SOP is the quantities and locations of MEC, MPPEH, and the amounts of MD, RRD, and NMRD recovered. Secondary outputs include equipment inspection records and daily quality reports, and any other documentation outlined in the project work plan.

6.0 QUALITY CONTROL

Quality control will be achieved through three-phase of control of the Definable Feature of Work, completion of the QC Checklist for Underwater Intrusive Investigation Operation (Section 6.3), and performance metrics identified in the plans are met. The checklist will be filled out and signed by the on-site quality lead or designee upon completing the production unit.

6.1 MEASUREMENT QUALITY OBJECTIVES

The Measurement Quality Objectives (MQOs) for Underwater Intrusive Investigation Operation are presented in the project plans. Results will be documented in the daily quality control report.

6.2 REPORTING

Input to the project MEC Accountability Log and disposal records are the only reporting output from this SOP.

6.3 QC CHECKLIST FOR INTRUSIVE INVESTIGATIONS

TEAM INFORMATION						
Team:		**Location:**				**Date:**
Team Leader:						
Personnel Present:						
Contract #:						
Task Order #:						
QC CHECKLIST POINTS						
Item	**Ref.**	**Inspection Points**	**Yes**	**No**	**N/A**	**Comments**
1	**UXO SOP**	Have personnel read and signed the workers' statement?				
2	**UXO SOP**	Has the equipment been checked out, and is it documented correctly?				
3	**UXO SOP**	Have all intrusive results been fully and appropriately documented?				
4	**UXO SOP**	Have the appropriate MQOs been achieved for underwater Intrusive Investigation?				
5	**UXO SOP**	Were all blind seeds (if instituted) recovered?				
FINDINGS						
Item	**Comments**					

Signature:

UXOQCS or Designee: ______________________ Date: ______________

ATTACHMENT D

TETRA TECH DIVING SAFE PRACTICES MANUAL

This page intentionally left blank.

TETRA TECH

Diving Safe Practices Manual

February 2021

Safety Excellence

This page intentionally left blank.

TMR Manual

DSP-01 Diving Safe Practices Manual

Status:	Approved	**Approved By:**	M.W.Dollar Mark W. Dollar, President
Version Date:	02/15/2021	**Title:**	DSP-01, Diving Safe Practices Manual
Revision #:	Rev 1	**Original Issue Date:**	04/15/2019
Category:	Procedures	**Sections:**	Diving
Reference Driver:	EM 385-1-1	**Document Type:**	Manual
Keyword Index:	Dive, Diving, SCUBA, Safety	**Document Owner:**	Scot Wilson

This page intentionally left blank.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

ACFM	actual cubic feet per minute
ADCI	The Association of Diving Contractors International
AED	automated external defibrillator
AGE	arterial gas embolism
AHA	Activity Hazard Analysis
Army	U.S. Army
ATA	Atmosphere Absolute
CFR	*Code of Federal Regulations*
CRL	Corporate Reference Library
CNS	central nervous system
CPR	cardiopulmonary resuscitation
DCS	decompression sickness
DDC	District Diving Coordinator
DDESB	Department of Defense Explosives Safety Board
DOT	U.S. Department of Transportation
DRB	Diving Review Board
DSO	Diving Safety Officer
DSR	Diving Safety Representative
DSPM	Diving Safe Practices Manual
EM	Engineers Manual
ESSQ	Environment, Safety, Security and Quality
FSW	feet of seawater
HAZWOPER	Hazardous Waste Operations and Emergency Response
HASDP	Health and Safety Dive Plan
MEC	munitions and explosives of concern
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanographic and Atmospheric Administration
NOSSA	Naval Ordnance Safety and Security Activity
OSHA	Occupational Safety and Health Administration

ABBREVIATIONS AND ACRONYMS (Continued)

PFD	personal flotation device
PPM	parts per million
PSI	pounds per square inch (gauge)
SCUBA	self-contained underwater breathing apparatus
SDS	Senior Diving Supervisor
SHM	Safety and Health Manager
SOP	Standard Operating Procedures
SSHO	Site Safety and Health Officer
SUXOS	Senior UXO Supervisor
TP	Technical Paper
Tt	Tetra Tech
TMR	Tetra Tech Munitions Response
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USN	U.S. Navy
U.S.	United States
UXO	unexploded ordnance

1.0 PURPOSE

This Tetra Tech Munitions Response (TMR) Diving Safe Practices Manual (DSPM) provides TMR employees and subcontractors with the requirements and guidance for conducting safe diving operations. Contractors working directly for the client will be required to have safe practices that meet or exceed the requirements of this manual while operating from TMR-owned or leased equipment or property.

This manual ensures TMR diving operations meet and/or exceed the requirements of federal and state agencies. The project management team, designated dive supervisor/lead divers, project quality managers (PQMs), and site safety and health officers (SSHOs) will ensure compliance with Occupational Safety and Health Administration (OSHA) regulations and standards by implementing these procedures during dive operations.

This manual was prepared in accordance with the OSHA regulations. Federal, state, and local regulations were also considered during the preparation of this manual. If a conflict arises between the current edition of this manual and applicable or updated federal or other legal directives or statutes, the latter shall always take precedence.

2.0 FEDERAL AND STATE STANDARDS REQUIREMENTS

This manual was developed using guidelines, procedures, rules, and regulations from the following government and civilian agencies:

- OSHA
- U.S. Army Corps of Engineers (USACE)
- The Association of Diving Contractors International (ADCI)
- U.S. Navy (USN)
- U.S. Coast Guard (USCG)
- U.S. Army (Army)
- National Oceanographic and Atmospheric Administration (NOAA)

This manual provides the **minimum regulatory standards** for team composition, diving procedures, equipment maintenance, and operations.

3.0 SCOPE

This document contains procedures applicable to all TMR projects involving underwater operations that use divers or snorkelers to perform work or scientific research. The procedures in this document shall meet the requirements in 29 *Code of Federal Regulations* (CFR) 1910.401, Subpart T. Requirements that are not specifically included in this DSPM will be included in the project specific Health and Safety Dive Plan (HASDP). When contracted to dive for clients who mandate following USACE standards, additional equipment, procedures, and review requirements will be addressed in the project specific HASDP. The specific requirements are identified in Section 30 of USACE Engineers

Manual (EM) 385-1-1, Safety and Health Requirements Manual. If there are any conflicts between this manual, OSHA, and/or federal and state/ local regulations, the most stringent regulations will take precedence, provided site safety is not compromised. All conflicts will be detailed, with procedures provided in the project specific HASDP.

4.0 REVISIONS

Revisions to this manual will be periodically completed based on new advances in diving practices, technological advances, and changes in regulations.

5.0 DIVING REVIEW BOARD

The diving program manager is designated the Chairman of the Diving Review Board (DRB) and is responsible for updating this manual. The designated diving safety officer (DSO) will maintain the qualification records of personnel approved for diving and will approve all other divers (including subcontracted divers) involved on TMR projects.

6.0 GENERAL RESPONSIBILITIES

This manual will be reviewed by the diving program manager, DSO, and the TMR senior diving supervisor (SDS) for technical content involving TMR diving. They will ensure diving operations are conducted in a safe and efficient manner throughout the company. Their responsibilities include:

- Review existing policies and procedures to ensure safe, effective diving operations.
- Develop recommendations to improve diving operations.
- Review and discuss diving accident report releases by various sources and ensure the distribution of copies to Dive Team members.
- Review any TMR near-miss or actual diving mishaps and develop procedures and policies to prevent future occurrences.
- Ensure that the TMR dive program conforms to all the guidelines in this DSPM, as well as all applicable federal, state, and local laws and regulations.
- Coordinate proper recordkeeping for diving personnel, diving operations, and dive equipment maintenance.
- Coordinate periodic diver training and safety programs as needed.
- Review, prior to approval, prospective TMR dive operations that use non-standard diving modes and procedures or carry above average risk.
- Review the qualifications and performance of all divers and potential Diving Supervisors/ Lead Divers.
- Stay updated on new safety procedures, as well as OSHA, USN, USCG, USACE, and ADCI requirements.
- The Quality Department will review this manual for compliance with appropriate laws and regulations.

- Approval authority rests with the TMR President, with review by the dive program manager.
- The Chairman of the DRB will be responsible for all required corporate recordkeeping in accordance with this manual, and maintenance of all identified references.
- For unexploded ordnance (UXO) diving operations, the dive program manager will review and approve all TMR employees and subcontractor personnel involved in UXO diving.

The DSPM will never substitute for prior planning, sound judgment, and a continuing concern for maximum safety. Safety is not a rulebook; it is a state of mind and must be continually maintained in our workplace culture. However, not all circumstances or situations can be explained and detailed in this DSPM. For this reason, TMR only recommends deviating from these guidelines when, in the opinion of the diving supervisor/lead diver, an emergency exists where the health and safety of personnel is a concern. The diving supervisor/lead diver will have final authority regarding safe conditions at the dive site. A written event report will be submitted to the Chairman of the DRB within 48 hours of the deviation from the DSPM to document possible changes to this manual and conformation to OSHA and other regulatory requirements.

6.1 Waiver of Requirements

The DRB may grant a waiver for specific requirements of training, examinations, and minimum activity to maintain certification.

6.2 Diving Program Manager/Chairman, DRB

The diving program manager is the Chairman of the TMR DRB. The DRB is composed of the diving program manager, the DSO, and the SDS from the TMR Operating Unit as assigned by the appropriate manager. The Chairman of the DRB is responsible for managing the TMR Diving Program in conjunction with the assigned board members; they will maintain the diving logs and references as required by OSHA in 29 CFR 1910.401, Subpart T. The DSO will maintain qualifications and physical records for all TMR divers. The Chairman will review and approve divers, including subcontractors who are assigned to individual projects.

6.3 DSO/DRB Member

The diving safety officer (DSO), as a permanent DRB member, is responsible for the safe conduct of UXO and construction diving operations. The DSO is responsible for the appropriate diver training and qualifications for UXO operations. The DSO will submit to the DRB the names of qualified UXO divers to be certified by TMR to work on company projects. The DSO will maintain a recent copy of the USN Diving Manual. OSHA, USACE, USCG, American National Standards Institute, applicable local regulations and the Association of Diving Contractors International Consensus and Technical Standards. The DSO will make these manuals available to the diving supervisors as required.

The DSO identifies diving supervisors/lead divers. Upon concurrence of the DRB, the DSO officially assigns them to the position in writing.

6.4 SDS/DRB Member

The senior diving supervisor (SDS) will be a senior TMR diver designated by the DSO and will be a member of the DRB. The SDS is responsible for the operational readiness of the TMR dive equipment and supporting assets. The SDS also provides supervision of the TMR divers, makes recommendations for dive staff assignments. The SDS is the SME for development of new diving procedures, technology, and capabilities.

6.5 Senior UXO Supervisor

A senior UXO supervisor (SUXOS) will be designated, in writing by the DSO, to projects that have both a UXO removal/investigation requirement and a diving requirement. The SUXOS will coordinate all ordnance response requirements and establish safe procedures for the investigation and removal of all UXO hazards.

On larger operations involving both diving and UXO operations, the Diving Supervisor/Lead Diver will normally supervise diving, and the SUXOS will oversee the UXO response. The same person can serve as SUXOS and diving supervisor/lead diver, if that person has both qualifications on smaller projects. The SUXOS shall be a qualified TMR environmental safety supervisor person in accordance with the guidelines outlined in Department of Defense Explosives Safety Board [DDESB] Technical Paper [TP] 18, Reference (e).

6.6 Diving Supervisor/ Lead Diver

The diving supervisor/lead diver will be designated in writing as the Designated Person in Charge for each diving operation. This designation is based on knowledge, experience, and level of training. The diving supervisor/lead diver is in charge of the overall diving operation and is responsible for the planning and execution of the dive, as well as the safety and health of the dive team. The diving supervisor/lead diver will be a qualified TMR qualified SUXOS. In carrying out these duties, their responsibilities will include, but will not be limited to:

- Ensuring that all dive team members who are exposed to, or control the exposure of others to, hyperbaric conditions will be trained in diving-related physics and physiology.
- Ensuring that each dive team member will be assigned tasks in accordance with the employee's experience or training. Limited additional tasks may be assigned to an employee undergoing training, provided that these tasks are performed under the direct supervision of an experienced dive team member.
- Ensuring that a dive team member will not be required to be exposed to hyperbaric conditions against the employee's will, except when necessary to complete decompression or treatment procedures.
- Ensuring that a dive team member will not be permitted to dive or otherwise be exposed to hyperbaric conditions for the duration of any physical impairment or condition which is known and is likely to adversely affect the safety or health of a dive team member.

- Investigating and evaluating each incident of decompression sickness based on the recorded information, consideration of the past performance of decompression table used, and individual susceptibility.
- Taking appropriate corrective action to reduce the probability of or recurrence of decompression sickness.
- Preparing a written evaluation of the decompression procedure assessment, including any corrective action taken, within 10 days of the incident of decompression sickness.
- Being fully aware of all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed.
- Being in immediate control and available to implement emergency procedures during diving operations. The dive supervisor/lead diver is not permitted to dive unless another qualified person is present and has been formally appointed and designated to assume this responsibility.
- Ensuring, prior to diving, that all additional parties are informed that diving operations are about to be undertaken. These parties include, but are not limited to, craft masters, boat pilots, harbormasters, managers of pipelines, and managers for civil engineering sites and inland waterways.
- Ensuring that diving operations are conducted from a suitable and safe location on the surface.
- Establishing a project specific HASDP, and ensuring that sufficient air supply, supplies, and proper equipment are available for the safe and timely completion of the job task. This must be approved by the TMR DRB prior to conducting any diving evolution.
- Briefing the dive team as to the plan of attack, and soliciting suggestions outlined in Attachment 1, diving supervisor/lead diver Dive Plan Brief, native file format located in the Guidelines Templates and Tools folder in the Corporate Reference Library (CRL). During the briefing, they will make team assignments, designate required equipment, review diving signals, establish a positive diver recall method, and cover emergency procedures.
- Using the TMR Diving Supervisor Pre-Dive and Post-Dive Checklists (see Attachments 2, Diving Supervisor/Lead Diver Pre-Dive Checklist, and 3, Diving Supervisor/Lead Diver Post-Dive Checklist, which are also available in the native file format located in the Guidelines Templates and Tools folder in the CRL
- Ensuring all members of the diving team are familiar with the emergency procedures contained in the Emergency Procedures (see Attachment 4, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL).
- Being aware of the procedures to follow and the routes to take to obtain medical support in the event of an accident, either diving- or non-diving-related.
- Ensuring that a two-way communication system is available and tested.
- Ensuring that the Emergency Phone Numbers Checklist (see Attachment 5, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL) is completed and posted at the dive site.

- Determining the qualifications and proficiency of all personnel and ensuring that no dives are made by unqualified persons.
- Verifying that all equipment required is on scene and in working order.
- Ensuring that all relevant operating instructions, manuals, decompression schedules, treatment tables, and regulatory publications are available on the dive site.
- Maintaining a dive profile log for each diver, which includes depth, bottom time, and residual nitrogen time (see Attachments 6 and 7, which are also available in the CRL).
- Terminating diving operations at any time when, in their opinion, safe diving procedures are not being followed or conditions prevent safeguarding the divers. The diving supervisor/lead diver will not resume diving operations until the unsafe conditions have been removed or corrected.
- Ensuring that, after every dive, the Post-Dive Checklists in Attachment 3, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL, are used.
- Ensuring that, after any treatment or unplanned dive conducted outside the no-decompression limits, the diver is instructed to stay awake and remain in the vicinity of the chamber for at least 1 hour.
- Reporting all accidents or incidents involving personnel as required by TMR procedures and relevant governmental regulations.
- Ensuring all reports and paperwork are completed and submitted at the end of the diving day.
- Maintaining certification in cardiopulmonary resuscitation (CPR), first aid (American Red Cross or equivalent), automated external defibrillator (AED), and emergency oxygen administration.

6.7 Divers and Snorkelers

Divers must be at least 18 years of age, be medically certified as "fit to dive," and have a knowledge of diving theory, diving-related physics, and physiology. They will provide copies of their certifications to the DRB Chairman before being allowed to dive. On diving projects involving UXO operations, the minimum age of the diver must be 21 years, per the Bureau of Alcohol, Tobacco and Firearms regulations concerning the handling of explosives.

Divers must have a full understanding of the diving equipment in use, and of the tasks assigned. A diver is assigned by the diving supervisor/lead diver to perform specific tasks underwater and topside. The diver must be qualified for the diving technique, equipment selected, and the task assigned. Each diver will meet the following requirements:

- Know how to use the tools, equipment, and systems relevant to assigned tasks.
- Know the techniques of the assigned diving mode.
- Accomplish all tasks assigned by the diving supervisor/lead diver. In the event that the diver is assigned a task for which he/she does not consider himself/herself

to be qualified either by training or experience, the diver will immediately inform the diving supervisor/lead diver.

- Read, understand, and comply with all TMR policies and with applicable government regulations as they relate to their qualifications or performance while engaged in diving.
- Maintain a high level of physical fitness.
- Immediately obey all commands or instructions from the diving supervisor/lead diver to return to the surface, or first decompression stop, as appropriate.
- Keep topside personnel advised of conditions on the bottom.
- Be responsible for the diving gear worn and ensure that it is complete, in good repair, and ready for use at any time in accordance with regulations or instructions concerning its use, maintenance, repair, and testing.
- Report to the diving supervisor/lead diver any defect or malfunction of the diving equipment provided for the diving operation.
- Ensure the deepest depth of the dive has been established before ascent.
- Report to the diving supervisor/lead diver any recent medical treatment or illness so that the proper determination can be made concerning the diver's fitness to dive.
- Immediately report all symptoms or suspected symptoms of decompression sickness as early and accurately as possible.
- Always follow safe diving practices during the diving operation, whether topside or in the water. The diver will bring any questionable items to the attention of the diving supervisor/lead diver and will be alert for the safety of all.
- Remain awake and in the vicinity of the decompression chamber for at least one hour following recompression treatment or a hyperbaric exposure beyond no-decompression limits.
- Know and observe the rules for ascending to altitude, including flying after diving.
- Ensure that their diving equipment has been properly maintained, prepared, and tested before each dive. This requirement should never be delegated to others.
- Maintain a divers' logbook, which details all dives, medical examinations, courses taken, and personal equipment maintenance.
- Ensure their medical certificates are up to date and recorded in the diving logbooks. Divers will present their logbooks to the diving supervisor/lead diver at every job when requested.
- Ensure that he/she is not exposed to hyperbaric conditions against their will, except when necessary to complete decompression or treatment procedures.
- Maintain certification in CPR, First Aid, AED, and emergency oxygen administration.

A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive. It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training, abilities or the regulations and guidelines in this manual or the project DSPM.

6.8 Standby Diver

The standby diver is a fully qualified diver, assigned for backup to provide emergency assistance, and is ready to enter the water when conducting diving operations with a single-tended diver. When assigned during buddy diving, where two divers are conducting the dive together, he/she will be ready to enter the water prior to commencing the dive, and then may remove tank, mask, and fins at the diving supervisor/lead diver's discretion. Under no circumstances will he/she leave the dive site. The standby diver receives the same briefings and instructions as the working divers, wears the same diving equipment, monitors the progress of the dive, and is fully prepared to respond if called upon for assistance. While acting as a standby diver, **in addition to** the requirements listed above, the standby diver will:

- Be rested and fully capable of performing emergency rescue assistance.
- Be sufficiently free of residual nitrogen to allow for enough bottom time for the prescribed task at the working depth without exceeding the no-decompression limits for that depth.
- Be dressed appropriately to allow prompt entry into the water as directed by the diving supervisor/lead diver.
- Remain at their station throughout the entire dive.
- Refuse any tasks that might interfere with their duties as a standby diver whenever there is a diver in the water.

6.9 Dive Tender

The tender is a member of the dive team who works most closely with the diver on the bottom. Though it is preferred that the tender be a qualified diver, it is not mandatory. If the tender is not a qualified diver, they must be familiar with line pull signals and all emergency procedures. The tender is assigned by the diving supervisor/lead diver to continuously tend (monitor) the diver. They will devote their full attention to tending the diver they are assigned to, from preparation of the dive through its completion. They will not be assigned any other task while the diver is in the water. The tender shall further:

- Assist the diver in dressing and undressing and confirm that the diver's equipment is functioning properly.
- Always tend the diver’s safety line and be aware of the diver’s depth and location.
- Set up and operate all equipment as directed by the diving supervisor/lead diver.
- Immediately inform the diving supervisor/lead diver if they are assigned a task for which they do not consider themselves qualified either by training or experience.
- Be alert and immediately report any conditions that are hazardous or unsafe.
- Assist in topside work as required or directed.
- Maintain certification in CPR, first aid, AED, and emergency oxygen administration.

7.0 DIVING POLICY

It is the policy of TMR to consistently provide safe diving operations that meet the client's required level of work and that are following applicable laws and regulations. This work shall be consistent with the project-defined scope, schedule, budget, and level of quality. To accomplish this objective, TMR will provide the appropriate qualified personnel, resources, and guidance to the Operating Units where diving is required. Such resources may include specialized diver expertise that may be in another office, or corporate affiliate, or maybe subcontracted to the appropriate company.

This DSPM addresses procedures for the safe utilization of self-contained underwater breathing apparatus (SCUBA) and surface-supplied air diving operations. Mixed-gas diving is not authorized for employees of TMR covered under these procedures. All dives will be planned to adhere to the Standard Air, No Decompression, or Shallow Water dive tables set forth in the USN Diving Manual, refer to Attachment 10, available in the Guidelines Templates and Tools folder in the CRL.

The individual local or state requirements will be reviewed and incorporated into the project specific HASDP. This review will be performed prior to commencing any diving operations within the affected state. Prior to diving, the project specific HASDP must be approved by the Chairman of the TMR DRB for construction diving or the scientific DSO for scientific diving, with the approved copy forwarded to and retained by the TMR Chairman of the DRB.

8.0 SCIENTIFIC DIVING

All TMR Scientific diving will be conducted in accordance with Tetra Tech Corporate Safety DCN 02-15 Scientific Diving Program[1] in the Corporate Health and Safety Manual.

9.0 REQUIREMENTS FOR DIVING AND SNORKELING

9.1 General Requirements

The requirements presented in this section will be used in conjunction with procedures and requirements for individual dive techniques presented in the following sections of the DSPM. All dives will be executed under the regulations and guidelines outlined in Section 2.0.

- The qualifications of personnel and equipment requirements for snorkeling are the same as diving, except for the required air supply for diving.
- A ladder extending a minimum of 3 feet below the diving platform below the surface of the water and appropriate handrails will be provided to assist the diver on entry and exit from the water. (<u>*Note*</u>*: Inflatable boats are exempt from this requirement.*)
- A means will be provided to assist an injured diver from the water.

[1] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/02_General%20Health%20and%20Safety%20Programs/DCN%2002-15%20Scientific%20Diving%20Program.pd

- When diving from vessels, the international code alpha and recreational dive flag with a minimum dimension of 23 square inches will be displayed whenever diving operations are being conducted. The flag will not be removed until diving operations have been completed and all divers are safely out of the water. TMR divers will comply with all site-specific local, state, federal, and international regulations regarding marking of diving activities.
- For enclosed areas, i.e., Intracoastal Waterway or marinas, individual buoys with recreational diver flags will mark the outline of the diving area. The divers may have a "marker" buoy with the recreational dive flag to determine their exact location. A rigid replica of the International Code Alpha flag at least 1 meter in height and visible from all directions will be displayed at the dive location.
- A diver will be stationed at the underwater point of entry when diving is conducted in enclosed or physically confining spaces.
- Positive communications to the recompression facility, the designated medical facility, and any required transportation to these facilities (medivac, ambulance, etc.) will be checked daily. This communication will include cellular telephone or radio communications with a constantly manned location with telephone access at the dive site. Diving operations will not be conducted without established communications.
- The diving supervisor/lead diver will not be permitted to dive, unless another qualified supervisor is present and has assumed the dive supervisor/lead diver roles and responsibilities.

9.2 Snorkeling Requirements

TMR employees engaged in snorkeling operations will comply with the general requirements for diving and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- Snorkeling will be conducted only with prior approval and acceptance of the district diving coordinator (DDC).
- Snorkeling will be allowed only for shallow water site assessments and reconnaissance. It will not be used for structural inspections or other work.
- An on-site snorkeling team shall be made up of no less than two persons: snorkeler and observer/assistant. Additional site personnel may be required by the DDC or safety office DSR based on site hazards and conditions. Snorkeling team plans and procedures shall be developed and enacted by a team supervisor who is qualified and experienced in snorkeling and incorporated in the HASDP.
- Snorkeling will only be done on the surface of the water. Breath-hold or free diving of any kind is not permitted.
- Generally, untethered snorkeling will NOT be allowed in waters deeper than 5 feet of seawater (FSW), in bodies of water that a snorkeler cannot wade across, or anywhere a pressure differential may exist.
- Snorkeling in open waters greater than 5 feet deep may be allowed by the DDC, based on an acceptable Activity Hazard Analysis (AHA) and compliance with the following:
    - Any requirements incorporated in the approved HASDP.

  - A single snorkeler shall be tethered with a harness and a maximum of 40 FSW of floating line. The tether must be constantly tended from the shore or boat.
  - The snorkeler must wear a device providing a minimum of 15.5 pounds of positive buoyancy (Type III personal flotation device [PFD], fully inflated snorkeling vest, etc.).
  - There are no potential tether entanglement hazards in the snorkeling area (e.g., overhanging branches, surface stumps, rocks, etc.).
- All snorkelers and observers/assistants will be certified as skin divers (snorkelers) or open water divers by a nationally recognized organization (e.g., Professional Association of Diving Instructors, National Association of Underwater Instructors, etc.) or the U.S. Forest Service Snorkel Safety Program.
- An observer/assistant will always accompany each untethered snorkeler either along the shore or in a boat and be within 50 feet of the snorkeler.
- Two untethered snorkelers in the same body of water may act as observer/assistant for each other if they remain within 50 feet of each other.
- Non-snorkeling observer/assistants shall wear a PFD and be equipped with a throw bag and/or ring buoy with at least 70 FSW of line and must be capable of performing a rescue on the specific snorkeler(s) in an emergency.
- Areas of extreme water velocity and turbulence will be avoided, especially those immediately upstream from debris jams or bedrock outcrops.
- Snorkelers will be provided with appropriate thermal protection.
- Employees will be determined medically fit by a licensed physician (doctor of osteopathy or medical doctor) prior to snorkeling. This certification shall be signed by a physician familiar with sports medicine, and state that each snorkeler is physically and medically fit to perform snorkeling activities according to commonly accepted sports medicine guidelines.
- All snorkeling team members shall be certified in first aid and CPR. Certification shall be in accordance with most recent emergency cardiovascular care guidelines, and/or American Heart Association or American Red Cross standards.
- A first aid kit will be available at each location where snorkeling is being performed. A means of securely transporting an unconscious person, such as a litter or stretcher, shall be provided when snorkeling is conducted in areas inaccessible to vehicles or boats.
- A means of communication capable of contacting emergency services must be available at locations where snorkeling is performed.
- Each snorkeler will be equipped with a professional grade mask, fins, snorkel, and snorkeling vest.
- A snorkeling protocol will be developed and included in the project HASDP. It will contain as a minimum, the following:
  - An AHA for each specific snorkeling mission (Particular detail will be given to currents and other environmental considerations.)
- Records for snorkeling activities will be maintained and will include as a minimum:
  - Snorkeler’s annual physician certifications

- AHAs
- A snorkeling plan incorporated in the HASDP that is based on the requirements of USACE EM 385-1-1; Section 30.A.15.a-e

- Snorkelers will wear apparel which provides appropriate protection from environmental conditions. The apparel must include fins or other appropriate foot protection.

9.3 SCUBA Diving Requirements

TMR employees engaged in SCUBA diving operations will comply with the general requirements for diving and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- The minimum sized SCUBA tank allowed as primary air is a standard 80 cubic-foot aluminum tank pressurized to at least 90 percent, or 2,700 pounds per square inch (PSI) at the beginning of dive operations.
- Divers shall terminate their dive so that they reach the surface with a minimum tank pressure of 500 PSI.
- Audio communications are preferred in all diving situations. However, this type of communication is not required for a diver who is accompanied by another diver (buddy), or who can communicate with the tender on the surface via a safety line using line pull signals.
- The planned time of such a diving operation will not exceed the no decompression limits according to the USN Dive Manual, or the air supply duration of the cylinders in use, exclusive of the reserve supply. The cylinder pressure will be determined immediately before each dive.
- Each diver will be equipped with a knife, a diving wristwatch, a depth gauge or dive computer, a facemask, a submersible cylinder pressure gauge, and a buoyancy compensator.
- A weight belt or integrated weight system with a quick release that is appropriate for the suit and the depth of the dive will be worn.
- A cylinder harness with a quick release will be worn to secure the SCUBA cylinders to the diver.
- The weight belt and cylinder harness will be independently attached to permit release of either one without interference by the other.
- A personal flotation or buoyancy compensation device will be worn. An exception will be considered during approval of the HASDP for diving in enclosed spaces or under the ice.
- SCUBA diving operations will not be conducted at depths deeper than 100 feet.
- USACE or DDC exemption approval is required for dives to any depths from 100 feet to 130 feet, and if approved, a recompression chamber must be available within 5 minutes of reaching the surface.
- During all SCUBA dives, a standby diver will be available while a diver is in the water.

- A SCUBA diver will be line-tended from the surface or accompanied by another diver in the water in continuous visual contact during the diving operations. If any SCUBA diver is tended, they will wear a harness meeting the following standard:
  - Each tethered SCUBA diver shall wear a safety harness with a positive buckling device, attachment point for the safety line, and a lifting point to distribute the pull force of the line over the diver's body while maintaining the body in a heads-up vertical position when unconscious.
- A diver-carried independent reserve breathing gas supply consisting of the following will be provided for each diver:
  - Each diver shall be equipped with a minimum 30 cubic-foot bailout bottle for emergency use pressurized to at least 90 percent of its working PSI rating and equipped with a separate first- and second-stage regulator. An "octopus" is not considered to be an alternate air source.

9.4 Surface-Supplied Diving Requirements

Employees engaged in surface-supplied diving will comply with the general requirements for diving, and the following additional requirements, unless otherwise specified in a project specific and approved HASDP:

- The approximate depth of each dive will be determined prior to the start of operations.
- A weight belt appropriate for the suit and depth of the dive will be worn, except when conditions dictate otherwise for the safety of the diver.
- A five-point safety harness, with a positive buckling device, will be worn under all other types of equipment (*except when diver is dressed in heavy gear*). This harness will have an attachment point for the umbilical to distribute the weight of the diver's body and prevent any strain from being placed on the diver's mask or helmet if/when the umbilical is pulled on. The safety harness will also have a lifting point to distribute the pull force of the line over the diver's body. The safety harness may be equipped with a backpack to contain a bailout bottle.
- Surface-supplied dives will not exceed 190 FSW and will not enter into exceptional exposure dives as set forth in the USN standard air decompression tables.
- A decompression chamber will be ready for use on site for any dive outside the no-decompression limits or deeper than 100 FSW.
- Each diver will be continuously tended by another dive team member while in the water.
- A diver will be stationed at the underwater entry point when diving is conducted in enclosed or physically confining spaces.
- A standby diver will be available while a diver is in the water.
- Each dive will have a primary air supply capable of supplying the diver(s) with the specified air volume, pressure, and flow rate, in accordance with the manufacturer's specifications associated with the diving apparatus worn, throughout the planned depth of the dive, including any required decompression.
- Each dive location will have a reserve breathing air supply, in line, capable of supporting the dive operation.

- A diver-carried reserve breathing gas supply will be provided for each diver on dives deeper than 60 FSW or outside no-decompression limits, or when the diver does not have direct access to the surface and on all surface-supplied dives operating under USACE EM 385-1-1. This does not apply when heavy gear is used.
- On all dives deeper than 100 FSW or outside the no-decompression limits, an extra breathing gas hose capable of supplying gas to the diver in the water will be available to the standby diver.
- On all dives deeper than 100 FSW or outside the no-decompression limits, an in-water stage will be provided.

10.0 DIVER TRAINING AND QUALIFICATIONS

The following section describes the minimum requirements for TMR divers. Additional training may be needed for site-specific conditions, or required under federal, state, or local regulations.

The level of experience or training required by the standard depends on the job the employees are required to do. All dive team members must have either experience or training in the use of tools, equipment, systems, techniques, operations, operational procedures, and emergency procedures that are pertinent to, and necessary for, the assigned tasks for the diving mode.

It is essential that those dive team members who are exposed to hyperbaric conditions, or those members who control the exposure of others, have knowledge of the physiological effects of diving and the related effects of pressure. Accordingly, this standard also requires that employees be trained in diving-related physics and physiology. Employee qualifications achieved through field experience and classroom training may be used to meet the requirements of the standard.

- Divers must have federal certificates (such as from the USACE, NOAA, and/or military diving school).
- Divers must have civilian diving school certificates of completion for the appropriate training level issued by schools associated with the ADCI.
- Each dive team member must be trained in CPR (American Red Cross or equivalent), first aid, AED, and emergency oxygen administration. Employees completing this training are issued a card certifying that they have successfully completed the course.
- Each member of the TMR diving team will be qualified to conduct the work assigned by completion of training and/or experience. This qualification will be documented by completion of a certified course of instruction, to include one or more of the following: a certified commercial course (Association of Commercial Diving Educators accredited), a civilian certification with experience for the profile of the dive, or a documented military diver training and experience.
- All divers will maintain a personal dive log that will document all hyperbaric exposures. Additionally, dates of diving physicals and a record of all relevant training will accompany the log. The following minimum information should be included in the log:

- Location of exposure
- Maximum depth
- Time left surface, total bottom time, and time reached surface
- Type of breathing apparatus and mixture used
- Task performed
- Decompression table and schedule used
- Any decompression sickness symptoms or injury
- Signature of the Diving Supervisor/Lead Diver
- Comments

10.1 Entry Level Training

All TMR non-divers who have the required skills and training to participate in diving-related activities must be certified by an internationally recognized agency.

10.2 SCUBA Training

All TMR divers will provide a copy of their diver certification to the Chairman of the DRB that represents successful completion of a swimming evaluation, practical diver training, written examination, and open water evaluation. Scientific divers will also provide a copy of their diver certification to the DSO. The certificate from the training activity will be used to document the location and date of training. The dive log will document the depth and number of diving qualification dives.

10.3 Surface-Supplied Diver Training

The training certificate to document previous training and dive log to document the number of dives and depth of diving qualifications will be provided. Training dives will be required to ensure all divers are current in the type of equipment and the depth expected of the diving project.

11.0 PERSONNEL REQUIREMENTS

In establishing the number of dive team members required for a dive, proper consideration must be given to 29 CFR 1910.421(d), Planning and Assessment, and 29 CFR 1910.421(e), Hazardous Activities. The second provision requires employers to provide a means to assist an injured diver from the water, such as a small boat or stokes basket, which may necessitate additional dive team members.

11.1 Self-Contained Underwater Breathing Apparatus (SCUBA)

For diving that requiring the use of SCUBA, the following number of divers are required for the work:

Dive Team Composition SCUBA – Untethered, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor	1
Divers (in visual contact)	2
Standby Diver*	1
TOTAL TEAM	**4**

Dive Team Composition SCUBA – Tethered with communications, 0 to 100 FSW	
Personnel	**Number**
Diving Supervisor **	1
Diver in water	1
Standby Diver* (tethered with communications)	1
Tender	1
TOTAL TEAM	**4**

** 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 supervisor may be the standby tender for dives under 100 FSW.*

11.2 Surface-Supplied Diving (0-100 FSW with no Decompression Diving)

For surface-supplied diving, from 0 to 100 FSW, the number of divers required to perform the work is listed below:

Dive Team Composition Surface Supplied Air – 0 to 100 FSW 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**

** 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 supervisor may be the standby tender for dives under 100 FSW.*

11.2.1 Deploying the Standby Diver as a Worker Diver

The standby diver may be deployed as a working diver provided **all** the following conditions are met:

1) Surface-supplied no-decompression dive of 60 FSW or less;
2) Divers are in proximity, (based on site specific requirements), with unimpeded access to each other;
3) Divers always have communications with each other;
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; and
7) Each diver has a full-time tender (which brings the minimum number of team members to five).

11.3 Surface-Supplied Diving (Deeper than 100 FSW or decompression diving)

For surface-supplied diving deeper than 100 FSW, or decompression diving, the number of divers required to perform the work is listed below:

Dive Team Composition Surface Supplied Air – 0 to 100 FSW Requiring Decompression All Surface Supplied Air, 101 to 190 FSW			
Personnel	**No Decompression Dives**	**Decompression Dives**	**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**

** 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 Competent Person/chamber operator may be any non-diving member of the dive team if all diving ceases during chamber decompression.*

11.4 Other Diving Operations

An additional dive crew member may be required for any diving operations involving an increased likelihood of diver entrapment or the potential for rendering the diver unconscious or incapacitated from chemical, physical, electrical, or topside hazards. These operations include, but are not limited, to:

- Diving on ordnance and/or explosives projects
- Diving from a small boat
- Diving in remote areas where assistance from non-diving crew personnel is not immediately available, but within communication range
- Penetration diving, both horizontal and vertical
- Diving requiring crane operations
- Diving in any situation where the diver uses surface-tended equipment
- Diving from a platform greater than 8 feet above the water surface

12.0 MEDICAL REQUIREMENTS

Each diver will receive a diving physical examination initially when assigned diving duties and yearly thereafter. In addition, a medical examination will be conducted whenever a diver has been hospitalized for more than 24 hours due to an injury or illness. A determination as to their fitness to continue to dive will be prepared by the examining physician. The physician will prepare a written report containing the following statement: “Based on the following, I certify the diver as ‘Fit to Dive’.” In addition, the report will contain the following information:

- Medical requirements of this standard and a summary of the nature and extent of hyperbaric exposure to which the diver will be exposed, including diving modes and types of work to be assigned (TMR will provide the dive information).
- The diver’s medical history (a diver’s Medical History and Supplemental Diving Questionnaire, available in the CRL), which will be filled out completely and will be provided to the examining physician.
- The results of the medical examination. A basic diving physical examination will be conducted initially and annually for all TMR divers, which will include a chest X-ray, vision testing, audiogram, pulmonary function test, blood chemistry panel, complete blood count with differential, urinalysis with microscopic analysis (U.S.), and any additional tests required by the examining physician. An electrocardiogram will be performed. An exercise stress test may be indicated based on a risk factor assessment performed by the doctor.
- The examining physician’s opinion of the employee’s fitness to be exposed to hyperbaric conditions, including any recommendations or limitations to such

exposure. TMR will provide the employee with a copy of the physician's written report.

Determination of the employee's fitness to dive will be based on the physician's written report and review by the DRB. If the physician has recommended a restriction or limitation on the employee's exposure to hyperbaric conditions, and the employee does not agree with the physician's findings, the employee has the right to obtain his own diving-certified physician to perform a diving physical. If the second physician does not agree with the findings of the first physician, a third physician will be consulted for resolution.

13.0 EQUIPMENT CONSIDERATIONS

The diving supervisor/lead diver, in conjunction with the DRB, will establish the equipment requirements for individual projects. This list will be included in the HASDP and will include the required dive gear, boat equipment, and any required task-specific equipment. This list should be submitted to the project manager when the HASDP has been approved. Each equipment modification, repair, test, calibration, or maintenance service that is required will be recorded by means of a tagging or logging system. This system will include the date, serial number of the item, nature of the work performed, and the initials of the person who conducted the work.

13.1 Equipment Maintenance

Typically, TMR underwater operations use a variety of diving systems and component equipment. This equipment is considered life support equipment and should be treated as such.

- All equipment will be maintained in accordance with the directives set forth by OSHA and the Manufacturer's Specifications.
- Any maintenance performed on equipment will be logged on the maintenance form and forwarded to the project equipment manager for entry into the Equipment Maintenance Log.
- Dive supervisor/lead divers shall have the required expertise to maintain the systems used by TMR.
- Dive Team Members shall treat all equipment in a responsible manner and immediately inform the dive supervisor/lead diver of any potential equipment problems that they may observe.
- Bi-annual air quality tests will be performed on all breathing air compressors, and the results kept on file by the Chairman of the DRB.
- Equipment requiring periodic calibrations shall be sent to their respective manufacturers or licensed professionals for proper maintenance and calibration. The dive supervisor/lead diver shall inform the project equipment manager of any equipment taken offline.

If the equipment was provided by the TMR warehouse, the equipment manager will manage and report equipment concerns in accordance with TMR Procedure PO-18, Warehouse Management.

13.2 Air Supply Requirements

Diver air will be procured from a facility where the compressors meet the requirements established in Compressed Gas Association Pamphlet G-7.1 or more stringent standards. The tanks will be filled with compressed air from a source that complies with, at a minimum, 29 CFR 1910.430 (equipment). The breathable air supplied to the diver will be tested every 6 months and will not contain:

- A level of carbon monoxide greater than 10 parts per million (ppm)
- A level of carbon dioxide greater than 1,000 ppm
- A level of oil mist greater than 5 milligrams per cubic meter
- A level of hydrocarbons, other than methane, greater than 25 ppm
- Noxious or pronounced odor

A copy of the latest air test results will be reviewed and/or obtained and filed with the HASDP. When using local established vendors, a check of current certification is required every 6 months. If air test results are not available, TMR will draw an air sample from the compressor for appropriate analyses.

13.3 Regulators

TMR divers will be responsible for inspecting and scheduling maintenance on their regulators prior to the first use and every 12 months thereafter. Documentation of the inspections and maintenance will be maintained in the TMR diving files.

13.4 Compressed Air Cylinders

Compressed breathing air cylinders will:

- Be constructed with seamless steel or aluminum that meets U.S. Department of Transportation (DOT) 3AA and DOT 3AL specifications.
- Have identification symbols stamped into the shoulder of the cylinder.
- Be inspected internally and externally for corrosion and pitting on an annual basis. If a defect is found that may impair the safety of the pressure vessel, a hydrostatic test must be performed.
- Be hydrostatically tested every fifth year in accordance with DOT regulations. The test dates will be stamped into the shoulder of each cylinder. Documentation of each cylinder inspection will be maintained in the TMR diving files.
- Be stored in a ventilated area and protected from excessive heat.
- Be secured from falling.
- Have shutoff valves recessed into the cylinder or protected by a cap, except when in use, when installed with a manifold, or when used for SCUBA diving.

13.5 Air Compressor Systems

Air compressors used to supply air to the diver will:

- Be equipped with a volume tank that has a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.

- Have intakes located away from areas where exhaust fumes or other air contaminants may be present.
- Be tested every 6 months by means of samples taken at the connection to the distribution system to ensure that the air supplied meets all applicable standards (see Section 3.6.1, above). Non-oil lubricated compressors do not have to be tested for oil mist.
- Be equipped with a moisture separator and filtration system.

A log shall be maintained showing all tests, repairs, maintenance, and run time on all air compressors systems.

13.6 Surface Supplied Air

The diver's surface-supplied air supply may originate from an air compressor, a bank of high-pressure air flasks, or a combination of both. Regardless of the source, the air must:

- Meet the purity standards stated above;
- Be supplied in an adequate volume for breathing;
- Have a rate of flow that properly ventilates the helmet or mask; and
- Be provided at enough pressure to overcome the bottom water pressure and the pressure losses due to flow through the diving hose, fittings, and valves.

The air supply requirements depend on specific factors for each dive, such as depth, duration, level of work, number of divers being supported, and type of diving system being used.

The capacity of the primary air supply must meet the consumption rate for the designated number of divers for the full duration of the dive (bottom time plus decompression time). The maximum depth of the dive, the number of divers, and the equipment to be used must be considered when sizing the supply.

The secondary air supply must be sized to support recovery of all divers using the equipment and dive profile of the primary supply, if the primary supply malfunctions or fails at the worst-case time (i.e., immediately prior to completion of planned bottom time of maximum dive depth, when decompression obligation is greatest).

13.6.1 Breathing Gas Supply Hoses

Breathing gas supply hoses will:

- Have a working pressure at least equal to the pressure of the total breathing gas system;
- Have a rated bursting pressure at least 4 times the working pressure;
- Be tested annually (at a minimum) to 1.5 times their working pressure;
- Have their ends taped, capped or plugged when not in use;
- Have connections made of corrosion resistant material, and be resistant to accidental disengagement; and
- Have connectors with a working pressure at least equal to the hose to which they are attached.

13.6.2 Divers' Air Supply Hoses

Umbilical's will:

- Be marked (starting from the diver's end) at 10-foot increments for the first 100 feet; and 50-foot increments thereafter;
- Be made of kink-resistant material; and
- Have a working pressure greater than the pressure equivalent of the maximum depth of the dive plus 100 pounds per square inch.

13.7 Gauges and Timekeeping Devices

The following requirements apply to each diver's gauge or timekeeping device:

- Each depth gauge will be deadweight tested or calibrated against a master reference gauge every 6 months, and when there is a discrepancy greater than 2 percent of full scale between any two equivalent gauges.
- A cylinder pressure gauge that is capable of being monitored by the diver during the dive will be worn by each SCUBA diver and surface-supplied diver when equipped with a bailout bottle.
- Each SCUBA diver will wear a diving watch capable of displaying elapsed time.
- A timekeeping device will be available at each dive location.
- Dive computers will be approved for use after the review and approval of the DRB (see paragraph 13.10 below).

13.8 Buoyancy Control

The following requirements apply to each diver's buoyancy control device:

- A dry suit or buoyancy compensator not directly connected to the helmet or mask will be equipped with an exhaust valve.
- Helmets or masks directly connected to a dry suit or other buoyancy-changing device will be equipped with an exhaust valve.
- When used for SCUBA diving, a buoyancy compensator will have an inflation source separate from the breathing gas supply and a manual inflator hose.
- An inflatable flotation device capable of maintaining the diver at the surface in a face-up position, having a manual activated inflation source independent of the breathing gas supply, an oral inflation device, and an exhaust valve is required for SCUBA diving, except when diving in enclosed spaces or under the ice.

13.9 Masks and Helmets

The following requirements apply to each diver's mask or helmet:

- Surface-supplied masks/helmets will have a non-return valve at the attachment point between helmet or mask and hose that will close readily and positively. Masks/ helmets will also have an exhaust valve.
- Surface-supplied air masks and helmets will have a minimum ventilation rate capability of 4.5 actual cubic feet per minute at any depth at which they are operated, or they will have the capability of maintaining the diver's inspired carbon

dioxide partial pressure below 0.02 atmosphere absolute (ATA) when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute.

13.10 Dive Computers

Dive computers that calculate decompression time based on time and depth are not to be used unless authorized by the dive supervisor/ lead diver and incorporated into the project specific HASDP. They must be checked for accuracy prior to use.

13.11 Backpacks

Backpacks worn during diving operations without integrated flotation devices and weight systems must be equipped with a quick-release device.

13.12 Handheld Power Tools

Handheld power tools are not normally used during SCUBA diving operations, but, if used, they will be used in accordance with the following safeguards:

- Handheld power tools and equipment will be de-energized before being placed into or out of the water.
- Handheld power tools will not be supplied with power from the dive location until requested from the diver.
- Two-way voice communications between divers and topside must be used.

13.13 Dive Tables

Dive tables shall be made available to divers at all diving locations.

13.14 Welding/Cutting/Burning

Welding, cutting, and burning procedures are not addressed in this manual. When a diving project requires welding, cutting, or burning operations, those specific procedures will be addressed in the project specific HASDP for that project.

13.15 First Aid/CPR/AED/Emergency Oxygen

A first aid kit, appropriate for diving operations and approved by a physician, will be available at the dive site. This kit will contain an American Red Cross standard first aid handbook or equivalent, a bag-type resuscitator with transparent mask and tubing, and a stokes litter or backboard with flotation capabilities.

Additionally, a portable source of oxygen will be available at the dive site for transport of a diving-related casualty to the hyperbaric treatment facility. One additional first aid kit will be the AED. It has been proved that, in the case of cardiac arrest, the AED, if used within the first 3 minutes, would save an additional 74 percent of patients.

13.16 Equipment Procedures Checklists

Pre-dive and post-dive checklists for both Surface-Supplied Air and SCUBA operations will be used during setup and breakdown of the dive station.

14.0 RECORDKEEPING REQUIREMENTS

The following records are required by 29 CFR 1910.401, Subpart T, and will be maintained as follows:

- The TMR Chairman, via the DRB, will maintain all historical records.
- Records will also be retained in the project, office, or department files, in accordance with TMR Procedure PO-08 Document Control and Records Management.
- Records and documents will be maintained in accordance with 29 CFR 1910.401, Subpart T, and will be provided upon request to employees, designated representatives, and others as determined by TMR.

14.1 Dive Profile Log (Depth-Time Profile)

The TMR Dive Smooth Log (Attachment 7, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL) will be forwarded to the Chairman of the DRB and maintained for 1 year. If there has been a diving-related illness or injury on the project, the records will be maintained for a period of 5 years. After the 5-year time limit, the records will be forwarded to the National Institute for Occupational Safety and Health (NIOSH). The TMR DSO will maintain copies for all scientific divers.

14.2 Diving-Related Injury Records

Any diving-related injury or illness, which requires any dive team member to be transported to a hospital for treatment related to any diving incident, will be reported to the safety and health manager (SHM) and documented by specifying the circumstances of the incident and extent of the injuries in the section provided in the Dive Profile Log.

The SSHO will subsequently report this accident/ incident to the TMR organization in accordance with procedure DCN 02-02, event reporting and investigation. The Dive Smooth Log and written Accident/Incident Report will then be forwarded to the designated SHM, who will forward it to the Chairman of the DRB. The Chairman will include the Dive Profile Log sheet in the TMR Dive Log, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL.

14.3 Recording of Dive

As stated above, a Dive Profile Log sheet will be completed for each dive, and, upon completion of the dive, will be forwarded to the Chairman of the DRB. The Chairman of the DRB will include the Dive Profile Log sheet in the TMR Dive Log, which will document all dives conducted by TMR personnel. The Diver’s Medical History and Supplemental Diving Questionnaire must be completed for each diver before they commence diving.

14.4 Decompression Procedure Assessment Evaluation

In the event of a diving-related incident that requires treatment by recompression, the section of the Dive Profile Log sheet for Decompression Procedure Assessment Evaluation will be completed and forwarded to the Chairman of the DRB, who will include the log in the TMR Dive Log. The Dive Log will be maintained for a period of 5 years. The Chairman of the DRB or designee will conduct the accident investigation.

14.5 Equipment Inspections and Testing Records

The current log entry or tag for required equipment must be maintained until the equipment is removed from service.

14.6 Records of Hospitalization

All medical records generated by a hospitalization visit must be forwarded to the TMR Medical Provider.

14.7 Diver Medical Records

The Tetra Tech Corporate Safety Procedure DCN 3-02F, MS-2, Release of Medical and Exposure Records[2] form is retained by TMR Human Resources Department. The Tetra Tech Corporate Safety Procedure DCN 3-02F, MS-1, Physician's Certification form[3] is retained by the Tetra Tech Medical Provider, and copies are maintained in project site files by the SSHO. All personal information protected by the Health Insurance Portability and Accountability Act is maintained by Tetra Tech's independent medical provider. Employee medical records will be handled in accordance with Tetra Tech Corporate Safety Procedure DCN 1-04, Recordkeeping and Reporting Requirements[4].

Diver qualification medical records that are signed by the TMR Medical Provider will be maintained for the duration of employment plus 30 years in accordance with 29 CFR 1910.1020(d).

14.8 Diving Safe Practices Manual

The current version of this DSPM is required to be maintained at the dive location.

14.9 Forwarding of Records

Employers are no longer required to notify and/or transfer records to NIOSH. OSHA's 29 CFR 1910.1020(h)(1) provides that whenever an employer is ceasing to do business, they must "transfer all records subject to this section to the successor employer. The successor employer shall receive and maintain these records.

14.10 Termination of Diving Operations

If TMR ceases to do business, the successor employer will receive and retain all dive and employee medical records required by 29 CFR 1910.1020(h)(2); The employer shall notify affected current employees of their rights of access to records at least three (3) months prior to the cessation of the employer's business

---

[2] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/03_Environmental%20and%20Remediation%20Operations/DCN%2003-02F%20MS-2%20Release%20of%20Medical%20and%20Exposure%20Records.pdf

[3] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/03_Environmental%20and%20Remediation%20Operations/DCN%2003-02F%20MS-1%20Physicians%20Certification%20Form.pdf

[4] https://tetratechinc.sharepoint.com/:b:/r/sites/Health-Safety/Health%20%20Safety%20Manual/01_Health%20and%20Safety%20Program%20Administration/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf

14.11 Training Records

Copies of each diver's successful completion of the USN Dive School or civilian certification, and any other certificates of any specialized training (relevant to the job), will be forwarded to the Chairman, of the DRB and kept on the project site. Additionally, any training conducted in preparation for the job will be documented and retained on site and copies forwarded to the Chairman of the DRB.

15.0 OPERATIONS PLANNING

This section provides guidance on effective dive planning for any size operation. The success of any diving operation is a direct outcome of careful, thorough planning. The site-specific circumstances of each operation determine the scope of the planning effort, but certain considerations apply to every operation.

The HASDP provides a basic outline of minimum required information to successfully plan the diving operation. A project specific plan will be developed and implemented by the DRB, Project Manager and designated Diving Supervisor/Lead Diver for each separate diving project. The TMR SSHO for the project shall complete applicable self-assessment checklists. A project HASDP shall be developed to address the general diving and to include the following:

- Describe dive team composition, personnel qualifications, and responsibilities, along with the proper up-to-date documentation.
- Provide name and qualifications of the designated person in charge/diving supervisor responsible for diving activities (that is, years and type of experience and training background).
- Describe safe work practices for other activities to be performed during this project (for example, use of ladders, fall protection, use of electrical power tools, and use of personal protective equipment).
- Describe site-specific training, diver workups, equipment uses, and other training requirements (e.g., hazard communication, first aid, and CPR).
- Describe methods to identify and protect wetlands, endangered species, or cultural/historic resources, if applicable.
- Describe procedures for operating in inclement weather, including lightning, high winds, and severe rainstorms.
- Describe the Emergency Response Plan for equipment, incident response, treatment, evacuation, and notifications.
- Provide supplemental diving safety procedures.

The HASDP can reference overlapping plans or other pertinent project documents to minimize redundancy.

15.1 Risk Management and Assessment

Identifying the risks of the dive and developing a plan of action to minimize one's exposure to risk is crucial to safe and effective diving operations. The HASDP will be developed to address possible emergencies that may arise at each specific dive site. This plan shall incorporate steps for extraction of a stricken diver from the water, subsequent first aid and emergency response, and evacuation to a higher level of care. Job hazard analysis forms and safety checklists that are site-specific may be substituted providing they meet or exceed the requirements outlined in this manual and are approved by the diving supervisor/lead diver. Each team member shall be provided a copy of the HASDP prior to starting a job.

Once on the job, the diving supervisor/lead diver shall give a safety briefing to the dive team prior to each day of diving, and at the start of a new task. Emergency procedures will be reviewed on site to include local emergency/rescue points of contact. Wherever practicable, dives will be planned within the No Decompression Limits according to the USN dive tables and procedures.

The project manager and diving supervisor/lead diver, prior to the start of any fieldwork, must complete detailed planning and all required forms. Dive Team members must be made aware of the following:

- All known and potential hazards at the job site as reflected on the Job Hazard Analysis form.
- Required scope of work and individual responsibilities as detailed in the Pre-Dive Briefing Form.
- Equipment and tool requirements for all tasks
- Contingency and emergency plans

Diving shall be discontinued if sudden squalls, electric storms, heavy seas, unusual tide, or any other condition exists that, in the opinion of the diving supervisor/lead diver, jeopardizes the safety of the divers. It must be noted here that **ANYONE ON A TMR DIVE TEAM CAN STOP WORK** on a job if they feel that the work environment is/becomes unsafe.

Prior to diving, the diving supervisor/lead diver shall be responsible for examining the dive site to identify potential hazards. Some examples of potential surface and subsurface hazards include the following:

- Surface vessel traffic and/or vehicular traffic
- Swift currents and sea state
- Subsurface/underwater debris
- Overhead crane operations
- Mooring lines
- Pedestrian traffic/onlookers
- Petroleum products and/or other materials that are hazardous to divers and/or tenders
- Airborne contaminants
- Contaminated water
- Outfall and intake pipes

- Flotsam/jetsam (marine debris)
- Propeller/thrusters and intake/discharges of moored vessels
- Potential for structural collapse
- Hazardous marine life
- Limited access and/or confined workplace
- Fishing lines and nets
- Turbid (limited visibility) water
- Hazardous materials
- Abandoned piles and/or other structures
- Sonar equipment likely to be used or tested on nearby vessels

15.2 Termination of Dive Operations

The working interval of a dive will be terminated under any of the following conditions:

- The activities are completed as planned.
- A diver requests termination.
- A diver fails to respond correctly to communications.
- Communications are lost and cannot be quickly re-established between the diver and a dive team member at the dive location, or between the designated person-in-charge and the person controlling the vessel in live boating operations.
- A diver begins to use diver-carried reserve breathing gas or the dive location reserve breathing gas.
- The diving supervisor/lead diver determines that any unsafe condition exists.

16.0 CONSIDERATIONS FOR DIVE PLANNING

TMR diving mode options include Surface-Supplied Air Diving, Lightweight Surface-Supplied Air Diving, and SCUBA (with or without communications). Specific tasks and environmental conditions will dictate the safest and most efficient diving mode; however, there are certain requirements that must be followed regardless of the chosen dive mode selected.

16.1 Primary Breathing Air Supply

Air will be the primary breathing gas used during diving operations. A low-pressure air compressor, volume tank and filter assembly or high-pressure cylinders, with a regulated supply, provide the breathing air during Surface-Supplied Air diving. Compressed air cylinders worn by the diver supply the primary breathing air during SCUBA diving operations.

16.2 Reserve Breathing Air Supply

High-pressure air cylinders connected to the dive manifold supply the reserve air to the Surface-Supplied Air Diver. Additionally, the diver carries a reserve breathing air supply known as a bail-out system. The bail-out system provides a reserve air supply for the diver when surface-supplied air is compromised.

A redundant tank and regulator, or spare air cylinder carried by the diver provide the reserve air supply for SCUBA diving operations.

16.3 Exposure Protection

The site and environmental conditions are directly related to the type and amount of exposure protection required for a diver's comfort and safety. In cold or contaminated water, a dry suit with an adequate thermal undergarment is required. In the absence of contaminants, a neoprene wetsuit may be worn. A lightweight wetsuit, dive skin, or swimsuit with chaffing coveralls may be considered in warmer climates, providing the environment in which the dive will take place is free of contamination. Divers will wear some form of hand and foot protection while working in the water to minimize the possibility of injury. A neoprene or Lycra wetsuit hood is suggested when using SCUBA to provide protection for the diver's head and ears.

16.4 Dive Team Assignments

Each TMR Dive Team will have, as a minimum, four qualified personnel. The diving program manager will assign personnel to the dive teams. Personnel requirements are outlined in Section 11. Team assignments will be based on the scope of the project and the availability of qualified personnel. The logistics of the project and any unusual safety considerations at the job site may dictate additional personnel requirements.

- Additional personnel may be required to supplement the dive team in order to comply with standards set forth by a client or agency. In these instances, the required standards will be reviewed and strictly adhered to.
- All diving projects undertaken by the company for TMR government clients (e.g. USN or the USACE) will be carried out in strict compliance with DDESB TP-18, reference (c).

16.5 Decompression Procedures

The TMR standard of practice is to plan dives as no decompression dives according to the USN no-decompression limits. Should situations arise that necessitate the use of decompression diving to safely and efficiently complete the scope of work, USN Standard Air Dive Tables and outlined ascent procedures will be implemented and incorporated into the HASDP at that time.

16.6 Water Entry/Egress

A securely attached ladder or similar device will be provided for the diver to enter and exit the water. The ladder must extend at least 3 feet below the surface of the water and be capable of supporting the combined loads of both the diver and tender.

Divers shall enter the water in a controlled manner. In turbid or low visibility water conditions, there is always a possibility of submerged hazards or protruding objects that could pose a danger to the diver; therefore, extreme caution must be exercised during water entry.

Equipment required for the safe extraction of an unconscious diver from the water shall be provided at each dive site.

16.7 Warning Display

An International Alpha code flag and recreational “Diver Down” flag shall be prominently displayed during all diving operations. Flags will be placed in a highly visible position to provide as much warning as possible for all approaching vessels. For work in navigable waters, flag dimensions shall be at least one meter in height and width (or as specified by local jurisdictions) and illuminated at night.

16.8 Pre-Dive Brief

Prior to each dive, the diving supervisor/lead diver shall conduct a pre-dive Briefing to inform each Dive Team Member of the following:

- Diver’s health and readiness
- Standard and emergency procedures for diving mode employed and location of work
- Review of the AHAs, equipment checklists, and hazards or environmental variables that will impact diving operations
- Any deviations from standard procedures which may be necessitated by the operation
- Diver re-call procedure
- Factors which will terminate the dive

17.0 SPECIAL CONSIDERATIONS FOR DIVE PLANNING

In addition to the requirements above, there are many other items or circumstances that must be considered when planning a dive, regardless of the chosen diving mode.

17.1 Hazardous Environmental Conditions

Effective dive planning must provide for extremes in environmental conditions. Diving will be discontinued if sudden squalls, electric storms, heavy seas, unusual tide, or any other condition exists that, in the opinion of the diving supervisor/lead diver, jeopardizes the safety of the divers.

17.2 Communications

Adequate communications for the dive site will be provided as follows:

- **<u>Diver to diver</u>** – Wireless electronic communication is preferred for SCUBA operations, but diver-to-diver hand signals or line pull signals, in accordance with the Navy Diving Manual, are acceptable, refer to Attachment 8 USN Diving Line Pull and Hand Signals, which is also available in the native file format located in the Guidelines Templates and Tools folder in the CRL. Surface-supplied diving requires an operational two-way audio communication system between the diver and topside.

- **<u>Surface to Diver/Diver to Surface</u>** – Wireless electronic communication is preferred for SCUBA operations, but line pull signals in accordance with the USN Diving Manual, are acceptable. Surface-supplied diving requires an operating two-way audio communication system between the diver and topside.
- **<u>Emergency Assistance</u>** – Telephone communications will be maintained on site via a landline, cell phone, or two-way radio communications with a constantly manned location to activate emergency services if required.

17.3 Cold Water Diving

Cold water diving is defined as diving in water at or below a temperature of 37 degrees Fahrenheit. Cold water diving requires the use of special equipment and techniques. All dives conducted in cold water will be in accordance with Attachment 9, Cold Water Considerations and Safety Precautions, which is available in the native file format located in the Guidelines Templates and Tools folder in the CRL.

Hypothermia demands immediate treatment and prompt evacuation to a medical facility. The Diving Supervisor/Lead Diver will also take into consideration hypothermia for the surface support personnel. The responding medical facility must be notified of the possibility of hypothermia prior to the commencement of diving operations. Emergency re-warming and evacuation plans should be established with the medical facility's recommendations.

Diving under the ice requires extremely specialized training and equipment and **<u>will not</u>** be performed by TMR employees.

17.4 Diving at Altitude

Diving operations may be required in bodies of water at higher altitudes. Because of the reduced atmospheric pressure, dives conducted at altitude require more decompression than identical dives conducted at sea level. Standard air decompression tables, therefore, cannot be used as written.

Planning must address the effects of the atmospheric pressures that may be lower than those at sea level.

- No correction is required for dives conducted at altitudes between sea level and 300 feet; the additional risk associated with these dives is minimal.
- At altitudes between 300 and 1,000 feet, correction is required for dives deeper than 145 FSW (actual depth).
- At altitudes above 1,000 feet, correction is required for all dives.

High-altitude diving requires special equipment and techniques and will be conducted in accordance with the provisions of the USN Diving Manual.

Additionally, Standard Operating Procedures (SOPs) addressing the special requirements and support will be developed prior to commencing any high-altitude diving and included in the project specific HASDP.

17.5 Diving on UXO

Diving in the vicinity of explosive ordnance combines the inherent risk of diving and the explosive hazards of ordnance. Diving to investigate, recover, or dispose of explosive ordnance found underwater, regardless of the type or fuzing, will only be accomplished by specifically trained and qualified UXO divers (in accordance with DDESB TP-18).

Generally, it is safer for divers to work in pairs rather than alone. However, when diving on explosive ordnance, the use of two divers doubles the exposure to the ordnance and the amount of bottom time expended and increases the risk to life from an unplanned detonation. Consequently, the Diving Supervisor/SUXOS should employ a single tended or marked diver when any manipulation or removal of the ordnance is anticipated. However, the option to use two divers for ordnance search operations is authorized and preferred.

When performing activities not involving intentional contact with munitions and explosives of concern (MEC) while using anomaly avoidance techniques within a MEC environment, it is preferred to deploy two UXO divers. Deploying one UXO diver and one non-UXO diver is allowable if authorized by a NOSSA-approved or DDESB-approved ESS/Explosives Safety Submittal.

The development and use of SOPs to address the hazards associated with explosive ordnance is required when conducting UXO diving.

17.6 Diving in Contaminated Water

Divers may encounter dangerous or unpleasant forms of pollution such as effluent from a sewer or industrial outfall, oil leaking from a wellhead or damaged fuel tank, toxic materials or volatile fuels leaking from barges or tanks, and ordnance or chemical warfare material, which can cause severe problems.

The dive team should not conduct the dive until the contaminant has been identified, the safety factors evaluated, and the process for decontamination set up. When diving in a known or suspected radiological environment, proper radiological procedures must be followed.

When diving in contaminated waters, the appropriate dress should be a fully contained dry suit with gloves and hood, with a positive-pressure full face mask or the Dirty Harry surface-supplied diving system. Technical advice for contaminated water diving is available from the NOAA Hazardous Materials Department at (206) 526-6317.

18.0 DIVING HAZARDS

In addition to environmental hazards, and the hazards directly attributable to diving, a diver may occasionally be exposed to operational hazards that are not unique to the diving environment. These hazards are described below.

- **Underwater Obstacles** – Various underwater hazards, such as broken pilings, rocks, wrecks, dumping grounds, and discarded munitions, offer serious hazards to divers.

- **Electrical Shock** – Electrical shock is rare underwater but may occur when using power equipment underwater or topside. A ground fault interrupter must be used with electrical equipment employed on the dive site, both on the surface and underwater.
- **Explosions** – Explosions may occur during demolition tasks or during ordnance clearance operations, intentionally or accidentally. When using explosives, or as identified during UXO diving, separate SOPs and work plans will be developed to cover all aspects of the use or possibility of encountering explosives/ordnance underwater. All divers will be out of the water prior to any planned detonation of explosives or ordnance.
- **Explosives** – All diving-related explosives will be pre-approved by the Manager of UXO Operations. The procedures for explosives handling, use, storage, and underwater procedures will be detailed in the specific HASDP for the project.
- **Sonar** – Additional precautions are required when diving in the vicinity of vessels that employ active sonar. Ships use low-frequency sonar for object location and depth finding. It is a dense, high-energy pulse of sound that can cause damage to divers' ears. Avoid diving in the vicinity of low-frequency sonar and approach no closer than 600 yards. The optimal separation distance is 3,000 yards.

Additionally, the USN Diving Manual has a worksheet to compute actual time and distance restrictions for various types of sonar. This worksheet considers such variables as depth, time, diving apparatus, and wetsuit hoods. High-frequency (greater than 100 kilohertz), short-duration sonar, such as that used with side-scan and hand-held sonar, poses little danger to the diver. The diver will abort the dive if active low-frequency sonar is energized while they are in the water.

- **Marine Life** – Certain marine life, because of its aggressive or venomous nature, may be dangerous to man. Some species of marine life are extremely dangerous, while some are merely an uncomfortable annoyance. Most marine life poses little threat, as they tend to leave humans alone. The diver's best defense against injury is knowledge. All divers should be able to identify the dangerous species that are likely to be found in the area of operations and should be able to deal with each appropriately. The USN Diving Manual provides specific information about dangerous marine life.
- **Ascent to Altitude including Flying after Diving** – Leaving the dive site may require temporary ascent to a higher altitude. For example, divers may drive over a mountain pass at higher altitude or leave the dive site by air. Ascent to altitude after diving increases the risk of decompression sickness because of the additional reduction in atmospheric pressure. The higher the altitude, the greater the risk. The cabin pressure in commercial aircraft is maintained at a constant value regardless of the actual altitude of the flight. Though cabin pressure varies somewhat with aircraft type, the nominal value is 8,000 feet.

For all diving projects, divers will wait at least **12 hours** before flying after any dive, or **24 hours following multiple days of repetitive dives**. The ascent to altitude table located in the USN Diving Manual gives the surface interval (hours, minutes) required before making a further ascent to altitude. The surface interval depends on the planned increase in altitude and the highest repetitive group designator obtained in the previous 24-hour period. Enter the table with the highest repetitive group designator obtained in the previous

24-hour period and read the required surface interval from the column for the planned change in altitude.

18.1 Boating

All boating activities will be conducted according to applicable state, USCG, and Tt Procedure. Further, the following guidelines will be adhered to:

- Diving operations involving live boating will not be conducted unless cleared by the DDC in writing in the approved HASDP or subsequent Field Change Request.
- Live boating will not be conducted unless 1) using surface-supplied air at depths that are restricted to no deeper than 100 FSW, in rough seas that significantly impede diver mobility or work function, or 2) in non-daylight hours.
- The propeller of the vessel will be stopped before the diver enters or exits the water.
- A device will be used that minimizes the possibility of entanglement of the diver's hose in the propeller of the vessel.
- Two-way voice communication between the designated person-in-charge (Dive Supervisor/Lead Diver) and the person controlling the vessel will be available while the diver is in the water.
- Each diver engaged in live boating operations will carry a diver-carried reserve breathing gas supply.

19.0 OTHER HAZARDS

Other diving-related hazards that may be encountered by TMR divers are described below.

19.1 Noise

Some operations may require the use of generators, pumps, compressors, engines, and other equipment that can generate high levels of noise. Short-term exposure to extremely loud noise and/or long-term exposure to low level noise can cause hearing loss. Personnel assigned to a high noise area will wear proper hearing protection and be enrolled in a hearing conservation program.

19.2 Lifting Hazards

During some operations, there may be several instances when personnel will be called on to lift and/or carry a heavy load, sometime over rough or unstable terrain. When doing so, personnel should be instructed to observe the following rules:

- Test the load to ensure it can be moved safely.
- Plan the move to ensure the travel path is clear.
- Keep the back in its normal arched position while lifting, bend at the knees to lift.
- Lift with the legs and stand up in one smooth motion.
- Move the feet to change direction, do not twist at the waist.

20.0 DIVING EMERGENCY PROCEDURES

20.1 Surface Supplied Diving

20.1.1 Loss of Primary Air Supply

- Activate the secondary back up breathing air supply.
- If necessary, ensure diver goes on bail-out bottle.
- Alert the standby diver.
- Have Diver surface and proceed to ladder or stage.
- Terminate the dive (if instructed by Dive Supervisor/Lead Diver).

20.1.2 Loss of Communications

- Attempt to establish line-pull signals.
- Alert the standby diver.
- If unable to establish any form of communications with the diver within 60 seconds, immediately deploy the standby diver for assistance.
- Ensure diver proceeds to the ladder or stage.
- Terminate the dive.

20.1.3 Fouled or Entrapped Diver

- Diver informs Surface Support.
- Alert the standby diver.
- Diver determines the nature and extent of entrapment.
- Diver attempts to free them.
- If required, deploy the standby diver to assist the diver.
- When free, diver and tender confirm that direct contact with each other is re-established.

20.1.4 Injured Diver in Water

- Diver informs Surface Support (if possible).
- Alert the standby diver.
- Diver determines nature and extent of injury.
- Deploy the standby diver to assist diver (if necessary).
- Standby diver remains with diver.
- Extract the diver and provide first aid or oxygen accordingly.
- Request immediate medical assistance and emergency evacuation (if required).

20.1.5 Severance of Complete Umbilical

- Diver activates bail-out bottle.

- Establish line pull signals, if possible, try to inform surface support of the situation.
- Top side crew should secure primary the air supply and activate the air supply to the pneumo hose. If the diver can maintain a hold of the severed section of the hose, they can use it for breathing air and call follow it up to the surface.
- Diver surfaces and terminates the dive.

20.1.6 Unconscious Diver

- Attempt to establish voice and line pull communications with the diver.
- Deploy the standby diver.
- Determine the nature and extent of the diver's situation.
- Secure the diver and ensure an open airway; open the dive helmet free flow if the diver is not breathing.
- Extricate the diver, provide First Aid, CPR, AED, and/or emergency oxygen accordingly.
- Request immediate medical assistance and emergency evacuation.

20.1.7 Activate the secondary back up breathing air supply

- Inform the diver of the situation and establish line pull signals if necessary.
- Diver activates bail-out bottle (if necessary).
- Extinguish fire and secure the equipment.
- Diver surfaces and terminates the dive.
- Determine the damage and test all equipment prior to continuing the dive.

20.1.8 Equipment Failure – Diver in the Water

- Inform the diver of the situation and establish line pull signals if necessary.
- Evaluate the effect on the diver.
- Alert the standby diver.
- Diver informs topside of their readiness.
- Terminate the dive.

20.2 SCUBA Diving

20.2.1 Out of Air – Primary Source

- Diver activates secondary the air supply.
- Diver informs buddy diver or topside crew.
- Terminate the dive.

20.2.2 Out of Air – Primary and Secondary Source

- Diver surfaces with controlled ascent and informs buddy diver or topside crew.
- Buddy diver gives secondary air source to diver.

- Terminate the dive.

20.2.3 Fouled or Entrapped Diver

- Diver determines the extent of entrapment.
- Diver attempts to correct the situation.
- Diver informs topside or buddy diver; deploy the standby diver if required
- When clear, diver returns to ladder and evaluates situation with the Dive Supervisor/ Lead Diver.
- Dive Supervisor/Lead Diver decides to continue or terminate the dive.

20.2.4 Diver Injured in Water

- Diver determines nature and extent of injury.
- Diver informs topside or buddy diver.
- Alert the standby diver and deploy if necessary.
- Buddy/standby diver remains with the diver.
- Extract the diver and terminate the dive.
- Provide First Aid or oxygen accordingly.
- Request medical assistance and emergency evacuation (if necessary).

20.2.5 Equipment Failure

- Evaluate effect on the system and the diver
- Diver informs topside or buddy diver.
- Deploy the standby diver (if necessary).
- Terminate the dive.

20.2.6 Lost Diver and Communication

- Use the Buddy Recall System.
- Each diver surfaces.
- If a diver is not quickly located, the Dive Supervisor/Lead Diver immediately initiates search procedures.
- Deploy additional diver (if necessary).
- When located, divers return to ladder and evaluates the situation with the Dive Supervisor/ Lead Diver.
- Dive Supervisor/Lead Diver decides whether to continue or terminate the dive.

20.2.7 Diver Rapid Ascent or Blow up to Surface

- Buddy diver surfaces in a controlled ascent.
- Both divers terminate the dive.
- Deploy the standby diver to assist; if necessary.

- Monitor the diver and provide oxygen accordingly.
- Immediately notify emergency and medical personnel and inform them of omitted decompression.

20.2.8 Loss of Consciousness

- Buddy diver/standby diver initiates rescue diving.
- Determine the nature and extent of the diver's situation.
- Secure the diver and ensure an open airway; overpressure second stage (if possible) if diver is not breathing.
- Extricate diver, provide First Aid, CPR/AED and/or oxygen accordingly.
- Request immediate medical assistance and emergency evacuation.

21.0 DIVING SPECIFIC EMERGENCY MEDICAL TREATMENT

21.1 DCS Type 1 – (Pain only)

Diver surfaces with or develops joint pain (dull ache) that gradually worsens over time, develops skin problems such as itching or a rash, or develops swelling and pain in lymph nodes. Time to onset of symptoms is 0 to 24 hours. Actions to be taken:

- Perform necessary first aid and give 100 percent emergency oxygen upon surfacing.
- Contact local emergency resources for transport to nearest hyperbaric facility.
- Follow USN Dive Manual Treatment Table procedures.

21.2 DCS Type 2 – Central Nervous System (CNS)

Diver has DCS symptoms in water, or surfaces with any neurological symptoms (numbness, tingling, decrease touch sensation, muscle weakness, or paralysis). Time to onset of symptoms is 0 to 24 hours. Actions to be taken:

- Perform necessary first aid and give 100 percent oxygen upon surfacing.
- Contact local emergency resources for transport to nearest hyperbaric facility.
- Follow USN Dive Manual Treatment Table procedures.

21.3 Arterial Gas Embolism (AGE)

Diver surfaces or becomes unconscious within 10 minutes of surfacing, exhibits signs of a stroke or other neurological disorder, blurred vision, or convulsions. Actions to be taken:

- Perform necessary first aid or CPR.
- Administer 100 percent oxygen with the diver supine or in the recovery position.
- Contact local emergency resources for immediate transport to the nearest hyperbaric facility and initiate recompression treatment as soon as possible.

21.4 Chokes (Heart Pumps Frothy Blood)

Diver surfaces with chest pain aggravated by inspirations, an irritating cough, an increased breathing rate, increased lung congestion with subsequent heart attack. Death is imminent due to heart attack. Actions to be taken:

- Perform necessary first aid and give 100 percent oxygen upon surfacing.
- Contact local emergency resources for immediate transport to nearest hyperbaric facility.

21.5 Pneumothorax

Diver displays difficult or rapid breathing leans towards affected side and experiences pain while inhaling deeply. Hypotension, cyanosis, and shock may be present, leading to death. Actions to be taken:

- Position diver on affected side.
- Administer 100 percent oxygen and treat for shock.
- Contact local emergency resources for immediate transport to nearest medical facility (air must be vented from chest cavity).

22.0 VESSEL OPERATIONS DURING DIVING OPERATIONS

22.1 Safe Boating Guidelines

These procedures are for the safety of the employees and other vessels on the waterways during waterborne operations. If a conflict arises between the current edition of this section and the approved project specific HASDP, applicable federal, state, local laws or other legal directives, the latter shall take precedence.

22.2 Preparing for Waterborne Operations

All personnel on board a vessel employed on a TMR assignment will be fully competent in the vessel operations, maintenance, and equipment usage. The Dive Supervisor/Lead Diver shall complete any project Pre-Operation Maintenance and Safety Inspection Checklists prior to casting off.

22.3 Operations

All TMR employees regularly involved in boat operations must be knowledgeable and capable in the area of rules of the road, vessel maintenance, marine safety, and vessel registration requirements.

22.4 Rules of the Road

As with vehicular traffic on land, rules exist to promote safe vessel movement on navigable waterways. All employees engaged in waterborne operations will know the rules of the road specific to the project area. The local rules can be researched through the USCG or the applicable state government agency that governs a body of water. Several topics included in the rules of the road, relevant to TMR operations, are listed below.

22.5 Navigation, Signals, Markers and Signs

Each crewmember will know the meaning and use of each signal for meeting and passing situations while underway, for leaving a mooring, and signals used in limited visibility conditions. The required signals will be used in accordance with the rules of the road.

Each crewmember will know and understand the meaning of all navigation markers, buoys, and lights on the waterways. The vessel operator will follow the directions of each navigation marker, buoy and light unless evidence indicates the marker is damaged and providing inaccurate information.

22.6 Anchoring and Mooring

Vessel crewmembers will know how to properly anchor and moor the vessel from which they are operating. They will ensure that the anchor, chain, all lines, fenders, bumpers, and cleats are in good working order. The anchor line should be at least seven times longer than the working water depth. Crewmembers will continually monitor anchor and mooring lines while moored in areas affected by tides and strong currents.

22.7 Required Safety Equipment

All vessels operated by TMR, except for vessels less than 18 feet in length, will have the following equipment on board and in operating condition:

- A fixed fire extinguishing system installed in machinery space(s) or B-1 type extinguishers
- Type 1 PFD required for each person on board plus one throw able Type 4 life ring or cushion
- A Coast Guard approved flare kit
- A sounding device to signal maneuvering intentions and position during periods of reduced visibility
- A fully charged and tested VHF radio, prior to departure from dock
- A bilge pump appropriately sized for the vessel
- Additional engine fluids
- Vessels operated by TMR that are less than 18 feet in length shall have a Type 1 PFD for each person onboard.

22.8 Vessel Maintenance

Due to the difficulty of performing repairs afloat, regular maintenance and necessary services shall be carried out onshore before commencing operations. Use of the owner's manuals, maintenance checklists, and repair logs are necessary to track equipment usage and inform future operators of equipment status.

<u>Engine</u> – The owner's manual will be stored on board each vessel in a watertight bag and compartment. Suggested maintenance schedules will be followed. The engine fuel and oil levels will be checked before each use. Other engine components and propeller(s) will be checked for proper function.

Batteries – Each battery will be checked for proper charge level, cleanliness of contact posts, condition of wiring, and water level if required. Batteries will be secured, and all electrical systems turned off after operations are completed. Bilge pumps are directly wired and as such, will remain in constant operation.

Fuel – Check fuel level of primary tanks and emergency supply tanks prior to embarkation. Refill all fuel tanks, with the proper fuel, to the full level after returning each day. Inspect all fuel lines, bilge, and areas around the vessel for leaks.

Electronic Systems – Inspect all circuits to ensure good connections and operation of all components and equipment. Have spare batteries, fuses, and wiring available for repairs. Ensure connection of shore power after returning, when deemed necessary.

Checklists and Logs – Accurately complete checklists and logs prior to and after each day's operation of the vessel.

Safety Equipment – Inspect all fire extinguishers for annual inspection and pressure, first aid kits for required and expired items, PFD for proper fit or deterioration and for spare carbon dioxide cartridges, signaling devices for expired or deteriorated items, and radios for proper functioning.

22.9 General Marine Safety

Dive operations conducted from the relative stability of a pier or shoreline requires safety awareness and constant diligence. Conducting operations from the deck of a pitching/rolling vessel only compound these requirements. All personnel will conduct themselves in a safe and responsible manner while near or on board any vessel and in accordance with SWP 5- 06 Working over or near water. These guidelines are in place for the safety and wellbeing of TMR employees involved in marine operations.

- A USCG-approved PFD must be available for each person on board the vessel. The PFD must have a proper fit for the individual who will be using it and each person should know how to don the PFD in the vessel and in the water. PFDs must be inspected regularly for damage and excessive wear.
- Shoes should have non-skid soles. Personnel should maintain three points of contact when transferring equipment or personnel to and from the vessel. Deck area should be clear of lines, hoses and unnecessary clutter.
- Personnel should not sit on the edge of a vessel or on lifelines while underway.
- Personnel should avoid sailing at night, in fog, in poor visibility, in ice flows, during flood conditions, debris flows, small craft advisories, gales, hurricanes, or other heavy surf conditions, whenever possible.
- Personnel should be familiar with and have the means to handle emergency situations, including man overboard, abandon ship, fire, loss of power or propulsion, storm, and use of emergency signaling devices, as well as how to recover a person in the water.
- Personnel should know what emergency and standard equipment is required on each TMR owned vessel, where it is located and how to operate that equipment.

- Detailed tide, current, and marine weather forecast should be obtained before commencing waterborne operations.
- Ensure that all equipment is secure or lashed properly when underway.
- Personnel should be familiar with, and anticipate water and weather states and conditions respectively, when mooring.

22.10 Vessel Registration

Each vessel operating on navigable waterways requires a state registration identification sticker or USCG Certification. The designated Equipment Manager will ensure that each TMR vessel maintains a current state registration for the state in which the vessel is located. Trailer registrations, if applicable, will also be kept up to date.

22.11 Chain of Command

22.11.1 Projects that are Captained and Crewed by a Subcontractor

The designated Captain of the vessel will have overall authority for the vessel and personnel aboard. They will work with the Project Manager, Dive Supervisor/Lead Diver and SSHO to ensure the safety of all personnel.

22.11.2 Projects that are not Captained and Crewed by a Subcontractor

The Project Manager shall designate the vessel operator for each project. If a designee has not been assigned, the Dive Supervisor/Lead Diver will assume or designate the position of vessel operator. The vessel operator has overall authority and responsibility of the crew, passengers, and vessel operations safety while moored or underway. Before embarking, the Dive Supervisor/Lead Diver will assign crew positions and responsibilities to each team member. They will also designate a chain of command should the vessel operator become injured or is away from the vessel. The vessel operator will work with the Dive Supervisor/Lead Diver and project DSO and SSHO to ensure the safety of all personnel.

22.12 Offshore Operations

When the vessel will be operating greater than 500 yards from the shoreline, in breaking waves, or in a strong current, additional safety precautions are warranted. Under such conditions, any vessel employed on a TMR assignment must adhere to the following:

- The vessel shall be operated by an experienced and qualified boat operator as approved by the Project Manager.
- The vessel operator must perform research on local conditions and be aware of potential hazards.
- A marine weather radio shall be on-board the vessel and periodically monitored to keep abreast of changing weather conditions.
- The vessel must be equipped with a backup propulsion system, such as an extra motor, that can return the vessel to a safe harbor in the event of failure of the primary propulsion system.

- The vessel shall be thoroughly examined by the vessel operator to verify the sound mechanical condition of the vessel and bilge pump, and the presence of appropriate safety equipment as designated above.

23.0 REQUIRED FORMS AND CHARTS

23.1 Forms

The vessel operator will ensure that all required forms are accurately and filled out before embarkation. Spare forms should be kept on board each TMR-operated vessel. The HASDP and Attachment 11, Equipment Checklists, will provide the required forms listed below:

- BOAT PRE-OPERATION CHECKLIST
- DIVE EQUIPMENT CHECKLIST (GENERAL, MEDICAL, SCUBA)
- PRE-DIVE: SSA DIVE HELMET CHECKOFF SHEET
- PRE-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (AGA)

23.2 Charts

The vessel operator will ensure that all required charts and maps for navigation to, from, and within the area of operations are on board before embarkation. All crewmembers will review and become familiar with these charts. These documents should be continually revised, as updates become available.

24.0 REFERENCES

ADCI (Association of Diving Contractors International). 2019. Consensus Standards for Commercial Diving Operations - Sixth Edition (Revision 6.3). Houston, TX. www.adc-int.org

CGA. 2018. G-7.1 Standards - Air quality standards; Compressed Gas Association. Chantilly, VA. www.cganet.com

DDESB (Department of Defense Explosives Safety Board). 2020. Technical Paper-18 Revision 1 - Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern-Related Activities. Washington, DC.

DOT (U.S. Department of Transportation). 2020. 49 CFR 178.37 - DOT Cylinder Maintenance, Retest and Certification Requirements. Washington DC. www.gpo.gov

OSHA (Occupational Safety and Health Administration). 2017. 29 CFR 1910.401 Subpart "T" - Commercial Diving Operations. Washington DC. www.osha.gov

OSHA (Occupational Safety and Health Administration). 2017. 29 CFR 1910.1020 Subpart Z (h)(1)(2) - Access to employee exposure and medical records. Washington DC. www.osha.gov

Tt (Tetra Tech). Health and Safety Manual:

________ DCN 1-04, Recordkeeping and Reporting Requirements.[5]

________ DCN 02-02 Event Reporting and Investigation.[6]

________ DCN 02-15 Scientific Diving Program.[7]

________ DCN 3-02, MS 1, Physician's Certification form.[8]

________ DCN 3-02, MS 2, Release of Medical and Exposure Records.[9]

---

[5] https://intranet.tetratech.com/healthsafety/Manual/DCN%2001-04%20Recordkeeping%20and%20Reporting%20Requirements.pdf
[6] https://intranet.tetratech.com/healthsafety/Manual/DCN%2002-02%20Incident%20Reporting%20and%20Investigation%20Program.pdf
[7] https://intranet.tetratech.com/healthsafety/Manual/DCN%2002-15%20Scientific%20Diving%20Program.pdf
[8] https://intranet.tetratech.com/healthsafety/Manual/DCN%2003-02F%20MS-1%20Physicians%20Certification%20Form.pdf
[9] https://intranet.tetratech.com/healthsafety/Manual/DCN%2003-02F%20MS- 2%20Release%20of%20Medical%20and%20Exposure%20Records.pdf

_________ SWP 05-06 Working Over or Near Water.[10]

TMR (Tetra Tech Munitions Response):

_________PO-08 – Document Control and Records Management.

_________PO-18 – Warehouse Management.

_________TMR HSE 01-10 - Boating

USACE (U.S. Army Corps of Engineers). .

_________2014. EM 385-1-1, Section 30. Department of the Army, Washington DC. www.publications.usace.army.mil

USCG (U.S. Coast Guard). 46 CFR CH I Subpart "V" – Marine Occupational Safety and Health Standards - Shipping, Volume 7, Chapter 1 – Coast Guard, Part 197 – General Provisions, Subpart B. Commercial Diving Operations. Department of Transportation, Washington, DC. https://www.law.cornell.edu/cfr/text/46/part-197/subpart-B

USN (U.S. Navy). 2018. U.S. Navy Diving Manual, Volumes 1-5, Revision 7 Change A – Commander, Navy Sea Systems Command, Supervisor of Salvage and Diving. https://www.navsea.navy.mil/Portals/103/Documents/SUPSALV/Diving/US%20DIVING%20MANUAL_REV7_ChangeA-6.6.18.pdf

[10] https://intranet.tetratech.com/healthsafety/Manual/SWP%2005-06%20Working%20Over%20or%20Near%20Water.pdf

25.0 ATTACHMENTS

Attachment 1 – Diving Supervisor/Lead Diver Dive Plan Brief

Attachment 2 – Diving Supervisor/Lead Diver Pre-Dive Checklist

Attachment 3 – Diving Supervisor/Lead Diver Post-Dive Checklist

Attachment 4 – Emergency Procedures

Attachment 5 – Emergency Phone Numbers Checklist

Attachment 6 – Working Dive Log

Attachment 7 – Dive Smooth Log

Attachment 8 – USN Diving Line Pull and Hand Signals

Attachment 9 – Cold Water Considerations and Safety Precautions

Attachment 10 – U.S. Navy Dive Tables

Attachment 11 – Equipment Checklists

GLOSSARY

Definitions are provided for the purpose of understanding their intent as they pertain to a procedure and projects requiring quality program planning. A Master List of Definitions is located in the CRL on the TMR intranet (https://tetratechinc.sharepoint.com/sites/OU-TMR). In addition, the definitions provided below are specific to this manual.

ASME Code or equivalent

ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VIII, or an equivalent code which the employer can demonstrate to be equally effective.

Arterial Gas Embolism (AGE)

An embolism caused by entry of gas bubbles into the arterial circulation system then act as blood vessel obstructions called emboli.

Atmosphere Absolute (ATA)

Total pressure exerted on an object, by a gas or mixture of gases at a specific depth or elevation, including normal atmospheric pressure.

Bell

An enclosed compartment pressurized (closed bell) or unpressurized (open bell), which allows the diver to be transported to and from the underwater work area and which may be used as a temporary refuge during diving operations.

Bottom Time

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom or from the deepest depth attained. This time is measured in minutes.

Breath-Holding Diving

A diving mode in which the diver uses no self-contained or surface-supplied air or oxygen supply.

Buddy Breathing

Sharing of a single air source between divers.

Buddy Diver

Second (paired) member of the dive team set.

Buddy System

Two comparably equipped self-contained underwater breathing apparatus (SCUBA) divers in the water in constant communication.

Buoyant Ascent

An ascent made using some form of positive buoyancy.

Bursting Pressure

The pressure under which a pressure-containment device would fail structurally.

Certified Diver

A diver who holds a recognized valid certification from an organizational member, internationally recognized certifying agency, or through military training.

Chairman, Diving Review Board (DRB)

Environment, Safety, Security and Quality (ESSQ) Department member who manages and oversees the DRB.

Controlled Ascent

Any one of several kinds of ascents including normal, swimming, and air-sharing ascents where the diver(s) maintain control so a pause or stop can be made during the ascent.

Cylinder

A pressure vessel for the storage of gases.

Decompression Chamber

A pressure vessel for human occupancy. Also called a hyperbaric chamber.

Decompression Schedule

A specific decompression procedure for a given combination of depth and bottom time as listed in a decompression table. It is normally indicated as feet/minutes.

Decompression Sickness

A condition with a variety of symptoms, which may result from the presence of gas and bubbles in the tissues of divers after pressure reduction.

Decompression Table

A profile or set of profiles of depth-time relationship for ascent rates and breathing mixtures to be followed by divers after a specific depth-time exposure or exposures.

Decompression Time

Elapsed time from when the divers leave the bottom to the time when they reach the surface.

Descent Time

The total elapsed time from when the divers leave the surface to the time, they reach the bottom. Descent time is rounded up to the next whole minute.

Dive Computer

A microprocessor-based device that computes a diver's theoretical decompression status, in real time, by using pressure (depth) and time as an input to a decompression model, or set of decompression tables, programmed into the device.

Dive Location

The surface location from which diving operations are conducted, such as a vessel, barge, wharf, pier, riverbank or offshore rig.

Dive Location Reserve Breathing Gas

A supply system of air at the dive location that is independent of the primary system and enough to support divers during the planned decompression.

Dive Team

Divers and support employees involved in a diving operation, including the Diving Supervisor/Lead Diver.

Diver

An employee working in water using underwater apparatus, including snorkel, that supplies breathing gas at the ambient pressure.

Diver-Carried Reserve Breathing Gas

A diver-carried independent supply of air enough under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by another driver.

Diving Review Board

The TMR Review Board has oversight for all diving operations within the company. Board members will review the diving procedures and qualification of divers before authorization is given to conduct diving operations. The board is made up of qualified divers from the UXO Group, the Science Department, and the ESSQ Department.

DSO

The individual who manages the TMR science diving program and represents the science divers on the Diving Review Board.

Diving Mode

A type of diving requiring specific equipment, procedures and techniques (SCUBA, surface-supplied air, or mixed gas).

Equivalent Single Dive Time

The sum of the residual nitrogen time and the bottom time of a repetitive dive. Equivalent single dive time is used to select the decompression schedule for a repetitive dive. This time is expressed in minutes.

Heavy Gear

Deep-sea dress, including helmet, breast plate, dry suit, and weighted shoes. Advances in diving equipment and technology have led to heavy gear that does not include a breastplate. Surface-supplied diving gear, including helmet, dry suit, and weighted shoes (i.e., with the helmet directly connected to the drysuit, forming a self-contained pressure envelope for the diver) constitutes heavy gear as well.

Hyperbaric Conditions

Pressure conditions in excess of surface pressure.

In-water stage

A suspended underwater platform that supports a diver in the water.

Lead Diver

A certified diver with the experience and training to lead the diving operations.

Live Boating

The practice of supporting a surface-supplied-air diver from a vessel which is underway

Mixed-Gas Diving

A diving mode in which the diver is supplied in the water with a breathing gas other than air.

No Decompression (No "D") Limits

The depth-time limits of the ‘‘no-decompression limits and repetitive dive group designation table for no-decompression air dives,’’ USN Diving Manual or equivalent limits which the employer can demonstrate to be equally effective.

Penetration Diving

Passing through a barrier where the diver’s lifeline/umbilical requires tending by another diver or swimmer.

Pressure-Related Injury

An injury resulting from pressure disequilibrium within the body as the result of hyperbaric exposure. Examples include decompression sickness, pneumothorax, mediastinal emphysema, air embolism, subcutaneous emphysema, or ruptured eardrum.

Pulmonary Over Inflation Syndrome

Disorders that are caused by gas expanding in the lungs, and include arterial gas embolism, pneumothorax, mediastinal and subcutaneous emphysema.

Recompression/Decompression Chamber

A pressure vessel for human occupancy, such as a surface decompression chamber, closed bell, or deep diving system, used to decompress divers and to treat decompression sickness.

Repetitive Dive

Any dives conducted within 12 hours of a previous dive.

Repetitive Group Designation

A letter that is used to relate directly to the amount of residual nitrogen remaining in a diver's body.

Residual Nitrogen

Nitrogen gas that is still dissolved in a diver's tissues after surfacing.

Residual Nitrogen Time

Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

Safety and Health Manager (SHM)

The individual responsible for all safety aspects of the diving evolution. The on-site SSHO qualified person reports to the SHM on all safety related matters.

Scientific Diving

Diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks. Scientific diving does not include performing any tasks usually associated with commercial diving such as: Placing or removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives.

SCUBA Diving

A diving mode independent of surface supply in which the diver uses an open-circuit self-contained underwater breathing apparatus.

Single Dive

Any dives conducted more than 12 hours after a previous dive.

Standby Diver

A designated safety diver at the dive location properly equipped and available to assist a working diver in the water.

Surface Interval

The time a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as he starts his next descent.

Surface-Supplied Air Diving

A diving mode where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver may rely on the tender at the surface to keep up with the diver's depth, time, and diving profile.

Tended/Marked Diver

A diver who has a buoy line to the surface or is tended by another diver located in the diving boat or on the surface platform.

Treatment Table

A USN developed and tested depth-time and breathing gas profile designed to treat decompression sickness or pulmonary over inflation syndromes.

Total Bottom Time

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom or from the deepest depth attained. This time is measured in minutes.

Total Decompression Time

The total elapsed time from when the divers leave the bottom to the time to the time all decompression obligations are met. For No Decompression dives, this is the time the diver reaches the surface. This time is measured in minutes.

Total Time of Dive

The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) until the diver reaches the surface. This time includes all ascent delays and decompression time. This time is measured in minutes.

Umbilical

The composite hose bundle between a dive location and the diver or bell, or between a diver and a bell, which supplies the diver or bell with breathing gas, communications, power, or heat as appropriate to the diving mode or conditions. This includes a safety line between the diver and the dive location or dive bell.

Volume Tank

A pressure vessel connected to the outlet of a compressor and used as an air reservoir.

Working Pressure

The maximum pressure to which a pressure containment device may be exposed under standard operating conditions.

This page intentionally left blank.

ATTACHMENT 1

DIVING SUPERVISOR/LEAD DIVER DIVE PLAN BRIEF

This page intentionally left blank.

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____

1. **NOTIFICATIONS –** The following list of notifications is not to be considered all-inclusive and should be modified to fit the intended task. Check off each representative as notified, include the phone number and person talked to:

   Harbor Master: ____

   Pipeline Manager: ____

   Boat Pilot: ____

   Port Services: ____

   Cognizant Authority: ____

   Ambulance/Air Evacuation: ____

   Recompression Chamber: ____

   Medical Facility: ____

   Coast Guard: ____

   U.S. Army Corps of Engineers Representative: ______________________________

   U.S. Navy Representative: ____

   Support Personnel: ____

2. **PERSONNEL ASSIGNMENTS**

   Diving Supervisor/Lead Diver: ____

   Senior UXO Supervisor: ____

   Diver/s: ____

   Tender: ____

   Standby Diver: ____

   Tender: ____

   Coxswain: ____

   Assistance: ____

	YES	NO	COMMENTS
• Has any diver been diving in the last 12 hours?	____	____	______________
• Is any diver taking any type of medication?	____	____	______________

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____

	YES	NO	COMMENTS
• Does any diver have any aches or pains?	____	____	________________
• Can divers clear on the surface?	____	____	________________
• Is any diver wearing contact lenses?	____	____	________________
• Do divers feel well enough to make the dive?	____	____	________________
• Do divers have any problem making the dive?	____	____	________________
• Do divers know the emergency procedures for the diving mode?	____	____	________________

3. **ENVIRONMENTAL DATA**:

Temperature: Water: ____________Air: ________________________________

Tide: High: ___________/___________ Low: ____________/___________

Visibility expected: _____________________ Bottom type: ____________________

Current speed/direction: ____

Wind Direction/Speed: ____________/_____________

Landmarks: ____

Sunrise/Sunset: ______________/______________

Wave action: Height: _____________ Direction: ____________________________

Dive platform: ____

4. **OBJECTIVES:**

Purpose of the dive (TASK): ____

Location: ____
General comments: ____

Dive schedule: __________/__________ Depth: __________ Max depth: _________

Dive mode to be used: ____

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ______________________________

5. **ANTICIPATED HAZARDS**:

Boating: ______________________________

- ☐ Ensure the “Code ALPHA” flag is flying from the vessel, or a 1-meter rigid “Code ALPHA” flag is prominently displayed from the non-vessel dive platform (pier, shore, etc.).
- ☐ Ensure the “Divers down” flag is also displayed.

Climate: ______________________________

Sea Life: ______________________________

Expected Ordnance: ______________________________

Pollution: ______________________________

Other: ______________________________

6. **EQUIPMENT REQUIREMENTS**:

Diving Mode: ______________________________

Search Equipment: ______________________________

Recovery Equipment: ______________________________

Explosive Disposal Equipment: ______________________________

Special Task Equipment: ______________________________

7. **GENERAL DIVING SAFETY PRECAUTIONS CHECKLIST**

- Ensure divers are physically and mentally ready to perform the assigned dive task.
- Determine the exact depth of the dive site through use of lead line or Fathometer.
- Gauge diving and emergency air cylinders prior to diving.
- All dives will be no-decompression dives.
- Ensure the dive platform is in a position for rapid and safe recovery of the divers.
- Each diver is responsible for the condition of his/ her own diving equipment.
- Ensure the standby diver is well briefed and ready to enter the water.
- The buddy system will be used whenever possible. If the buddy system is not used or inappropriate for the dive, the diver will be tended.

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____

- Ensure the international code "alpha" and "divers down" are prominently displayed. If diving is not conducted from a vessel, then a 1-meter square rigid replica of the "alpha" flag will be displayed.
- Ensure divers are briefed and protected against local harmful marine life.
- The Diving Supervisor/ Lead Diver must be aware of local ship and small boat traffic in the vicinity of the diving operation.
- Ensure the appropriate diving mode and dress have been selected for the task at hand.
- All dives conducted where there is not free access to the surface must be tended dives.
- Do not inflate life jacket or BCD where ascent to the surface is restricted.
- The Diving Supervisor/ Lead Diver will use the Pre-dive and Post-dive check-off sheets, Attachment 2 and 3, respectively.
- Review the methods of diver recall IAW the HASDP.
- The dive will be aborted in the event of any equipment malfunction.
- Inflate your life vest if surfacing with injuries or excessive fatigue.
- Use the proper ascent and descent rates of 75 feet per minute for descent and 30 feet per minute for ascent.
- Divers will not position themselves between any objects (camels, pier, boat, etc.).
- Brief task-specific safety precautions (UXO diving, altitude diving, ordnance/ explosive safety, etc.).
- Brief special line-pull signals Attachment 8.
- Brief appropriate ordnance safety precautions.
- If necessary, review cold water precautions (EHS 2-02 Attachment 9).

8. **COMMUNICATIONS:**

Radio frequency: ____

Radio call signs:

Primary: ____

Secondary: ____

Telephone location: ____

Site cell phone number: ____

Other cell phones: ____

ATTACHMENT 1

DIVING SUPERVISOR/ LEAD DIVER DIVE PLAN BRIEF

PROJECT NAME/NUMBER: ____

9. **SPECIAL CONSIDERATIONS**:

   Meals: ______________ Water: _______________ Heat source: _______________

   Clothing change: ____

10. **EMERGENCY PROCEDURES**: Review as outlined in Project HASDP and TtEC DSPM (EHS 2-02 Attachments 4 and 5).

This page intentionally left blank.

ATTACHMENT 2

DIVING SUPERVISOR/LEAD DIVER PRE-DIVE CHECKLIST

This page intentionally left blank.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

1. DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST FOR SCUBA DIVING

a. All divers shall have the following minimum equipment:

______ Proper dress for dive conditions, dry/wet suit, coveralls

______ Safety Harness w/tending line or witness float attached for single diver
***NOTE*: Mandatory for projects which fall under EM385-1-1 (if any diver is tended).**

______ Adequate emergency breathing supply with separate independent regulator

______ SCUBA with regulator

______ Buoyancy Compensator (BC)

______ Submersible cylinder pressure gauge

______ Weight belt

______ Mask

______ Knife

______ Depth gauge

______ Diving watch or diving computer

______ Fins

______ Cylinder pressure is adequate for both the emergency air supply ***(90% capacity @ 2700 psig)*** and primary SCUBA supply ***(2500 psig minimum)***.

______ All quick-release buckles and fastenings can be reached by either hand and are properly rigged for quick release.

______ Weight belt is outside of all other belts, straps, and equipment, and is not likely to become pinched under the bottom edge of the cylinders.

______ Buoyancy Compensator is not constrained, is free to expand.

______ Check position of the knife to ensure that it will remain with the diver no matter what equipment he may jettison.

______ Conduct time check and synchronize watches.

______ Open cylinder valve and then back off 1/4 to 1/2 turn.

______ Ensure all inflation hoses are attached and function properly.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

_______ Depth gauge is zeroed.

_______ AGA/ FFM Pre-Dive Checks (***Skip if not applicable***)

- ☐ Adjust pressure equalizer pad.
- ☐ Ensure all screws on mask are tight, and exhaust valve retaining ring is tight.
- ☐ Check connection from mask to supply hose.
- ☐ Check comm wire connection and through water transmitter.
- ☐ Don Mask.
- ☐ Inhale deeply to turn on positive pressure. (*If equipped*)
    - Check positive pressure flow.

_______ Have diver breathe for 30 seconds. While doing this, diver should be alert for any impurities in the air or for any unusual physiological reactions.

_______ Conduct final review of the dive plan.

_______ Brief the divers on the following reasons for terminating the dive:

- ☐ The diver requests termination.
- ☐ The diver fails to respond correctly to communications or signals.
- ☐ Communications are lost and cannot be quickly reestablished.
- ☐ The diver begins to use his/her reserve breathing air.
- ☐ Puncture/tear of a dry suit.

_______ Divers physically and mentally ready to enter the water.

_______ Ladder is in place to retrieve divers from water.

_______ Divers know the maximum depth and bottom time.

_______ Review proper/special line pull signals.

_______ Code Alpha and Divers Down flags are displayed.

_______ Conduct Dive Supe checks on Standby diver.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Ensure standby diver knows searching signals.

______ Verify that personnel and equipment are ready to give proper visual, sound, or radio signals to warn off other vessels.

______ Ensure O_2 kit is on dive station with adequate supply, and the O2 bottle has been gauged and documented.

______ Diver or divers are now ready to enter the water.

b. Surface Check :

______ Conduct a breathing check of the SCUBA. Breathing should be easy, without resistance, and with no evidence of water leaks.

______ Visually check dive partner's equipment for leaks, especially at all connection points (cylinder valves hoses at regulator and mouthpiece).

______ Check face mask seal.

______ Check partner for loose or entangled straps.

______ Check buoyancy. SCUBA divers should strive for neutral buoyancy.

______ If divers are wearing a dry suit, check valve function and for leaks.

______ Orient yourself with your surroundings. Note any obstructions that you may encounter upon surfacing.

NOTES:

1. ***Ensure divers are not sick or have not been recently treated for an injury or illness.***
2. ***Ensure all dive station personnel are monitored during surface intervals when extreme weather conditions exist.***

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

2. DIVING SUPERVISOR'S PRE-DIVE CHECKLIST FOR SURFACE-SUPPLIED DIVING

CAUTION: ***This checklist is an overview intended for use with the detailed Operating Procedures (OPs) from the appropriate equipment checklists as outlined in Attachment 11 and the specific equipment O&M technical manual.***

a. Basic Preparation:

______ ***Dives deeper than 100 FSW or dives requiring decompression***, verify that a recompression chamber is present on the diving station and is on line.

______ Verify that proper signals indicating underwater operations being conducted are displayed correctly.

______ Ensure that all personnel concerned, or in the vicinity, are informed of diving operations.

______ Determine that all valves, switches, controls, and equipment components affecting diving operations are tagged-out to prevent accidental shut-down or activation.

b. Equipment Protection:

______ Assemble all members of the diving team and support personnel (winch operators, boat crew, etc.) for a pre-dive briefing.

______ Assemble and lay out all dive equipment, both primary equipment and standby spares for diver (or standby diver), including all accessory equipment and tools.

______ Check all equipment for superficial wear, tears, dents, distortion, or other discrepancies.

______ Check all masks, helmets, view ports, faceplates, seals, and visors for damage.

______ Check all harnesses, laces, strain relief, and lanyards for wear; replace as needed.

c. Helmets and Masks:

______ Ensure that all set up and operating procedures have been completed in accordance with the appropriate Technical Manual and Operating Procedures.

d. General Equipment:

______ Check that all accessory equipment – tools, lights, special systems, spares, etc. are on site and in working order. In testing lights, tests should be conducted with lights submerged in water and extinguished before removal, to prevent overheating and failure.

ATTACHMENT 2

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Erect diving stage or attach diving ladder. In the case of the stage, ensure that the screw pin shackle connecting the stage line is securely fastened with the shackle pin seized with wire or a safety shackle is used to help prevent opening.

______ Ensure first aid kits, portable O_2, and automatic external defibrillators are available and working.

e. Preparing the Diving System:

______ Check that a primary and suitable back-up air supply is available with a capacity in terms of purity, volume, and supply pressure to completely service all divers and standby diver, including decompression, recompressions, and accessory equipment throughout all phases of the planned operation.

______ Verify that all diving system operating procedures have been conducted to properly align the dive system.

______ Ensure that qualified personnel are available to operate and stand watch on the dive system.

f. Compressors:

______ Determine that sufficient fuel, coolant, lubricants, and antifreeze are available to service all components throughout the operation. All compressors should be fully fueled, lubricated, and serviced (with all spillage cleaned up completely).

______ Check maintenance and repair logs to ensure the suitability of the compressor (both primary and back-up) to support the operation.

______ Verify that all compressor controls are properly marked and appropriate valves are tagged with ***"Divers Air Supply - Do Not Touch"*** signs.

______ Ensure that the compressor is secure in the diving craft and will not be subject to operating angles, caused by roll or pitch that will exceed 15 degrees from the horizontal.

______ Verify that oil in the compressor is an approved type. Check that the compressor oil does not overflow the FULL mark; contamination of air supply could result from fumes or oil mist.

______ Check that compressor exhaust is vented away from work areas and, specifically, does not foul the compressor intake.

______ Check that compressor intake is obtaining a free and pure suction without contamination. Use pipe to lead intake to a clear suction location if necessary.

______ Check all filters, cleaners, and oil separators for cleanliness.

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

_______ Bleed off all condensed moisture from filters and from the bottom of volume tanks. Check all manifold drain plugs, and that all petcocks are closed.

_______ Check that all belt-guards are properly in place on drive units.

_______ Check all pressure-release valves; check valves and automatic unloaders.

_______ Verify that all supply hoses running to and from compressor have proper leads, do not pass near high-heat areas such as steam lines, are free of kinks and bends, and are not exposed in such a way that they could be rolled over, damaged, or severed by machinery or other means.

_______ Verify that all pressure supply hoses have safety lines and strain reliefs properly attached.

g. Activate the Air Supply in accordance with approved Operating Procedures.

1. Compressors

_______ Ensure that all warm-up procedures are completely followed.

_______ Check all petcocks, filler valves, filler caps, overflow points, bleed valves, and drain plugs for leakage or malfunction of any kind.

_______ Verify that there is a properly functioning pressure gauge on the air receiver and that the compressor is meeting its delivery requirements.

2. Cylinders

_______ Gauge all cylinders for proper pressure.

_______ Verify availability and suitability of reserve cylinders.

_______ Check all manifolds and valves for operation.

_______ Activate and check delivery.

For all air supply systems, double check "Do Not Touch" tags (tag out).

h. Diving Hoses:

_______ Ensure all hoses have a clear lead and are protected from excessive heating and damage.

DIVING SUPERVISOR/ LEAD DIVER PRE-DIVE CHECKLIST

PROJECT NAME/NUMBER:____

______ Ensure that the hose (or any length) has not been used in a burst test program. No hose length involved in such a program will be part of an operational diving hose.

______ Check that hoses are free of moisture, packing material, or chalk.

______ Soap test hose connections after connection to air supply and pressurization.

______ Ensure umbilical boots are in good condition.

i. Test Equipment with Activated Air Supply:

______ Hook up all air hoses to helmets, masks, and chamber; make connections between back-up supply and primary supply manifold.

______ Verify flow to helmets and masks from primary and secondary air supply.

______ Check all exhaust and non-return valves.

______ Hook up and test all communications.

______ Check air flow from both primary and back-up supplies to chamber.

j. Recompression Chamber Checkout (Pre-dive only):

______ Check that chamber is completely free and clear of all combustible materials.

______ Check primary and back-up air supply to chamber and all pressure gauges.

______ Check that chamber is free of all odors or other "contaminants."

______ Hook up and test all communications.

______ Check air flow from both primary and back-up supplies to chamber.

k. Final Preparations:

______ Verify that all necessary records, logs, and timesheets are on the diving station.

______ Check that appropriate decompression tables are readily at hand.

______ Place the dressing bench in position, reasonably close to the diving ladder or stage, to minimize diver travel.

l. Dress Diver/s:

______ Dress divers in accordance with requirements of approved workplan and in considerations of the site environmental conditions.

This page intentionally left blank.

ATTACHMENT 3

DIVING SUPERVISOR/LEAD DIVER POST-DIVE CHECKLIST

This page intentionally left blank.

ATTACHMENT 3

DIVING SUPERVISOR/ LEAD DIVER POST-DIVE CHECKLIST

PROJECT NAME/ NUMBER:____

______ Check the physical condition of the diver.

_______ Instruct the diver to report any physical problems or adverse physiological effects including symptoms of decompression sickness.

_______ Advise the diver of the location of the closest recompression chamber that is ready for use.

_______ Alert the diver to the potential hazards of ascending to altitude, including flying after diving (see DSPM Section 18)

_______ Assemble diving equipment and return to site support facility.

_______ Have divers shower and consume warm liquids, avoid beverages with caffeine.

_______ Observe the divers on the surface for symptoms of diving disorders for a minimum of 10 minutes before allowing the divers to leave the dive site.

_______ Wash all diving equipment in fresh water and hang to dry.

_______ Reorder/replace equipment as necessary.

_______ Complete a dive profile log for all divers and submit the log to the Chairman of the Diving Review Board for input into TtEC's master dive log.

This page intentionally left blank.

ATTACHMENT 4

EMERGENCY PROCEDURES

This page intentionally left blank.

ATTACHMENT 4

EMERGENCY PROCEDURES

GENERAL DIVING EMERGENCY PROCEDURES

1. **Decompression Sickness or Arterial Gas Embolism**:
   - Recall all divers.
   - Administer first aid, CPR and emergency O_2 as required.
   - Notify Recompression Chamber.
   - Begin transport to chamber on oxygen.
2. **Fire in Equipment**:
   - Evaluate effect of fire on diver AND topside crew.
   - Terminate dive.
   - Inform crew and diver of action planned.
   - Activate plan outlined in Project HASDP.
3. **Explosive Detonation with Divers in the Water**:
   - Try to establish communications with the divers using standard line pull signals or communications.
   - If contact is established with the divers, recall, recover, and administer first aid as required. Transport in accordance with project HASDP as required.
   - If communications cannot be established, activate the standby diver and recover the divers via the tending line, and administer first aid as required.
   - Request medical assistance and remember that unconscious divers should be treated for possible arterial gas embolism (AGE)
   - Discontinue diving operations until the cause of the explosion is determined.
4. **Boat Breakdown:**

   This situation is considered to constitute an emergency due to the loss of control of the divers.
   - Recall and recover the divers.
   - Discontinue diving operations.
   - Deploy the anchor
   - Request assistance via radio, phone, or signals.
5. **Variations in Ascent Rate**

   Always ascend at a rate of 30 feet per minute (FPM) (20 seconds per 10 feet of seawater [FSW]). Minor variations in the rate of travel between 20 and 40 FSW/minute are acceptable. Any variation in the rate of ascent must be corrected in accordance with the following procedures; however, a delay of up to 1 minute in reaching the first decompression stop can be ignored.
   - **Travel Rate Exceeded.** On a Standard Air Dive, if the rate of ascent is greater than 30 FPM, STOP THE ASCENT, allow the watches to catch up, and then

continue ascent. If the decompression stop is arrived at early, start the stop time after the watches catch up.

- **Delay greater than 1 minute, deeper than 50 FSW**. Add the total delay time (rounded up to the next whole minute) to the bottom time, re-compute a new decompression schedule, and decompress accordingly.
- **Delay greater than 1 minute, shallower than 50 FSW**. If the rate of ascent is less than 30 FPM, add the delay time to the diver's first decompression stop. If the delay is between stops, disregard the delay. The delay time is rounded up to the next whole minute.

6. Unplanned Ascent (Blowup)

- **Ascent from 20 Feet or Shallower with No Decompression Stops Required.** No recompression is required if the diver surfaces from 20 feet or shallower but was within no-decompression limits and is asymptomatic. The diver should be observed on the surface for 1 hour. Consider administering O_2.
- **Ascent from 20 Feet or Shallower (Shallow Surfacing) with Decompression Stops Required.** If decompression is required and the diver surfaces from 20 FSW or shallower (missed the 20- and/or 10-foot stop) and is asymptomatic, the diver is returned to that decompression stop.
    - If the time from the surface back to the stop was less than 1 minute, add 1 minute to the stop.
    - If the time from the surface back to the stop was more than 1 minute and the diver remains asymptomatic, multiply the 20- and/or 10-foot stops by 1.5.
    - Observe diver for 1 hour. Consider administering O_2.
- **Ascent from Deeper than 20 Feet (Uncontrolled Ascent).** Any unexpected surfacing of the diver from depths in excess of 20 feet is considered an uncontrolled ascent. If the diver is within no-decompression limits and asymptomatic, he/she should be observed for at least 1 hour on the surface. Recompression is not necessary unless symptoms develop. Consider administering emergency O_2.
- **Asymptomatic Uncontrolled Ascent.** Asymptomatic divers who experience an uncontrolled ascent and who have missed decompression stops are treated by recompression based on the amount of decompression missed as follows:
    - **Oxygen Available.** Immediately compress the diver to 60 feet in the recompression chamber. If less than 30 minutes of decompression (total ascent time from the tables) was missed, decompress from 60 feet on appropriate Treatment Table. If more than 30 minutes of decompression was missed, decompress from 60 feet on appropriate Treatment Table.
    - **Oxygen Not Available**. If less than 30 minutes of decompression was missed, compress the diver to 100 feet in the recompression chamber and treat on appropriate Treatment Table. If more than 30 minutes was missed, compress to 165 feet and treat on appropriate Treatment Table.

EMERGENCY PROCEDURES

- **Symptomatic Uncontrolled Ascent.** If a diver has had an uncontrolled ascent and has any symptoms, he/she should be recompressed immediately in a recompression chamber to 60 FWS.
    - If the diver surfaced from 60 FWS or shallower, compress to 60 FSW and begin appropriate Treatment Table.
    - If the diver surfaced from a greater depth, compress to 60 FSW or depth where the symptoms are significantly improved, not to exceed 165 FSW, and begin appropriate Treatment Table.

7. Emergency Evacuation

- Notify diver and dive team of emergency and abort dive.
- Evacuate all unnecessary personnel.
- Decompress the diver (if required) and recover. If decompression is not possible, follow omitted decompression procedures.

ATTACHMENT 4

EMERGENCY PROCEDURES

SCUBA EMERGENCY PROCEDURES

1. **Buddy Separation** – Make a 360-degree check, above and below; if your buddy is not found, surface immediately. Check the surface for bubbles and notify the Diving Supervisor/ Lead Diver immediately.
2. **Lost Diver** – The first stage of a lost diver is when communications have been lost and emergency recall has failed.
   - Initiate diver recall.
   - Wait 1 minute for response.
   - Deploy lost diver buoy.
   - Deploy standby diver (Dive Supervisor's/ Lead Diver's discretion); follow bubbles or conduct expanding circle line search from last known position.
   - Notify ships/ boats in the area to look out for lost diver and request assistance from the Coast Guard Rescue Center, if necessary.
3. **Loss of Air/Equipment Malfunction (SCUBA)**
   - Signal buddy/surface and abort dive.
   - Buddy breath/activate reserve/breath from emergency air supply.
   - Exhale to the surface.
4. **Mechanical Injury:**
   - Signal buddy/surface and abort dive.
   - Inform Diving Supervisor/Lead Diver.
   - Rule out possible decompression sickness.
   - If immediate treatment required, recall all divers and transport to hospital.
5. **Fouled/Trapped Diver**:
   - Don't panic, stop and think!
   - Notify your buddy diver or topside, if possible (2-2-2 fouled and need assistance, or 3-3-3 fouled and can clear myself).
   - Carefully and calmly try to work yourself free of the entanglement.
   - If required, ditch your equipment and make a buoyant ascent to the surface.
   - If the diver is trapped, the buddy diver should mark the position of the trapped diver with a circle line, his tending line or any available method of marking the trapped diver's position, and then surface and report to the Diving Supervisor.
   - The Diving Supervisor/ Lead Diver will formulate a rescue plan, while the diver delivers additional air to the trapped diver.
   - The Diving Supervisor/Lead Diver will then brief the rescue plan to the dive team and execute the rescue.

ATTACHMENT 4

EMERGENCY PROCEDURES

After rescue, observe the divers on the surface for signs of AGE, asphyxia, physical injury, omitted decompression, and hypothermia.

SURFACE SUPPLIED EMERGENCY PROCEDURES

1. **Loss of Breathing Media**
   - Re-establish breathing media supply:
     - Activate topside secondary breathing media supply
     - Diver initiate emergency procedure using bailout bottle.
     - **ONLY AS A LAST RESORT** – Pressurize the diver’s pneumofathometer hose (135 PSI) and have the diver insert the hose into his/her helmet or mask.
   - Alert standby diver.
   - Have stricken diver go to bell, stage or ladder.
   - If required, send standby diver to assist.
   - Terminate dive.

2. **Loss of Communications**
   - Attempt to establish communications with line pull signals.
   - Put constant air to the diver’s pneumofathometer.
   - Alert standby diver.
   - If communications are established using line pull signals, abort dive and decompress if required.
   - If communications are not established, send stand-by diver to diver’s assistance, abort dive, and decompress if required.

3. **Fouled or Trapped Diver**
   - Avoid panic and ensure diver does NOT ditch equipment.
   - Diver informs topside — gives a detailed report.
   - Alert standby diver.
   - Diver determines the extent of entrapment.
   - Diver attempts to free yourself.
   - If required, deploy standby for assistance.
   - Abort dive and decompress if required

4. **Injury in the Water**
   - Diver informs topside of injury and extent — gives a detailed report.
   - Alert standby diver.

- If required, deploy standby diver to assist stricken diver.
- Abort dive and follow decompression protocol, unless injury indicates a greater risk than omitted decompression. Check surface decompression tables for alternate protocol.
- Request required medical assistance.

5. Severance of Divers Air Supply

- Diver initiates emergency procedure using bailout bottle.
- **<u>If pneumofathometer hose intact and then ONLY AS A LAST RESORT –</u>** Pressurize the diver's pneumofathometer hose (135 PSI) and have the diver insert the hose into his helmet or mask.
- Alert standby diver.
- Abort dive and decompress.
- Deploy standby diver with more air and/or assist stricken diver if required.

6. Severance of Complete Umbilical

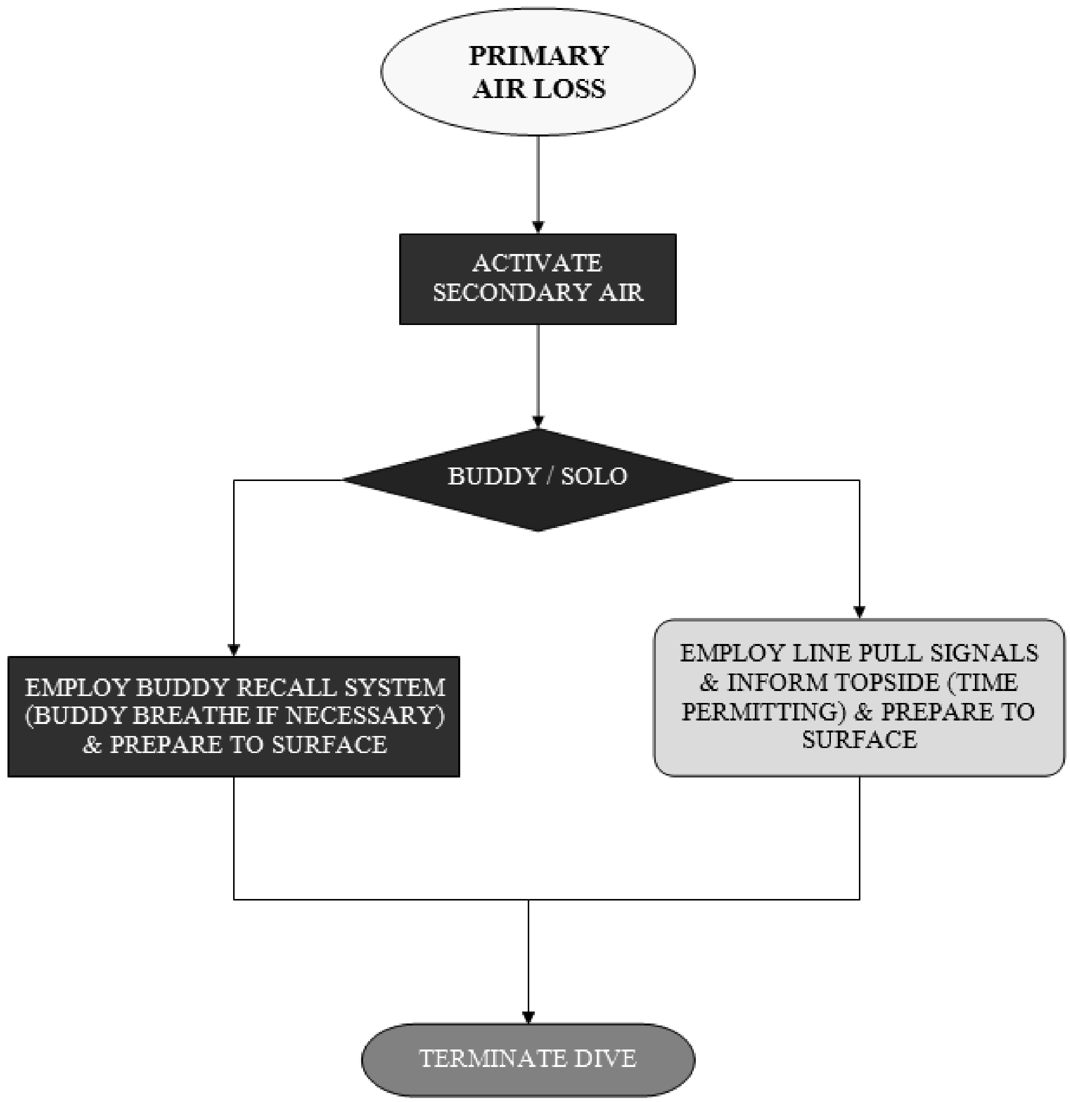
- Diver initiates emergency procedure using bailout bottle.
- Topside alerts standby diver.
- Deploy standby diver down stage line, diver's umbilical (if visible), or descent line with additional air supply (pneumofathometer, if necessary) to assist stricken diver and inform topside of conditions.
- Abort dive and decompress. Check surface decompression tables for shorter water time.

ATTACHMENT 4

EMERGENCY PROCEDURES

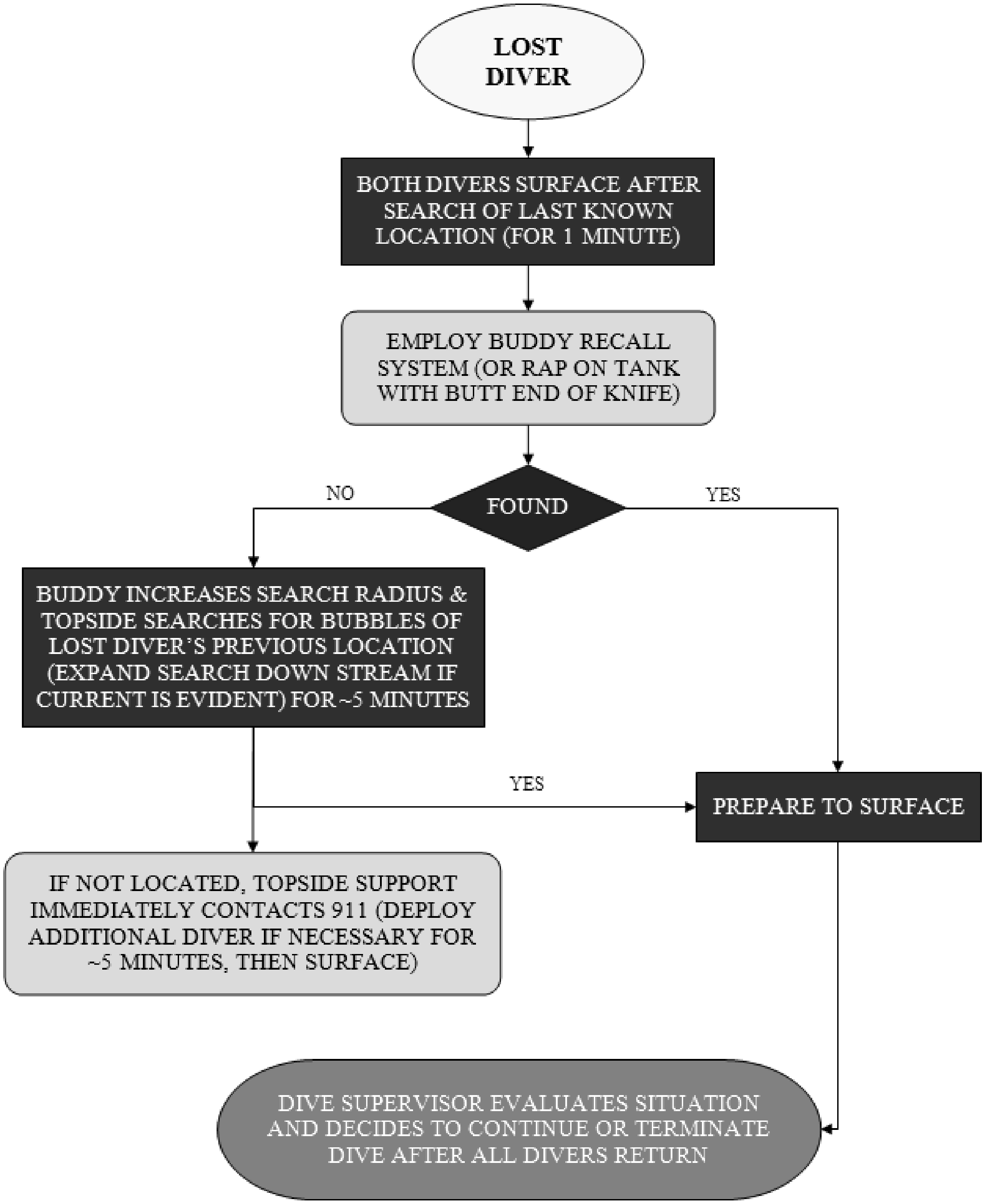
DIVING EMERGENCY DECISION FLOW CHARTS

SCUBA EMERGENCY PROCEDURES



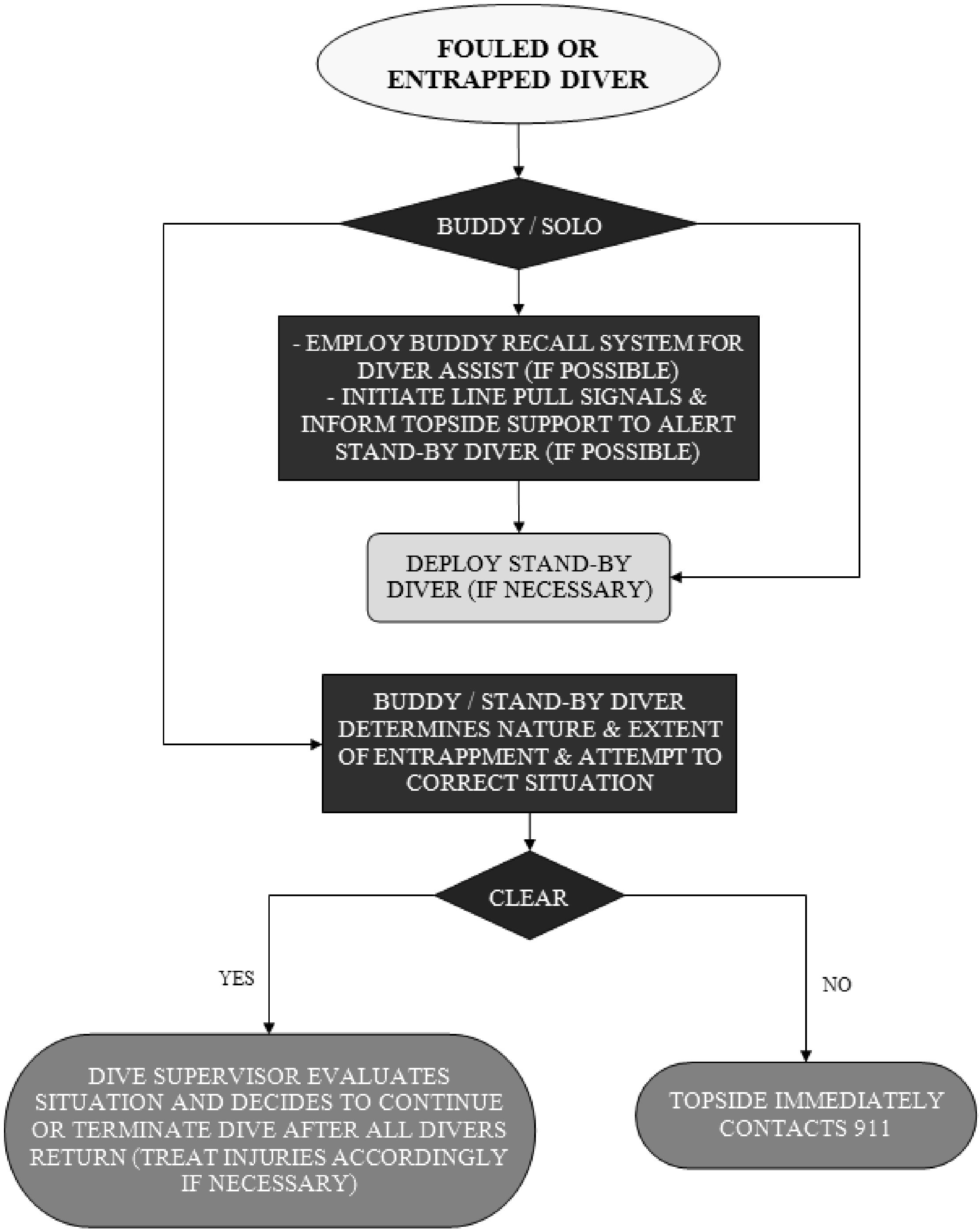
ATTACHMENT 4

EMERGENCY PROCEDURES



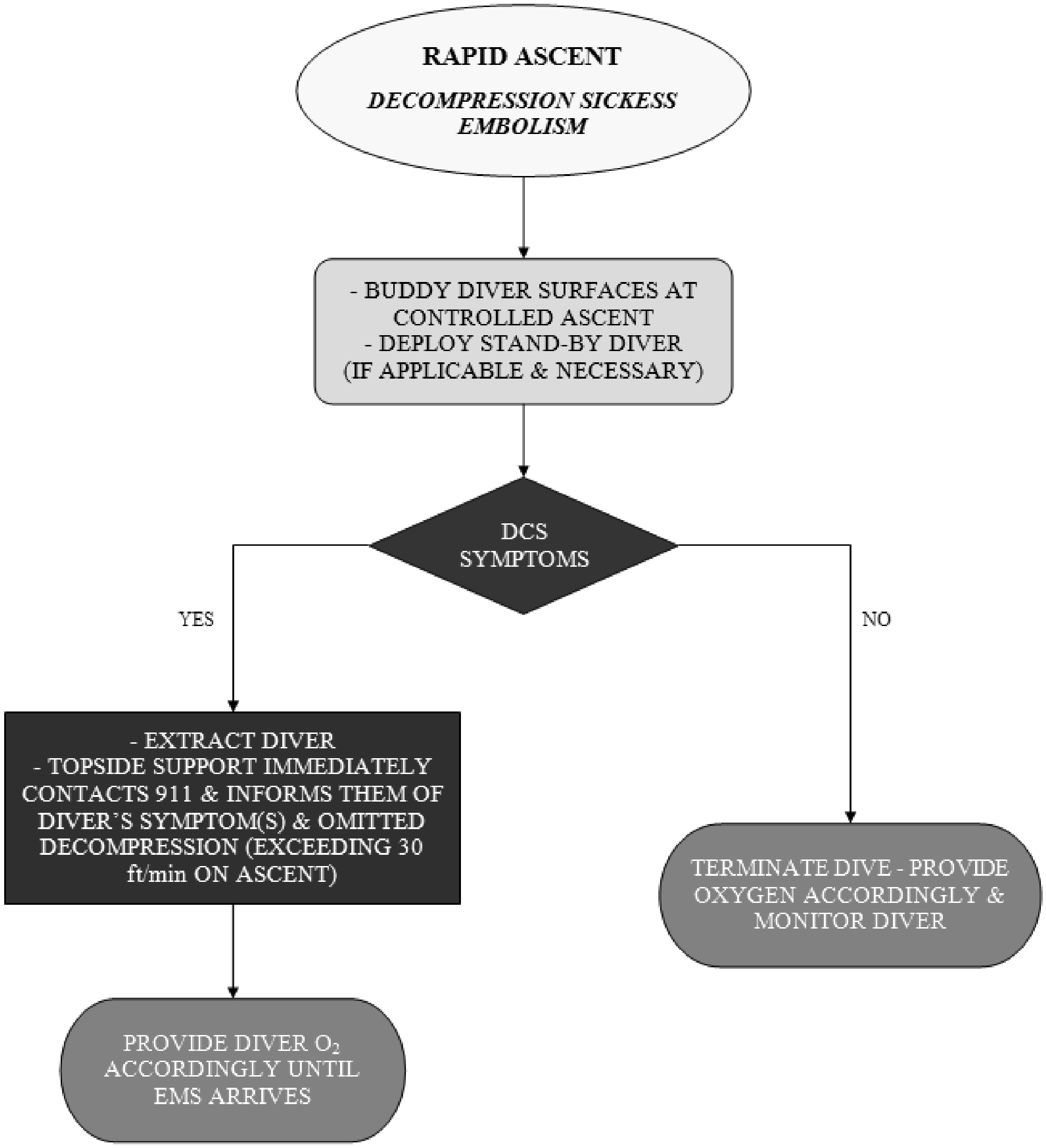
ATTACHMENT 4

EMERGENCY PROCEDURES



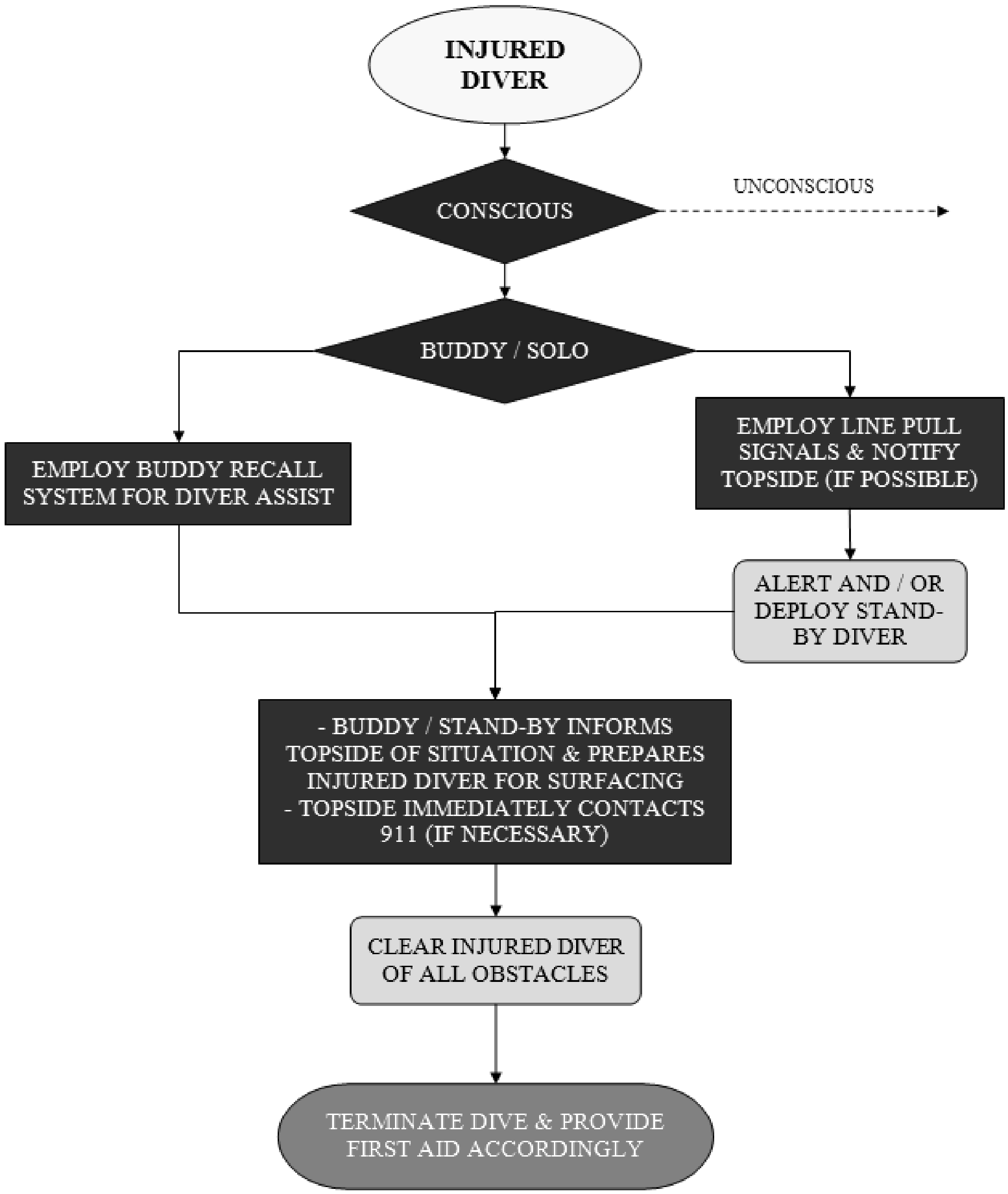
ATTACHMENT 4

EMERGENCY PROCEDURES



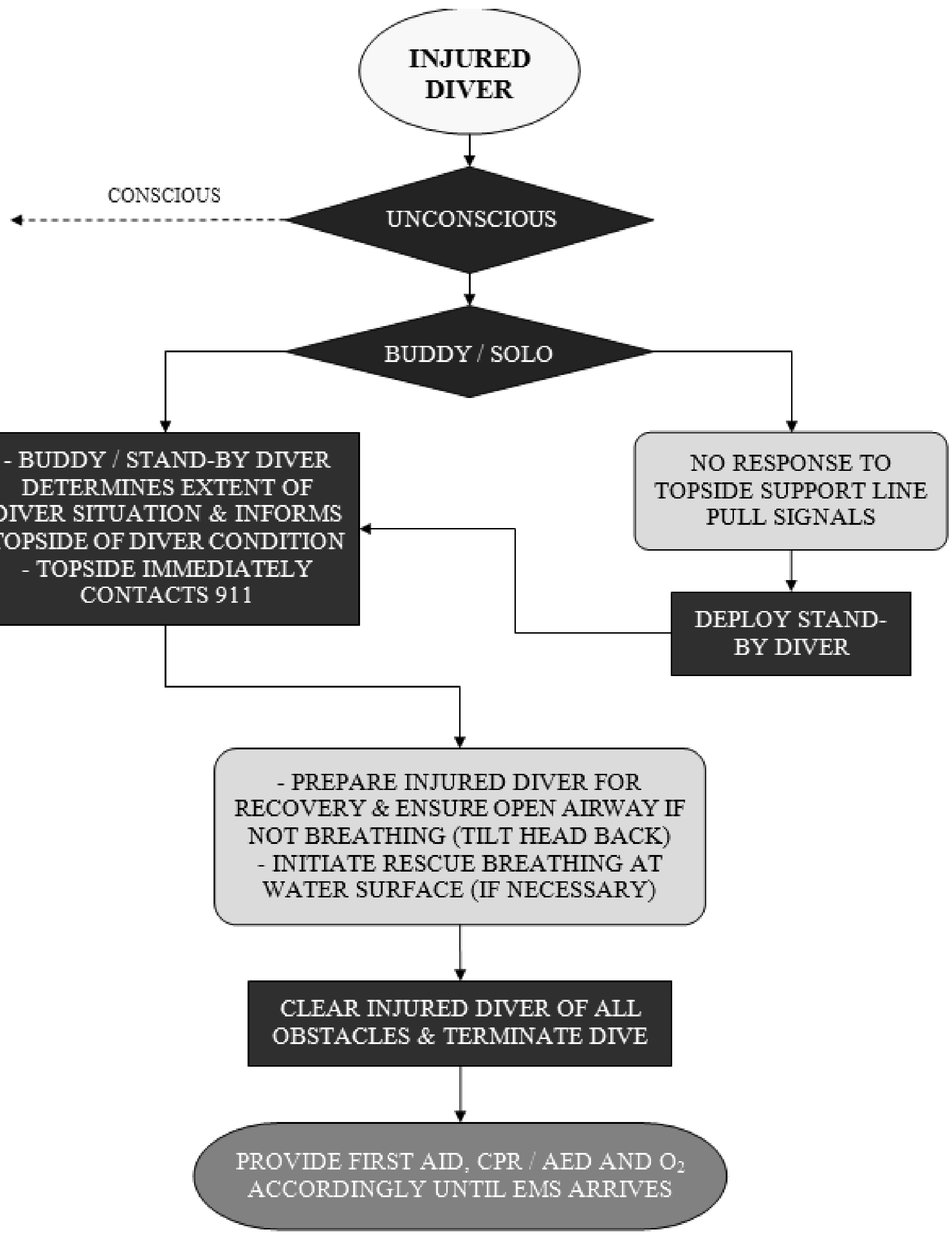
ATTACHMENT 4

EMERGENCY PROCEDURES

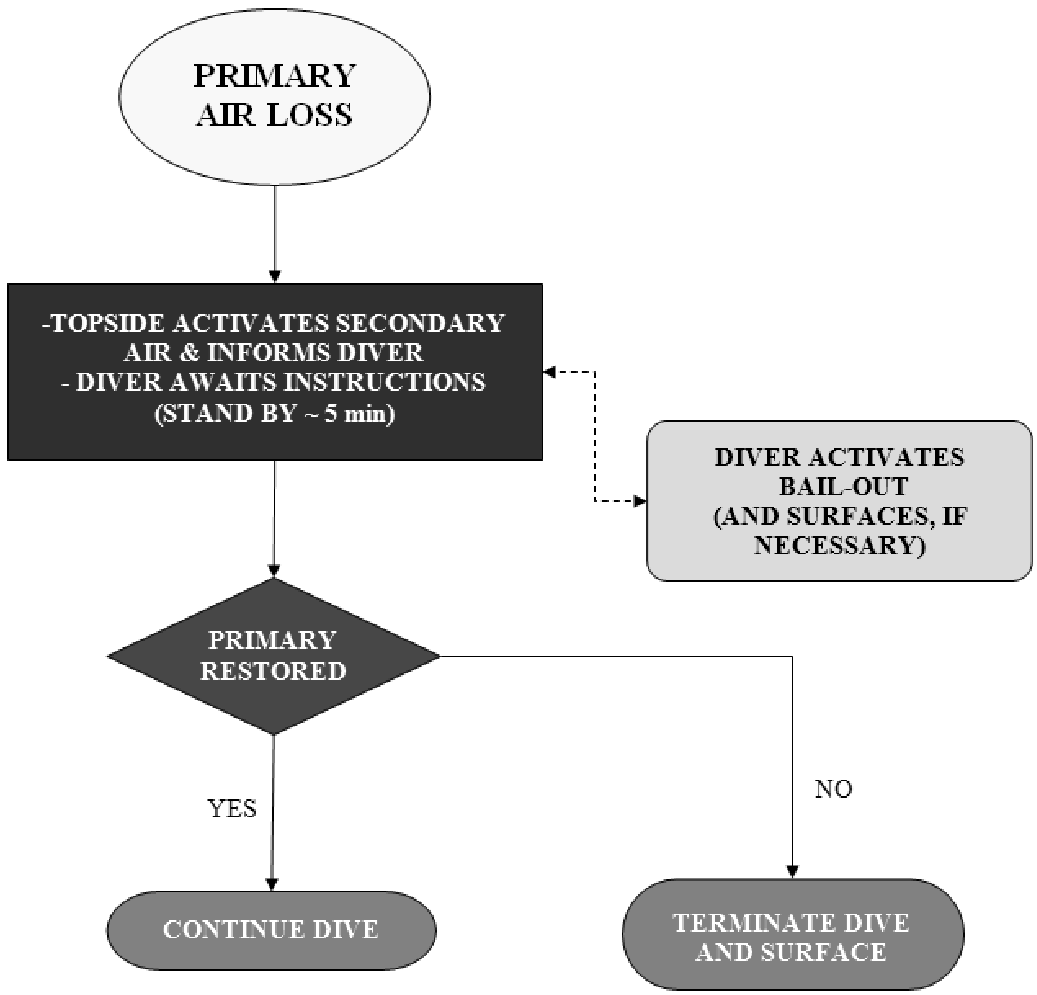


ATTACHMENT 4

EMERGENCY PROCEDURES

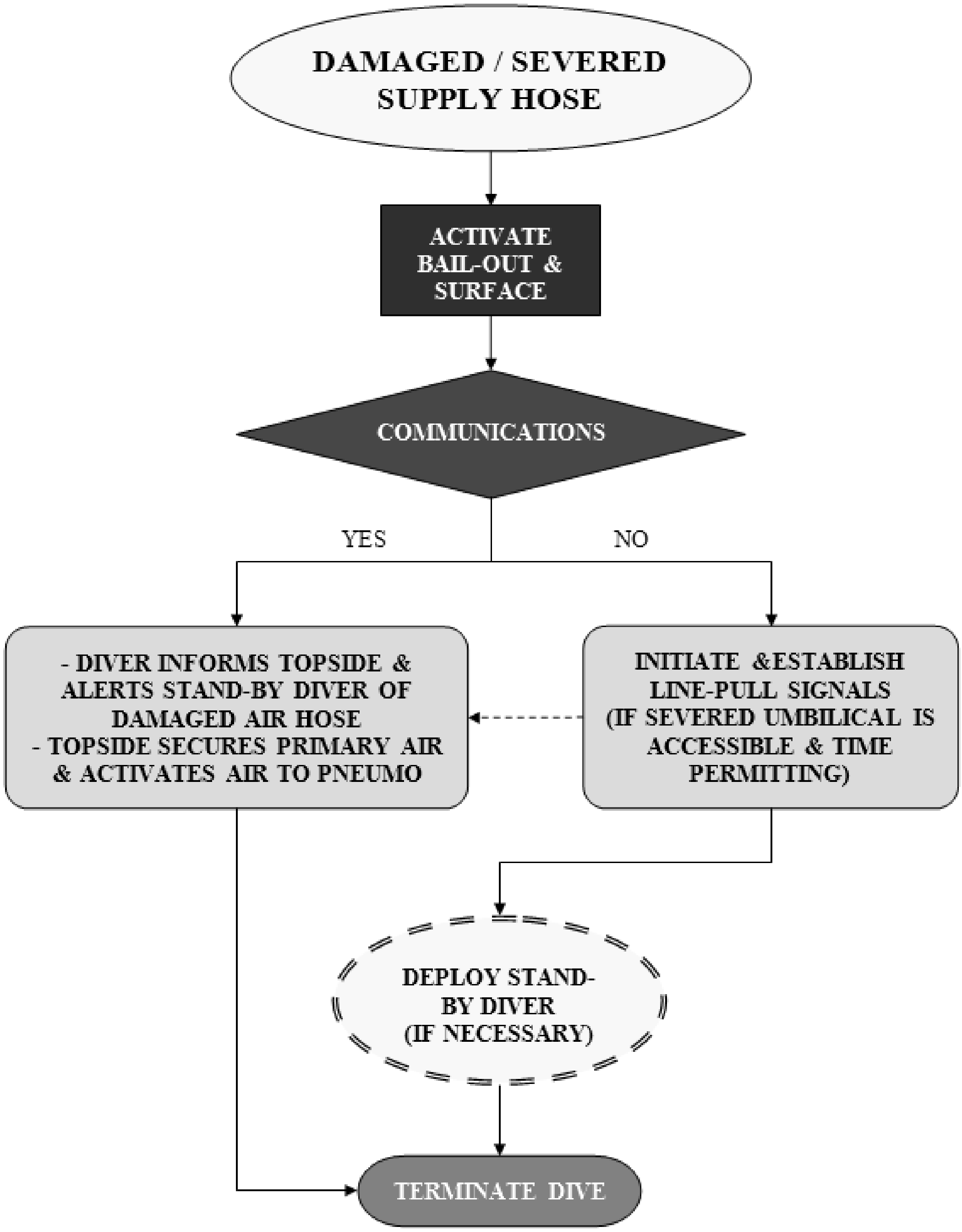


SURFACE SUPPLIED EMERGENCY PROCEDURES



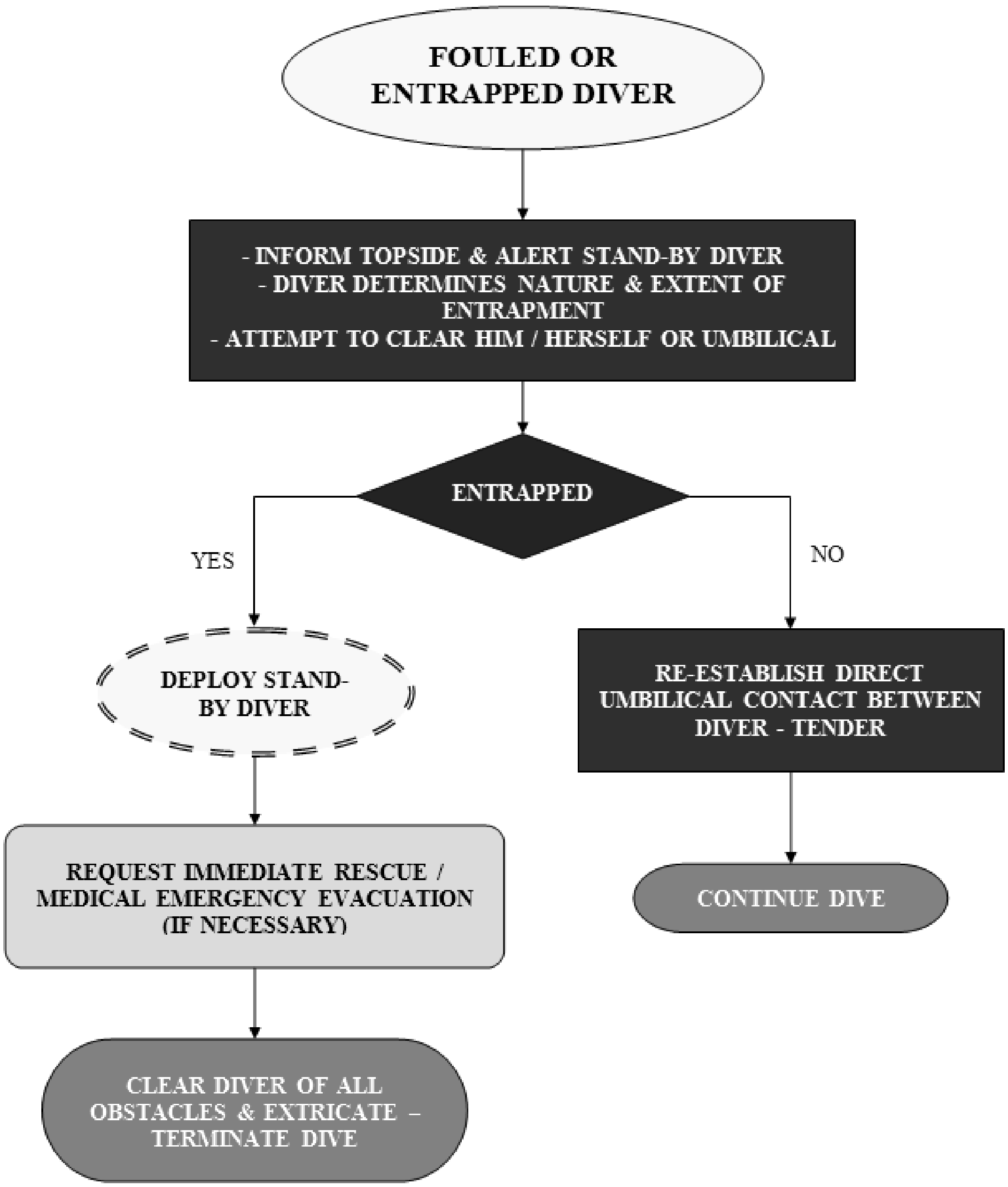
ATTACHMENT 4

EMERGENCY PROCEDURES



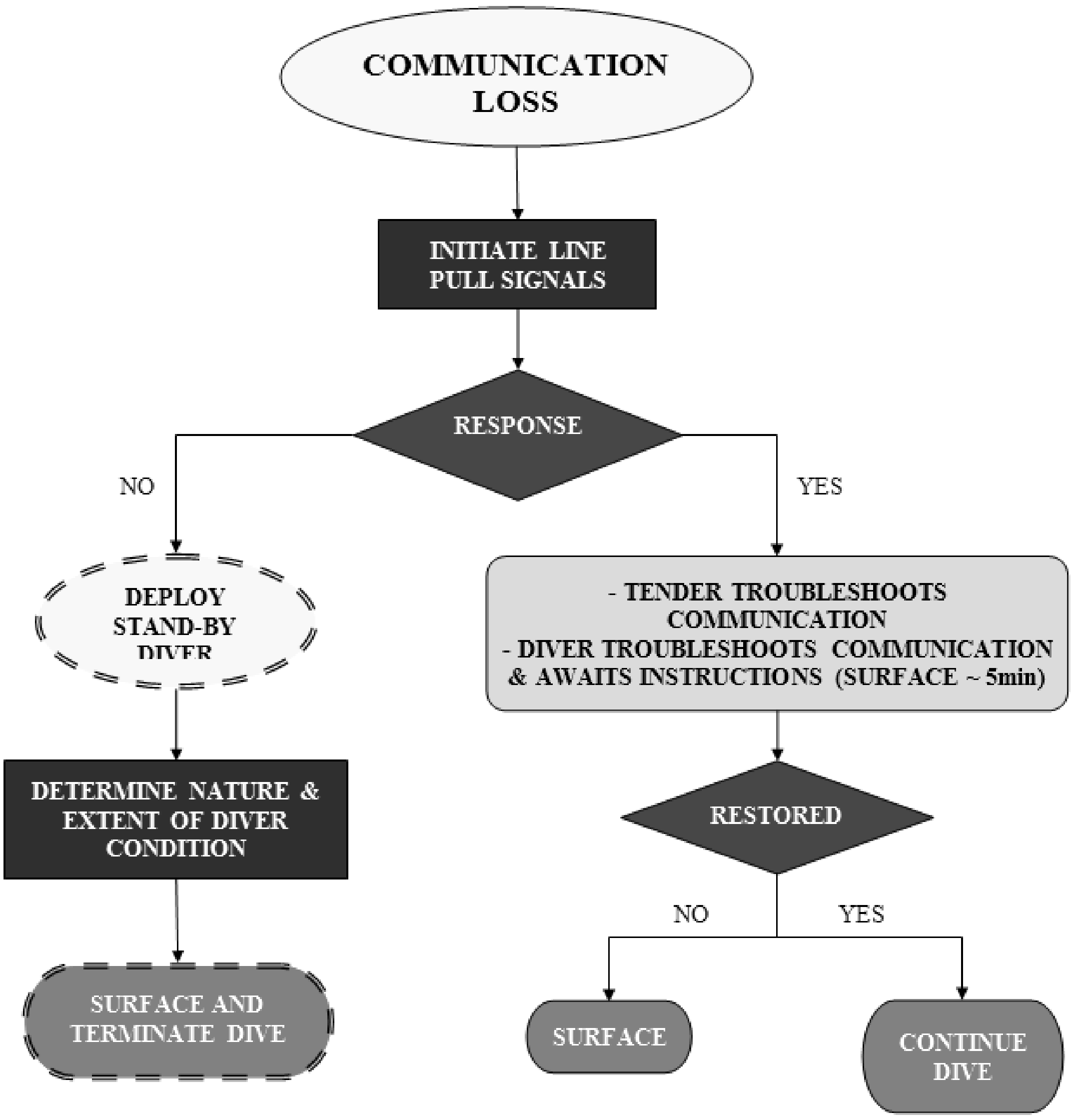
ATTACHMENT 4

EMERGENCY PROCEDURES



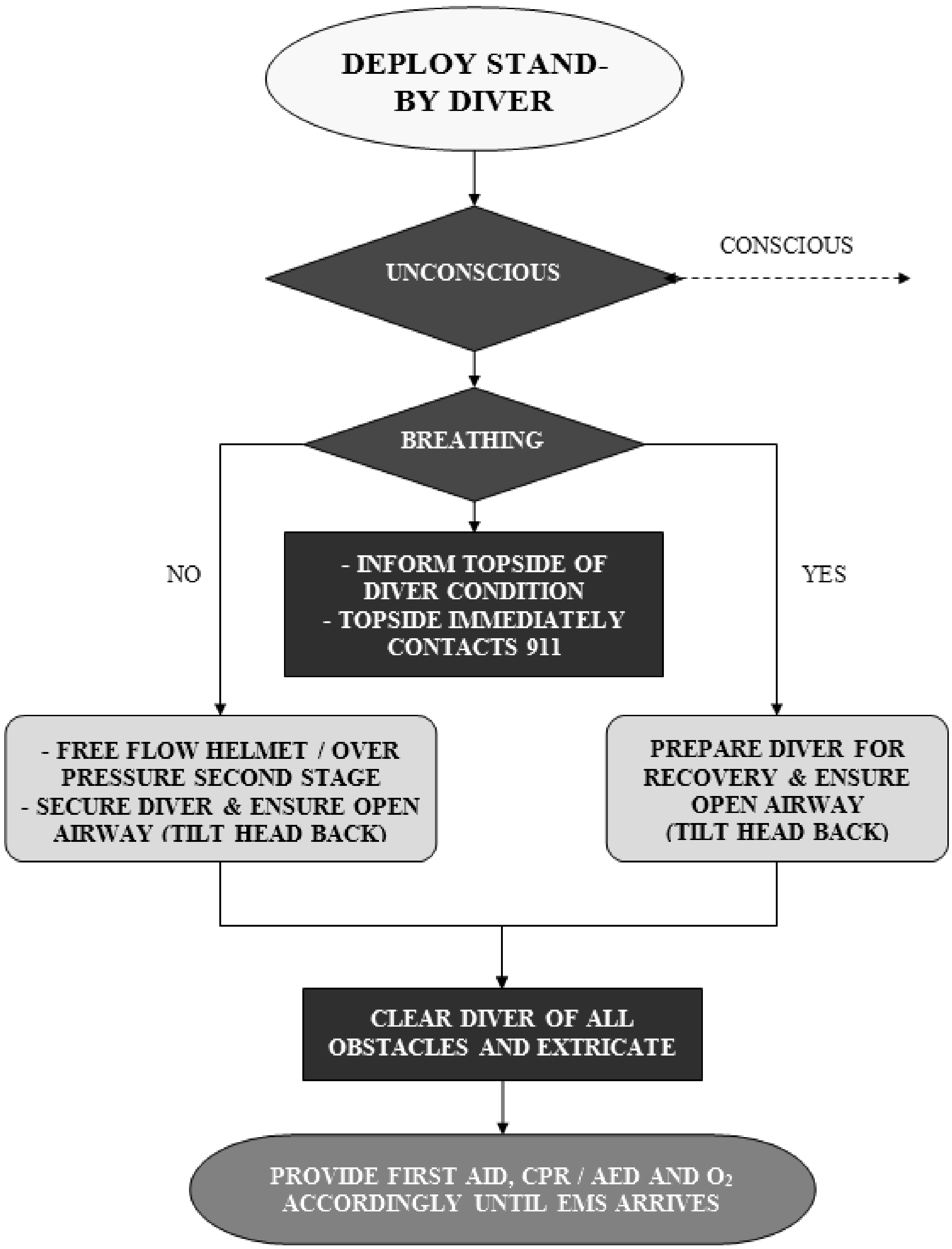
ATTACHMENT 4

EMERGENCY PROCEDURES



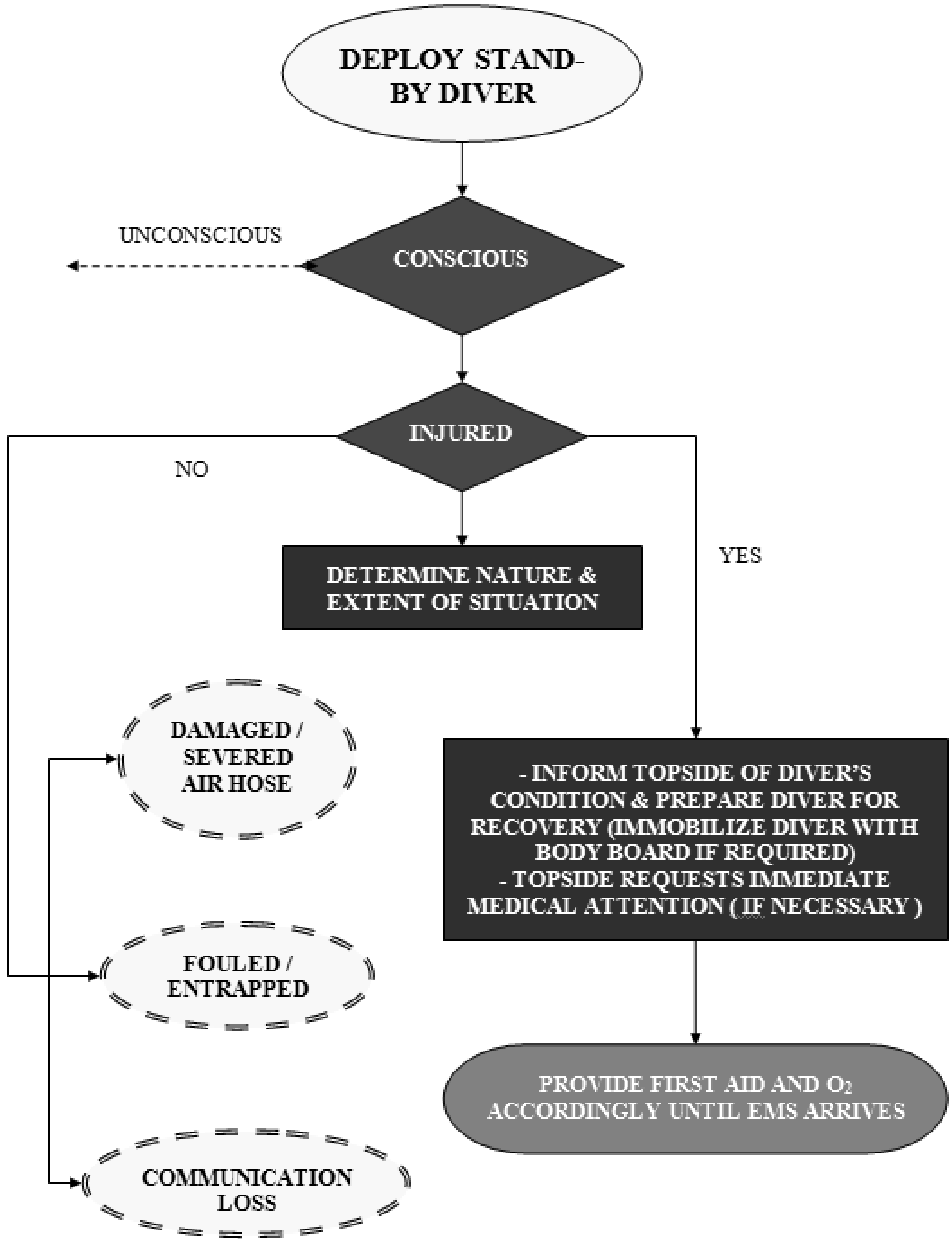
ATTACHMENT 4

EMERGENCY PROCEDURES



ATTACHMENT 4

EMERGENCY PROCEDURES



ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

This page intentionally left blank.

ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

PROJECT NAME/NUMBER:____

RECOMPRESSION CHAMBER:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

HOSPITAL:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

AIR TRANSPORTATION:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

SEA TRANSPORTATION:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

ATTACHMENT 5

EMERGENCY PHONE NUMBERS CHECKLIST

PROJECT NAME/NUMBER:____

AMBULANCE:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

PHYSICIAN:

ADDRESS/LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

COMMUNICATIONS:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

USCG RESCUE:

ADDRESS/ LAT-LONG ____

PHONE NUMBER: ____

POC: ____

RESPONSE TIME: ____

NOTE – THIS CHECKLIST WILL BE PROMINENTLY POSTED AT THE DIVE SITE AND BE PLACED IN ALL BOATS AND RESPONSE VEHICLES.

ATTACHMENT 6

WORKING DIVE LOG

This page intentionally left blank.

ATTACHMENT 6

TETRA TECH TMR WORKING DIVE LOG

1. All Tetra Tech TMR (Tt TMR) dives will be recorded on this attachment during field operations each dive day.

2. The information on these working Dive Logs will be then transferred/ recorded on the Tt TMR Dive Smooth Log by the Dive Supervisor/ or designee and forwarded to the Project Manager for the official project files. A copy will be further forwarded to the Chairman of the Tt TMR Diving Review Board.

   For scientific divers, a copy will also be sent to the Tt TMR Diving Safety Officer. The Chairman of the Diving Review Board will retain this log for 1 year, except where there has been an injury or incident of decompression sickness and then the record will be retained for 5 years.

3. Definitions:

   a. <u>Old Group</u> – Repetitive group designation from previous dive. Leave blank if this is the first dive.

   b. <u>Surface Interval</u> – The time, which a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as the diver starts his/her next descent. Not required for first dive.

   c. <u>RNT – RESIDUAL NITROGEN TIME</u> – Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

   d. <u>Depth</u> – Depth of current dive.

   e. <u>Bottom Time</u> – The total elapsed time from when the divers leave the surface to the time (rounded up to the next whole minute) they begin their ascent from the bottom.

   f. <u>Decompression time</u> – Decompression schedule/decompression time.

   g. <u>Equivalent Single Dive Time</u> – RNT plus actual bottom time.

   h. <u>New Group</u> – REPETITIVE GROUP DESIGNATION – A letter, which is used to relate directly to the amount of residual nitrogen remaining in a diver's body.

4. <u>RNT Exception Rule</u> – If performing a repetitive dive to the same depth or deeper, and the RNT is greater than the bottom time of the previous dive, use the bottom time of the previous dive as the RNT.

5. See Attachment 10 for the required U.S. Navy Dive Tables needed to complete these logs.

ATTACHMENT 6

TETRA TECH EC WORKING DIVE LOG

PROJECT NAME/NUMBER: ______________________________ **DATE:** ____________________

NAME	LS	RS	TBT	DEPTH	TDT	RNT	ESDT	T/S	REPET GROUP	SI
DIVE SUPERVISOR					STBY DIVER					

ATTACHMENT 7

DIVE SMOOTH LOG

This page intentionally left blank.

ATTACHMENT 7

TETRA TECH TMR DIVE SMOOTH LOG

PROJECT NAME/ NUMBER: ____

1. All Tetra Tech TMR dives will be recorded on this attachment and be the final legal record concerning a diver's hyperbaric exposure during operations.

2. Upon completion of the project or weekly, all working Dive Logs from Attachment 6 will be recorded on this Dive Smooth Log by the Dive Supervisor/ Lead Diver and forwarded to the Project Manager for the Project files and the Chairman Diving Review Board. For science divers, a copy will also be sent to the Tt TMR Diving Safety Officer. The Chairman of the Diving Review Board will retain this log for 1 year, except where there has been an injury or incident of decompression sickness and then the record will be retained for 5 years.

3. Data field definitions:

   a) Date – Date of the diving operation.
   b) Project Name – Name of the Project that dive operations are supporting.
   c) Project Number – Associated Project number.
   d) Location – General Project Location.
   e) Platform – Platform from which the dive operations are conducted.
   f) Gas Source – Source of diver's breathing medium.
   g) Apparatus – The diving mode and equipment used during the operation.
   h) Dress – The exposure protection used by the diver(s).
   i) Project Location – The specific location in the project location that the dive is conducted.
   j) Air Temp – The ambient air temperature at the project dive site.
   k) Current – The observed or reported current at the dive site.
   l) Visibility – The observed underwater visibility reported by the diver(s) at depth.
   m) Altitude – The observed altitude recorded at the dive site.
   n) Water Temp – The observed underwater temperature reported by the diver(s) at depth.
   o) Wave Ht. – The observed wave height recorded at the dive site.
   p) Bottom Type – The observed bottom type reported by the diver(s) at depth.
   q) Tools Used – The tools used for the specific Project task during the dive.
   r) Divers Name – Self-explanatory.
   s) Left Surface (LS) – The recorded time that the diver(s) left the surface (begin descent)
   t) Left Bottom (LB) – the recorded time that the diver(s) left the bottom. (begin ascent)
   u) Total Bottom Time (TBT) – the recorded bottom time (From when diver LS to diver LB).
   v) Total Decompression Time (TDT) – The recorded time of ascent (to include any decompression stops or delays) from when diver LB to diver RS.
   w) Reach Surface (RS) – The recorded time that the diver(s) reach the surface.

PROJECT NAME/ NUMBER: ____

x) Total Time of Dive (TTD) – The recorded time from when the diver(s) LS to when the diver(s) RS.

y) Depth – The deepest depth recorded of the reported dive.

z) Surface Interval (SI) – The time, that a diver has spent on the surface following a dive. It begins as soon as the diver surfaces and ends as soon as the diver starts his/her next descent. Not required for first dive.

aa) Residual Nitrogen Time (RNT) – Time, in minutes, which must be added to the bottom time of a repetitive dive to compensate for the nitrogen still in solution in a diver's tissues from a previous dive.

bb) Equivalent Single Dive Time (ESDT) – A diver's RNT time plus total bottom time. Used to measure remaining time and new schedule for repetitive dives

cc) Table and Schedule (T/S) – The Table and Schedule used to measure a diver's hyperbaric exposure for a recorded dive.

dd) Repetitive Group (RG) – Repetitive group designation from previous dive and used for repetitive and final dive calculations. Leave blank if this is the diver's first dive.

4. RNT Exception Rule – If performing a repetitive dive to the same depth or deeper, and the RNT is greater than the bottom time of the previous dive, use the bottom time of the previous dive as the RNT.

5. Repetitive Group Designation – A final letter designation, which is used to relate directly to the amount of residual nitrogen remaining in a diver's body after that dive.

6. Use the applicable U.S. Navy Dive Tables located in Attachment 10. These tables are required to complete this log.

TETRA TECH

DIVE LOG

Project

Date: ____________ Project Name: ____________ Location: ____________

Project Number: ____________

Equipment

Platform: ____________ Gas Source: ____________ Apparatus: ____________ Dress: ____________

Environment

Project Location: ____________ Altitude: ____________ Tools Used: ____________

Air Temp: ____________ Water Temp: ____________

Current: ____________ Wave Ht. ____________

Visibility: ____________ Bottom Type: ____________

Dive Data

Diver (Last, First MI)	LS	LB	TBT	TDT	RS	TTD	Depth	SI	RNT	ESDT	T/S	RG	NOTES

Dive Description

Purpose: ____________

Description: ____________

Approval

Signature: ____________ Date: ____________

Dive Supervisor: ____________

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

This page intentionally left blank.

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

From Tender to Diver		From Diver to Tender	
1 Pull	**Are you all right? When diver is descending, 1 pull means STOP.**	**1 Pull**	**I am all right. When diver is descending, 1 pull means I am on the bottom.**
2 Pulls	**Leave surface; Go down.**	**2 Pulls**	**Give me slack.**
3 Pulls	**Standby to come up.**	**3 Pulls**	**Take up my slack.**
4 Pulls	**Come up.**	**4 Pulls**	**Haul me up.**
7 Pulls	**On/Off search signals.**	**7 Pulls**	**On/Off search signals.**
1 Pull	**Stop and search where you are at.**	**2-1 Pull**	**I understand, Talk to me.**
2 Pulls	**Move directly away from the tender if given slack; Move towards the tender if strain is taken.**	**3-2 Pulls**	**More air.**
3 Pulls	**Face umbilical, take a strain, and move RIGHT.**	**4-3 Pulls**	**Less air.**
4 Pulls	**Face umbilical, take a strain, and move LEFT.**	**1-2-3 Pulls**	**Send me a square mark.**
2-1 Pull	**I understand, talk to me.**	**2-1-2 Pulls**	**Send me a slate.**
3-2 Pulls	**Ventilate rig.**	**5 Pulls**	**Send me a line.**
4-3 Pulls	**Circulate rig.**	**5-5 Pulls**	**Reacquired anomaly *(for UXO tasking only).***

EMERGENCY—From Diver to Tender	
2-2-2 Pulls	**I am fouled and need assistance ("I need you").**
3-3-3 Pulls	**I am fouled but can clear myself ("I need me").**
4-4-4 Pulls	**Haul me up immediately.**

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

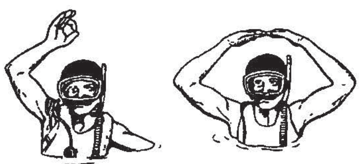
	Meaning/Signal	Comment
	**STOP** Clenched fist.	
	**SOMETHING IS WRONG** Hand flat, fingers together, palm out, thumb down then hand rocking back and forth on axis of forearm.	This is the opposite of Okay. The signal does not indicate an emergency.
	**I AM OKAY or ARE YOU OKAY?** Thumb and forefinger making a circle with three remaining fingers extended (if possible).	Divers wearing mittens may not be able to extend three remaining fingers distinctly. Short range use.
	**OKAY ON THE SURFACE (CLOSE)** Right hand raised overhead giving Okay signal with fingers. **OKAY ON THE SURFACE (DISTANT)** Both hands touching overhead with both arms bent at 45° angle.	Given when diver is close to pickup boat. Given when diver is at a distance from the pickup boat.
	**DISTRESS or HELP or PICK ME UP** Hand waving overhead (diver may also thrash hand in water).	Indicates immediate aid is required.
	**WHAT TIME? or WHAT DEPTH?** Diver points to either watch or depth gauge.	When indicating time, this signal is commonly used for bottom time remaining.
	**GO DOWN or GOING DOWN** Two fingers up, two fingers and thumb against palm.	
	**GO UP or GOING UP** Four fingers pointing up, thumb against palm.	
	**I'M OUT OF AIR** Hand slashing or chopping at throat. **I NEED TO BUDDY BREATHE** Fingers pointing to mouth or regulator.	Indicates signaler is out of air. Signaler's regulator may be in or out of mouth.

Figure 7-9. SCUBA Hand Signals (page 1 of 3).

ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

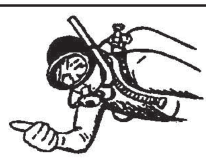
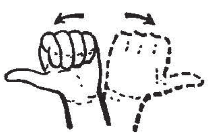
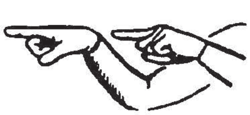
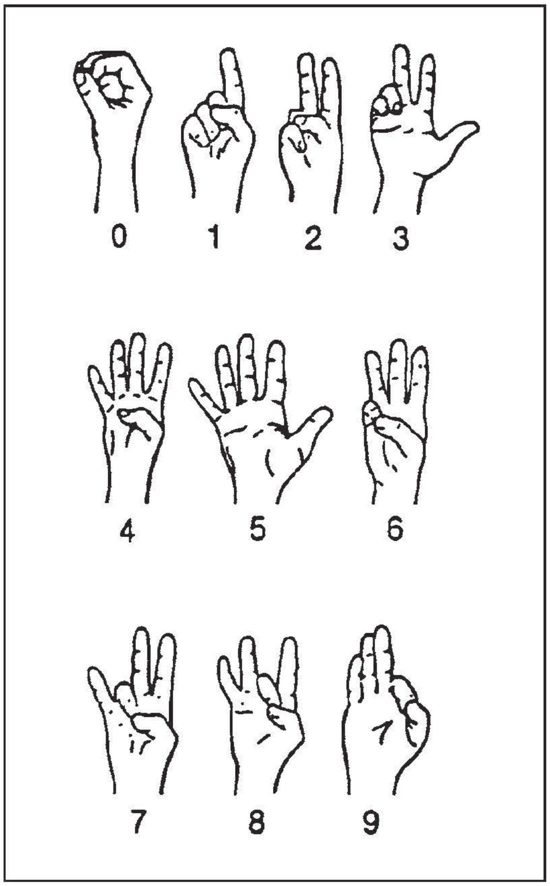
	Meaning/Signal	Comment
	**COME HERE** Hand to chest, repeated.	
	**ME or WATCH ME** Finger to chest, repeated.	
	**OVER, UNDER, or AROUND** Fingers together and arm moving in and over, under, or around movement.	Diver signals intention to move over, under, or around an object.
	**LEVEL OFF or HOW DEEP?** Fingers and thumb spread out and hand moving back and forth in a level position.	
	**GO THAT WAY** Fist clenched with thumb pointing up, down, right, or left.	Indicates which direction to swim.
	**WHICH DIRECTION?** Fingers clenched, thumb and hand rotating right and left.	
	**EAR TROUBLE** Diver pointing to either ear.	Divers should ascend a few feet. If problem continues, both divers must surface.
	**I'M COLD** Both arms crossed over chest.	
	**TAKE IT EASY OR SLOW DOWN** Hand extended, palm down, in short up-and-down motion.	
	**YOU LEAD, I'LL FOLLOW** Index fingers extended, one hand forward of the other.	

Figure 7-9. SCUBA Hand Signals (page 2 of 3).

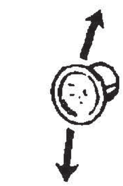
ATTACHMENT 8

USN DIVING LINE PULL AND HAND SIGNALS

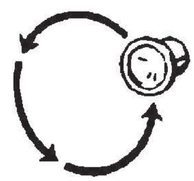


NIGHT DIVING SIGNALS
(Buddy at Distance)

When buddy is near, use regular hand signals in front of light.



Something is wrong.
I require assistance.
(Large, rapid up-and-down motions with arm extended.)



I am Okay.
Are you Okay?
(Large, slow circles with light.)

Figure 7-9. SCUBA Hand Signals (page 3 of 3).

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

This page intentionally left blank.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

UNDER ICE DIVING

Diving under the ice requires extremely specialized training and equipment and will not be performed by Tetra Tech TMR employees unless approved by the Diving Review Board.

COLD WATER DIVING

In addition to decompression, thermal problems arising from exposure to cold water pose the major consideration when planning operational dives and selecting equipment. The working diver commonly experiences heat loss during immersion and often expects to be uncomfortably chilled at the end of a dive. Bottom time limits may be determined by the diver's cold tolerance rather than by decompression considerations.

An individual thoroughly conditioned physically can be transported from warm climates into cold climates and immediately begin diving without harmful effects. However, individuals differ in how well suited they are for cold weather operations. At least half of the diving team should have previous experience in ice or cold water diving operations and should be well qualified to train the less experienced.

Personnel scheduled to go to Polar Regions should be instructed in cold weather physiology and the prevention of cold injuries. To prevent injury, any techniques that aid heat balance, protection, and basic metabolism should be used.

Cold water immersion may also cause excessive urination, severely dehydrating the diver. This in turn reduces performance and may increase the risk of developing decompression sickness. A diver who is dehydrated may appear normal in the water. However, exiting the water combined with warming of the skin may cause pooling of the blood in the extremities leading to fainting. This means that divers who have been in cold water for any period of time and who appear cold should be assisted from the water and sit or lie down and take fluids until they are sure they can stand without problems.

Vertigo is caused by cold water stimulating the balance mechanism of the inner ear.

In repetitive diving with cold exposure, the operation should be planned so that the diver is re-warmed to the point of sweating before diving again. If cold water exposures are severe and if more than a 30-minute duration, then consideration should be given to requiring an overnight rest between exposures. The diver must also have sufficient non-caffeine beverages to replace the excessive body fluid loss from cold water induced urination.

The support equipment required for ice and cold water diving must be carefully evaluated for effectiveness and suitability.

Maintaining proper body temperature is particularly difficult for a diver working underwater. The principal temperature control problem encountered by divers involves keeping the body warm. The high thermal conductivity of water, coupled with the normally cool-to-cold waters in which divers operate, can result in rapid and excessive heat loss. At extremely low temperatures or with prolonged immersion, body heat loss will reach a point at which death will occur. Appropriate dress can greatly reduce the effects of heat loss, and a diver with proper dress can work in very cold water for reasonable periods of time.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

In very cold water, the wet suit is only a marginally effective thermal protective measure and its use exposes the diver to hypothermia and restricts available bottom time. The use of alternative thermal protective equipment should be considered in these circumstances.

The variable volume dry suit and hot water suit are effective means of thermal protection for cold water diving. Wet suits made of incompressible material are now available. Such suits offer more protection at depth than standard wet suits of the same thickness. Prior to the use of variable volume dry suits and hot water suits in cold and ice-covered waters, divers must be trained in their use and be thoroughly familiar with the operation of these suits.

More weight must be used with a variable volume dry suit than with a wet suit due to the great positive buoyancy of a dry suit. Manufacturer's recommendations should be followed to select starting weight. The additional weight makes use of a weight vest or harness desirable. A shoulder harness is one method of preventing the heavy, awkward belts from slipping down during a dive. A few heavy hip hugger weights are better than several smaller weights.

Both single- and double-hose regulators are used for ice and cold water diving. The single-hose regulator is preferred for buddy breathing, is less bulky, and is easier to maintain than the double-hose; however, it is more subject to freeze-up than the double-hose regulator. Due to the serious nature of the freeze-up problems in single-hose regulators, they should not be allowed to free-flow or be purged for over five seconds at a time. Only regulators having a cold water conversion will be used for ice/cold water diving.

The single-hose regulator should be kept in a warm place before diving. It is important that the divers test the regulator in a warm place, then refrain from breathing it until submerging. When returning to the surface, the regulator should remain submerged and the diver should refrain from breathing from the regulator until re-submerging. The diver's time on the surface should be kept to a minimum. Once under the water, chances of a freeze-up are reduced. However, if a regulator is allowed to free-flow at depth for as little as 5 seconds, freeze-up may occur. The diver should therefore avoid purging the second stage of the regulator when diving in cold water. If water needs to be purged from the mouthpiece, the diver should do so by exhaling into it.

Where water temperature is at or below 37ºF, a redundant SCUBA system (twin SCUBA bottles, each having a "K" valve and an approved cold water regulator) or twin SCUBA bottles with one common manifold and an approved cold water regulator (with octopus) may be used. When selecting the redundant SCUBA system, maximum depth and bottom time are greatly reduced because the extra SCUBA will be used for emergencies only.

Using surface supplied diving in cold water requires detailed operations planning and extensive logistical support. This includes thermal protection for an elaborate dive station and recompression chamber and hot water heating equipment. In addition, dive equipment may require cold climate modification. Because of logistical considerations, scuba is used in most ice diving situations. However, surface supplied diving may be required because of prolonged bottom times, depth requirements, and complex communications between topside and diver. When diving in cold water that is not ice covered, logistic and equipment support requirements are reduced; however, very cold water poses many of the same dangers to the surface-supplied diver as ice diving.

The diver's mask may show an increased tendency to fog in cold water. An anti-fog solution should be used to prevent this from occurring. Saliva will not prevent this fogging.

HYPOTHERMIA

When diving in cold water, hypothermia may predispose the diver to decompression sickness. Hypothermia is easily diagnosed. The hypothermic diver loses muscle strength, the ability to concentrate, and may become irrational or confused. The victim may shiver violently, or, with severe hypothermia, shivering may be replaced by muscle rigidity. Profound hypothermia may so depress the heartbeat and respiration that the victim appears dead. However, a diver should not be considered dead until the diver has been re-warmed and all resuscitation attempts have been proven to be unsuccessful.

Hypothermia demands immediate treatment and prompt evacuation to a medical facility. A hypothermic diver must not be allowed to walk; i.e., the diver should be transported in a horizontal position. Improper handling of the diver can cause dangerous rhythms of the heart and a drop in the body core temperature, known as after drop. The local/responding medical facility must be notified of the possibility of hypothermia PRIOR to the commencement of diving operations. Emergency re-warming and evacuation plans should be established with their recommendations.

Some of the signs and symptoms of hypothermia are shivering, mental confusion, and loss of memory, speech /sensory impairment, and hallucinations. At approximately 88ºF, all shivering stops, the victim will not recognize familiar people, followed by the victim experiencing muscle rigidity and loss of consciousness.

ATTACHMENT 9

COLD WATER CONSIDERATIONS AND SAFETY PRECAUTIONS

This page intentionally left blank.

ATTACHMENT 10

U.S. NAVY DIVE TABLES

This page intentionally left blank.

ATTACHMENT 10

U.S. NAVY DIVE TABLES

1. All Tetra Tech TMR dive logs will use the tables in the attachment to complete the dive logs in Attachment 6 and 7 and when developing any Tt TMR project Health and Safety Dive Plans.

2. **U.S. Navy No-Decompression Table (Table 9-7)** – This table gives the maximum time that can be spent at a given depth without the need for decompression stops during the subsequent ascent to the surface. This table is sometimes called the “no-stop” table. At depths of 20 feet of seawater (FSW) and shallower, there is no limit on the amount of time that can be spent at depth. Deeper than 20 FSW, the time that can be spent is limited. For example, at 60 FSW, any dive longer than 63 minutes will require decompression stops.

   The No-Decompression Table also provides the repetitive group designators for dives that fall within the no-decompression limits. Even though no decompression stops are required during ascent, the diver still surfaces with some residual nitrogen in his tissues. This residual nitrogen needs to be accounted for if a repetitive dive is planned. If a diver exceeds the limits given in the No-Decompression Table, then the decompression stop requirement must be calculated using U.S Navy Standard Air Table (Table 9-9).

   For each depth listed in the No-Decompression Table, the corresponding no decompression limit is indicated in the second column. This limit is the maximum bottom time that a diver may spend at that depth and still return to the surface without taking decompression stops. To find the no-decompression limit, enter the table at the depth equal to or next greater than the maximum depth of the dive.

   Follow that row to the second column to obtain the no-decompression limit. The columns to the right of the no-decompression limit column contain the repetitive group designators for dives with bottom times equal to or shorter than the no-decompression limit. A repetitive group designator must be assigned to a diver after every dive, even a no-decompression dive.

3. **Optional Shallow Water No-Decompression Table (Table 2A-1)** – This table contains an expanded version of Table 9-7 and Table 9-8 covering the depth range of 30–50 FSW in one-foot increments. In this depth range, a small change in the diver’s maximum depth can make a substantial difference in the allowable no-decompression time. For example, at 35 FSW the no-decompression limit is 232 minutes; at 40 FSW it is only 163 minutes, more than an hour less. When the diver’s maximum depth is accurately known at the beginning of the dive, for example in ballast tank dives, or when continuous depth recording is available, for example with a decompression computer, the expanded table can be used to maximize no-decompression time.

   These optional tables are most suited to ship husbandry diving, but can be used in other shallow air diving applications as well.

4. **Residual Nitrogen Time Table for Repetitive Air Dives (Figure 9-8)** - The procedures for conducting a repetitive dive are summarized in this table. Upon completing the first dive, the diver is assigned a repetitive group designator from either the Air Decompression Table or the No-Decompression Table. This designator tells the diver how much residual nitrogen he has

upon surfacing from the first dive. A diver in Group A has the lowest amount of residual nitrogen; a diver in Group Z has the highest.

As nitrogen passes out of the diver's body during the surface interval, the repetitive group designation changes to a lower letter group to reflect the lower quantity of residual nitrogen.

The top half of the table allows the repetitive group designator to be determined at any time during the surface interval. The lower half of the table gives the Residual Nitrogen Time (RNT) corresponding to the repetitive group designator at the end of the surface interval and the depth of the repetitive dive. The residual nitrogen time is the time a diver would have had to spend at the depth of the repetitive dive to absorb the amount of nitrogen he has left over from the previous dive. The residual nitrogen time is added to the bottom time of the repetitive dive to obtain the Equivalent Single Dive Time (ESDT).

The decompression schedule for the repetitive dive is obtained by entering either the Air Decompression Table or the No-Decompression Table at the depth of the repetitive dive and the equivalent single dive time.

NOTE: When using the Optional Shallow Water No Decompression Tables above ensure the corresponding *Residual Nitrogen Timetable for Repetitive Shallow Water Air Dives (Table 2A-2)* is used for your repetitive dive calculations.

5. **U.S Navy Standard Air Table (Table 9-9)** – This table combines three modes of decompression into one table. These modes are: (1) in-water decompression on air, (2) in-water decompression on air and oxygen, and (3) surface decompression on oxygen.

   Refer to reference (b), Chapter 9, when using the Standard Air Tables in any of the above modes when developing HASDPs where decompression diving profiles are anticipated.

   These tables are to be available to the Dive Supervisor/ Lead Diver on Tt TMR dive sites for emergency procedure in water decompression on planned no decompression dive plans.

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.

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

Group	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *

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.

Table 2A-1. *No-Decompression Limits and Repetitive Group Designators for Shallow Water Air No-Decompression Dives.*

Depth (fsw)	No-Stop Limit (min)	Repetitive Group Designation															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
31	334	16	26	37	48	60	73	87	102	119	138	158	182	209	242	282	334
32	304	15	25	35	46	58	70	83	98	114	131	150	172	197	226	261	304
33	281	15	24	34	45	56	67	80	94	109	125	143	163	186	212	243	281
34	256	14	23	33	43	54	65	77	90	104	120	137	155	176	200	228	256
35	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
36	212	14	22	31	40	50	61	72	84	97	110	125	142	160	180	204	212
37	197	13	21	30	39	49	59	69	81	93	106	120	136	153	172	193	197
38	184	13	21	29	38	47	57	67	78	90	102	116	131	147	164	184	
39	173	12	20	28	37	46	55	65	76	87	99	112	126	141	157	173	
40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
41	155	12	19	27	35	43	52	61	71	81	92	104	117	130	145	155	
42	147	11	19	26	34	42	50	59	69	79	89	101	113	126	140	147	
43	140	11	18	25	33	41	49	58	67	76	87	98	109	122	135	140	
44	134	11	18	25	32	40	48	56	65	74	84	95	106	118	130	134	
45	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
46	116	10	17	23	30	38	45	53	61	70	79	89	99	110	116		
47	109	10	16	23	30	37	44	52	60	68	77	87	97	107	109		
48	102	10	16	22	29	36	43	51	58	67	75	84	94	102			
49	97	10	16	22	28	35	42	49	57	65	73	82	91	97			
50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			

Table 2A-2. *Residual Nitrogen Time Table for Repetitive Shallow Water 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

A																:10 2:20 *
B															:10 1:16	1:17 3:36 *
C														:10 :55	:56 2:11	2:12 4:31 *
D													:10 :52	:53 1:47	1:48 3:03	3:04 5:23 *
E												:10 :52	:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15 *
F											:10 :52	:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08 *
G										:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00 *
H									:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52 *
I								:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44 *
J							:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36 *
K						:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29 *
L					:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21 *
M				:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13 *
N			:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05 *
O		:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58 *
Z	:10 :52	:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50 *
	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

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
30	372	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18
31	334	282	243	210	183	159	139	120	103	88	74	61	49	38	27	17
32	305	262	227	198	173	151	132	115	99	85	71	59	47	36	26	17
33	282	244	213	187	164	144	126	110	95	81	69	57	46	35	25	16
34	262	229	201	177	156	138	121	105	91	78	66	55	44	34	25	16
35	245	216	191	169	149	132	116	101	88	75	64	53	43	33	24	15
36	231	204	181	161	143	126	111	98	85	73	62	51	41	32	23	15
37	218	194	173	154	137	122	107	94	82	70	60	50	40	31	23	14
38	207	185	165	148	132	117	103	91	79	68	58	48	39	30	22	14
39	197	177	158	142	127	113	100	88	77	66	56	47	38	29	21	14
40	188	169	152	136	122	109	97	85	74	64	55	45	37	29	21	13
41	180	163	146	132	118	105	93	82	72	62	53	44	36	28	20	13
42	173	156	141	127	114	102	91	80	70	61	52	43	35	27	20	13
43	166	150	136	123	110	99	88	78	68	59	50	42	34	26	19	12
44	160	145	131	119	107	96	85	75	66	57	49	41	33	26	19	12
45	154	140	127	115	104	93	83	73	64	56	48	40	32	25	18	12
46	149	136	123	111	101	90	81	71	63	54	46	39	32	25	18	12
47	144	131	119	108	98	88	78	70	61	53	45	38	31	24	18	11
48	139	127	116	105	95	85	76	68	60	52	44	37	30	24	17	11
49	135	123	112	102	92	83	74	66	58	51	43	36	30	23	17	11
50	131	120	109	99	90	81	73	65	57	49	42	35	29	23	17	11

Residual Nitrogen Times (Minutes)

Table 9-9. *Air Decompression Table.*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
30 FSW														
371	1:00	AIR									0	1:00	0	Z
		AIR/O_2									**0**	1:00		
380	0:20	AIR									5	6:00	0.5	Z
		AIR/O_2									**1**	2:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
420	0:20	AIR									22	23:00	0.5	Z
		AIR/O_2									**5**	6:00		
480	0:20	AIR									42	43:00	0.5	
		AIR/O_2									**9**	10:00		
540	0:20	AIR									71	72:00	1	
		AIR/O_2									**14**	15:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
600	0:20	AIR									92	93:00	1	
		AIR/O_2									**19**	20:00		
660	0:20	AIR									120	121:00	1	
		AIR/O_2									**22**	23:00		
720	0:20	AIR									158	159:00	1	
		AIR/O_2									**27**	28:00		
35 FSW														
232	1:10	AIR									0	1:10	0	Z
		AIR/O_2									**0**	1:10		
240	0:30	AIR									4	5:10	0.5	Z
		AIR/O_2									**2**	3:10		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
270	0:30	AIR									28	29:10	0.5	Z
		AIR/O_2									**7**	8:10		
300	0:30	AIR									53	54:10	0.5	Z
		AIR/O_2									**13**	14:10		
330	0:30	AIR									71	72:10	1	Z
		AIR/O_2									**18**	19:10		
360	0:30	AIR									88	89:10	1	
		AIR/O_2									**22**	23:10		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
420	0:30	AIR									134	135:10	1.5	
		AIR/O_2									**29**	30:10		
480	0:30	AIR									173	174:10	1.5	
		AIR/O_2									**38**	44:10		
540	0:30	AIR									228	229:10	2	
		AIR/O_2									**45**	51:10		
600	0:30	AIR									277	278:10	2	
		AIR/O_2									**53**	59:10		
660	0:30	AIR									314	315:10	2.5	
		AIR/O_2									**63**	69:10		
720	0:30	AIR									342	343:10	3	
		AIR/O_2									**71**	82:10		

__Table 9-9.__ Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
40 FSW														
163	1:20	AIR									0	1:20	0	O
		AIR/O_2									**0**	1:20		
170	0:40	AIR									6	7:20	0.5	O
		AIR/O_2									**2**	3:20		
180	0:40	AIR									14	15:20	0.5	Z
		AIR/O_2									**5**	6:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
190	0:40	AIR									21	22:20	0.5	Z
		AIR/O_2									**7**	8:20		
200	0:40	AIR									27	28:20	0.5	Z
		AIR/O_2									**9**	10:20		
210	0:40	AIR									39	40:20	0.5	Z
		AIR/O_2									**11**	12:20		
220	0:40	AIR									52	53:20	0.5	Z
		AIR/O_2									**12**	13:20		
230	0:40	AIR									64	65:20	1	Z
		AIR/O_2									**16**	17:20		
240	0:40	AIR									75	76:20	1	Z
		AIR/O_2									**19**	20:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
270	0:40	AIR									101	102:20	1	Z
		AIR/O_2									**26**	27:20		
300	0:40	AIR									128	129:20	1.5	
		AIR/O_2									**33**	34:20		
330	0:40	AIR									160	161:20	1.5	
		AIR/O_2									**38**	44:20		
360	0:40	AIR									184	185:20	2	
		AIR/O_2									**44**	50:20		
420	0:40	AIR									248	249:20	2.5	
		AIR/O_2									**56**	62:20		
480	0:40	AIR									321	322:20	2.5	
		AIR/O_2									**68**	79:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
540	0:40	AIR									372	373:20	3	
		AIR/O_2									**80**	91:20		
600	0:40	AIR									410	411:20	3.5	
		AIR/O_2									**93**	104:20		
660	0:40	AIR									439	440:20	4	
		AIR/O_2									**103**	119:20		
Exceptional Exposure: SurDO_2 --														
720	0:40	AIR									461	462:20	4.5	
		AIR/O_2									**112**	128:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
45 FSW														
125	1:30	AIR									0	1:30	0	N
		AIR/O_2									**0**	1:30		
130	0:50	AIR									2	3:30	0.5	O
		AIR/O_2									**1**	2:30		
140	0:50	AIR									14	15:30	0.5	O
		AIR/O_2									**5**	6:30		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
150	0:50	AIR									25	26:30	0.5	Z
		AIR/O_2									**8**	9:30		
160	0:50	AIR									34	35:30	0.5	Z
		AIR/O_2									**11**	12:30		
170	0:50	AIR									41	42:30	1	Z
		AIR/O_2									**14**	15:30		
180	0:50	AIR									59	60:30	1	Z
		AIR/O_2									**17**	18:30		
190	0:50	AIR									75	76:30	1	Z
		AIR/O_2									**19**	20:30		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
200	0:50	AIR									89	90:30	1	Z
		AIR/O_2									**23**	24:30		
210	0:50	AIR									101	102:30	1	Z
		AIR/O_2									**27**	28:30		
220	0:50	AIR									112	113:30	1.5	Z
		AIR/O_2									**30**	31:30		
230	0:50	AIR									121	122:30	1.5	Z
		AIR/O_2									**33**	34:30		
240	0:50	AIR									130	131:30	1.5	Z
		AIR/O_2									**37**	43:30		
270	0:50	AIR									173	174:30	2	
		AIR/O_2									**45**	51:30		
300	0:50	AIR									206	207:30	2	
		AIR/O_2									**51**	57:30		
330	0:50	AIR									243	244:30	2.5	
		AIR/O_2									**61**	67:30		
360	0:50	AIR									288	289:30	3	
		AIR/O_2									**69**	80:30		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
420	0:50	AIR									373	374:30	3.5	
		AIR/O_2									**84**	95:30		
480	0:50	AIR									431	432:30	4	
		AIR/O_2									**101**	117:30		
Exceptional Exposure: SurDO_2 --														
540	0:50	AIR									473	474:30	4.5	
		AIR/O_2									**117**	133:30		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
50 FSW														
92	1:40	AIR									0	1:40	0	M
		AIR/O_2									**0**	1:40		
95	1:00	AIR									2	3:40	0.5	M
		AIR/O_2									**1**	2:40		
100	1:00	AIR									4	5:40	0.5	N
		AIR/O_2									**2**	3:40		
110	1:00	AIR									8	9:40	0.5	O
		AIR/O_2									**4**	5:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
120	1:00	AIR									21	22:40	0.5	O
		AIR/O_2									**7**	8:40		
130	1:00	AIR									34	35:40	0.5	Z
		AIR/O_2									**12**	13:40		
140	1:00	AIR									45	46:40	1	Z
		AIR/O_2									**16**	17:40		
150	1:00	AIR									56	57:40	1	Z
		AIR/O_2									**19**	20:40		
160	1:00	AIR									78	79:40	1	Z
		AIR/O_2									**23**	24:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
170	1:00	AIR									96	97:40	1	Z
		AIR/O_2									**26**	27:40		
180	1:00	AIR									111	112:40	1.5	Z
		AIR/O_2									**30**	31:40		
190	1:00	AIR									125	126:40	1.5	Z
		AIR/O_2									**35**	36:40		
200	1:00	AIR									136	137:40	1.5	Z
		AIR/O_2									**39**	45:40		
210	1:00	AIR									147	148:40	2	
		AIR/O_2									**43**	49:40		
220	1:00	AIR									166	167:40	2	
		AIR/O_2									**47**	53:40		
230	1:00	AIR									183	184:40	2	
		AIR/O_2									**50**	56:40		
240	1:00	AIR									198	199:40	2	
		AIR/O_2									**53**	59:40		
270	1:00	AIR									236	237:40	2.5	
		AIR/O_2									**62**	68:40		
300	1:00	AIR									285	286:40	3	
		AIR/O_2									**74**	85:40		
Exceptional Exposure: In-Water Air/O_2 Decompression ------------- SurDO_2 Required---														
330	1:00	AIR									345	346:40	3.5	
		AIR/O_2									**83**	94:40		
360	1:00	AIR									393	394:40	3.5	
		AIR/O_2									**92**	103:40		
Exceptional Exposure: SurDO_2 --														
420	1:00	AIR									464	465:40	4.5	
		AIR/O_2									**113**	129:40		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
55 FSW														
74	1:50	AIR									0	1:50	0	L
		AIR/O_2									**0**	1:50		
75	1:10	AIR									1	2:50	0.5	L
		AIR/O_2									**1**	2:50		
80	1:10	AIR									4	5:50	0.5	M
		AIR/O_2									**2**	3:50		
90	1:10	AIR									10	11:50	0.5	N
		AIR/O_2									**5**	6:50		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
100	1:10	AIR									17	18:50	0.5	O
		AIR/O_2									**8**	9:50		
110	1:10	AIR									34	35:50	0.5	O
		AIR/O_2									**12**	13:50		
120	1:10	AIR									48	49:50	1	Z
		AIR/O_2									**17**	18:50		
130	1:10	AIR									59	60:50	1	Z
		AIR/O_2									**22**	23:50		
140	1:10	AIR									84	85:50	1	Z
		AIR/O_2									**26**	27:50		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
150	1:10	AIR									105	106:50	1.5	Z
		AIR/O_2									**30**	31:50		
160	1:10	AIR									123	124:50	1.5	Z
		AIR/O_2									**34**	35:50		
170	1:10	AIR									138	139:50	1.5	Z
		AIR/O_2									**40**	46:50		
180	1:10	AIR									151	152:50	2	Z
		AIR/O_2									**45**	51:50		
190	1:10	AIR									169	170:50	2	
		AIR/O_2									**50**	56:50		
200	1:10	AIR									190	191:50	2	
		AIR/O_2									**54**	60:50		
210	1:10	AIR									208	209:50	2.5	
		AIR/O_2									**58**	64:50		
220	1:10	AIR									224	225:50	2.5	
		AIR/O_2									**62**	68:50		
230	1:10	AIR									239	240:50	2.5	
		AIR/O_2									**66**	77:50		
240	1:10	AIR									254	255:50	3	
		AIR/O_2									**69**	80:50		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
270	1:10	AIR									313	314:50	3.5	
		AIR/O_2									**83**	94:50		
300	1:10	AIR									380	381:50	3.5	
		AIR/O_2									**94**	105:50		
330	1:10	AIR									432	433:50	4	
		AIR/O_2									**106**	122:50		
Exceptional Exposure: SurDO_2 ---														
360	1:10	AIR									474	475:50	4.5	
		AIR/O_2									**118**	134:50		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
60 FSW														
63	2:00	AIR									0	2:00	0	K
		AIR/O_2									**0**	2:00		
65	1:20	AIR									2	4:00	0.5	L
		AIR/O_2									**1**	3:00		
70	1:20	AIR									7	9:00	0.5	L
		AIR/O_2									**4**	6:00		
80	1:20	AIR									14	16:00	0.5	N
		AIR/O_2									**7**	9:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
90	1:20	AIR									23	25:00	0.5	O
		AIR/O_2									**10**	12:00		
100	1:20	AIR									42	44:00	1	Z
		AIR/O_2									**15**	17:00		
110	1:20	AIR									57	59:00	1	Z
		AIR/O_2									**21**	23:00		
120	1:20	AIR									75	77:00	1	Z
		AIR/O_2									**26**	28:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
130	1:20	AIR									102	104:00	1.5	Z
		AIR/O_2									**31**	33:00		
140	1:20	AIR									124	126:00	1.5	Z
		AIR/O_2									**35**	37:00		
150	1:20	AIR									143	145:00	2	Z
		AIR/O_2									**41**	48:00		
160	1:20	AIR									158	160:00	2	Z
		AIR/O_2									**48**	55:00		
170	1:20	AIR									178	180:00	2	
		AIR/O_2									**53**	60:00		
180	1:20	AIR									201	203:00	2.5	
		AIR/O_2									**59**	66:00		
190	1:20	AIR									222	224:00	2.5	
		AIR/O_2									**64**	71:00		
200	1:20	AIR									240	242:00	2.5	
		AIR/O_2									**68**	80:00		
210	1:20	AIR									256	258:00	3	
		AIR/O_2									**73**	85:00		
220	1:20	AIR									278	280:00	3	
		AIR/O_2									**77**	89:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
230	1:20	AIR									300	302:00	3.5	
		AIR/O_2									**82**	94:00		
240	1:20	AIR									321	323:00	3.5	
		AIR/O_2									**88**	100:00		
270	1:20	AIR									398	400:00	4	
		AIR/O_2									**102**	119:00		
Exceptional Exposure: SurDO_2 --														
300	1:20	AIR									456	458:00	4.5	
		AIR/O_2									**115**	132:00		

Table 9-9. Air Decompression Table (Continued).
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
70 FSW														
48	2:20	AIR									0	2:20	0	K
		AIR/O_2									**0**	2:20		
50	1:40	AIR									2	4:20	0.5	K
		AIR/O_2									**1**	3:20		
55	1:40	AIR									9	11:20	0.5	L
		AIR/O_2									**5**	7:20		
60	1:40	AIR									14	16:20	0.5	M
		AIR/O_2									**8**	10:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
70	1:40	AIR									24	26:20	0.5	N
		AIR/O_2									**13**	15:20		
80	1:40	AIR									44	46:20	1	O
		AIR/O_2									**17**	19:20		
90	1:40	AIR									64	66:20	1	Z
		AIR/O_2									**24**	26:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
100	1:40	AIR									88	90:20	1.5	Z
		AIR/O_2									**31**	33:20		
110	1:40	AIR									120	122:20	1.5	Z
		AIR/O_2									**38**	45:20		
120	1:40	AIR									145	147:20	2	Z
		AIR/O_2									**44**	51:20		
130	1:40	AIR									167	169:20	2	Z
		AIR/O_2									**51**	58:20		
140	1:40	AIR									189	191:20	2.5	
		AIR/O_2									**59**	66:20		
150	1:40	AIR									219	221:20	2.5	
		AIR/O_2									**66**	78:20		
160	1:20	AIR								1	244	247:00	3	
		AIR/O_2								**1**	**72**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
170	1:20	AIR								2	265	269:00	3	
		AIR/O_2								**1**	**78**	91:00		
180	1:20	AIR								4	289	295:00	3.5	
		AIR/O_2								**2**	**83**	97:00		
190	1:20	AIR								5	316	323:00	3.5	
		AIR/O_2								**3**	**88**	103:00		
200	1:20	AIR								9	345	356:00	4	
		AIR/O_2								**5**	**93**	115:00		
210	1:20	AIR								13	378	393:00	4	
		AIR/O_2								**7**	**98**	122:00		
Exceptional Exposure: SurDO_2 --														
240	1:20	AIR								25	454	481:00	5	
		AIR/O_2								**13**	**110**	140:00		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
80 FSW														
39	2:40	AIR									0	2:40	0	J
		AIR/O_2									**0**	2:40		
40	2:00	AIR									1	3:40	0.5	J
		AIR/O_2									**1**	3:40		
45	2:00	AIR									10	12:40	0.5	K
		AIR/O_2									**5**	7:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
50	2:00	AIR									17	19:40	0.5	M
		AIR/O_2									**9**	11:40		
55	2:00	AIR									24	26:40	0.5	M
		AIR/O_2									**13**	15:40		
60	2:00	AIR									30	32:40	1	N
		AIR/O_2									**16**	18:40		
70	2:00	AIR									54	56:40	1	O
		AIR/O_2									**22**	24:40		
80	2:00	AIR									77	79:40	1.5	Z
		AIR/O_2									**30**	32:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
90	2:00	AIR									114	116:40	1.5	Z
		AIR/O_2									**39**	46:40		
100	1:40	AIR								1	147	150:20	2	Z
		AIR/O_2								**1**	**46**	54:20		
110	1:40	AIR								6	171	179:20	2	Z
		AIR/O_2								**3**	**51**	61:20		
120	1:40	AIR								10	200	212:20	2.5	
		AIR/O_2								**5**	**59**	71:20		
130	1:40	AIR								14	232	248:20	3	
		AIR/O_2								**7**	**67**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
140	1:40	AIR								17	258	277:20	3.5	
		AIR/O_2								**9**	**73**	94:20		
150	1:40	AIR								19	285	306:20	3.5	
		AIR/O_2								**10**	**80**	102:20		
160	1:40	AIR								21	318	341:20	4	
		AIR/O_2								**11**	**86**	114:20		
170	1:40	AIR								27	354	383:20	4	
		AIR/O_2								**14**	**90**	121:20		
Exceptional Exposure: SurDO_2 ---														
180	1:40	AIR								33	391	426:20	4.5	
		AIR/O_2								**17**	**96**	130:20		
210	1:40	AIR								51	473	526:20	5	
		AIR/O_2								**26**	**110**	158:20		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
90 FSW														
33	3:00	AIR									0	3:00	0	J
		AIR/O_2									**0**	3:00		
35	2:20	AIR									4	7:00	0.5	J
		AIR/O_2									**2**	5:00		
40	2:20	AIR									14	17:00	0.5	L
		AIR/O_2									**7**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
45	2:20	AIR									23	26:00	0.5	M
		AIR/O_2									**12**	15:00		
50	2:20	AIR									31	34:00	1	N
		AIR/O_2									**17**	20:00		
55	2:20	AIR									39	42:00	1	O
		AIR/O_2									**21**	24:00		
60	2:20	AIR									56	59:00	1	O
		AIR/O_2									**24**	27:00		
70	2:20	AIR									83	86:00	1.5	Z
		AIR/O_2									**32**	35:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
80	2:00	AIR								5	125	132:40	2	Z
		AIR/O_2								**3**	**40**	50:40		
90	2:00	AIR								13	158	173:40	2	Z
		AIR/O_2								**7**	**46**	60:40		
100	2:00	AIR								19	185	206:40	2.5	
		AIR/O_2								**10**	**53**	70:40		
110	2:00	AIR								25	224	251:40	3	
		AIR/O_2								**13**	**61**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
120	1:40	AIR							2	28	256	288:20	3.5	
		AIR/O_2							2	**14**	**70**	98:40		
130	1:40	AIR							5	28	291	326:20	3.5	
		AIR/O_2							5	**14**	**79**	110:40		
140	1:40	AIR							8	28	330	368:20	4	
		AIR/O_2							8	**14**	**87**	126:40		
Exceptional Exposure: SurDO_2 --														
150	1:40	AIR							11	34	378	425:20	4.5	
		AIR/O_2							11	**17**	**94**	139:40		
160	1:40	AIR							13	40	418	473:20	4.5	
		AIR/O_2							13	**20**	**101**	151:40		
170	1:40	AIR							15	45	451	513:20	5	
		AIR/O_2							15	**23**	**106**	166:40		
180	1:40	AIR							16	51	479	548:20	5.5	
		AIR/O_2							16	**26**	**112**	176:40		
240	1:40	AIR							42	68	592	704:20	7.5	
		AIR/O_2							42	**34**	**159**	267:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
100 FSW														
25	3:20	AIR									0	3:20	0	H
		AIR/O_2									**0**	3:20		
30	2:40	AIR									3	6:20	0.5	J
		AIR/O_2									**2**	5:20		
35	2:40	AIR									15	18:20	0.5	L
		AIR/O_2									**8**	11:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
40	2:40	AIR									26	29:20	1	M
		AIR/O_2									**14**	17:20		
45	2:40	AIR									36	39:20	1	N
		AIR/O_2									**19**	22:20		
50	2:40	AIR									47	50:20	1	O
		AIR/O_2									**24**	27:20		
55	2:40	AIR									65	68:20	1.5	Z
		AIR/O_2									**28**	31:20		
60	2:40	AIR									81	84:20	1.5	Z
		AIR/O_2									**33**	36:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
70	2:20	AIR								11	124	138:00	2	Z
		AIR/O_2								**6**	**39**	53:00		
80	2:20	AIR								21	160	184:00	2.5	Z
		AIR/O_2								**11**	**45**	64:00		
90	2:00	AIR							2	28	196	228:40	2.5	
		AIR/O_2							2	**14**	**53**	82:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
100	2:00	AIR							9	28	241	280:40	3	
		AIR/O_2							9	**14**	**66**	102:00		
110	2:00	AIR							14	28	278	322:40	3.5	
		AIR/O_2							14	**14**	**76**	117:00		
120	2:00	AIR							19	28	324	373:40	4	
		AIR/O_2							19	**14**	**85**	136:00		
Exceptional Exposure: SurDO_2 --														
150	1:40	AIR						3	26	46	461	538:20	5	
		AIR/O_2						3	26	**23**	**109**	183:40		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
110 FSW														
20	3:40	AIR									0	3:40	0	H
		AIR/O_2									**0**	3:40		
25	3:00	AIR									5	8:40	0.5	I
		AIR/O_2									**3**	6:40		
30	3:00	AIR									14	17:40	0.5	K
		AIR/O_2									**7**	10:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
35	3:00	AIR									27	30:40	1	M
		AIR/O_2									**14**	17:40		
40	3:00	AIR									39	42:40	1	N
		AIR/O_2									**20**	23:40		
45	3:00	AIR									50	53:40	1	O
		AIR/O_2									**26**	29:40		
50	3:00	AIR									71	74:40	1.5	Z
		AIR/O_2									**32**	35:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
55	2:40	AIR								5	85	93:20	1.5	Z
		AIR/O_2								**3**	**33**	44:20		
60	2:40	AIR								13	111	127:20	2	Z
		AIR/O_2								**7**	**36**	51:20		
70	2:40	AIR								26	155	184:20	2.5	Z
		AIR/O_2								**14**	**42**	64:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
80	2:20	AIR							9	28	200	240:00	2.5	
		AIR/O_2							9	**14**	**54**	90:20		
90	2:20	AIR							18	28	249	298:00	3.5	
		AIR/O_2							18	**14**	**68**	113:20		
100	2:20	AIR							25	28	295	351:00	3.5	
		AIR/O_2							25	**14**	**79**	131:20		
110	2:00	AIR						5	26	28	353	414:40	4	
		AIR/O_2						5	26	**14**	**91**	154:00		
Exceptional Exposure: SurDO_2 --														
120	2:00	AIR						10	26	35	413	486:40	4.5	
		AIR/O_2						10	26	**18**	**101**	173:00		
180	1:40	AIR					3	23	47	68	593	736:20	7.5	
		AIR/O_2					3	23	47	**34**	**159**	298:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
120 FSW														
15	4:00	AIR									0	4:00	0	F
		AIR/O_2									**0**	4:00		
20	3:20	AIR									4	8:00	0.5	H
		AIR/O_2									**2**	6:00		
25	3:20	AIR									9	13:00	0.5	J
		AIR/O_2									**5**	9:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
30	3:20	AIR									24	28:00	0.5	L
		AIR/O_2									**13**	17:00		
35	3:20	AIR									38	42:00	1	N
		AIR/O_2									**20**	24:00		
40	3:00	AIR								2	49	54:40	1	O
		AIR/O_2								**1**	**26**	30:40		
45	3:00	AIR								3	71	77:40	1.5	Z
		AIR/O_2								**2**	**31**	36:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
50	3:00	AIR								10	85	98:40	1.5	Z
		AIR/O_2								**5**	**33**	46:40		
55	3:00	AIR								19	116	138:40	2	Z
		AIR/O_2								**10**	**35**	53:40		
60	3:00	AIR								27	142	172:40	2	Z
		AIR/O_2								**14**	**39**	61:40		
70	2:40	AIR							13	28	190	234:20	2.5	
		AIR/O_2							13	**14**	**51**	86:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
80	2:40	AIR							24	28	246	301:20	3	
		AIR/O_2							24	**14**	**67**	118:40		
90	2:20	AIR						7	26	28	303	367:00	3.5	
		AIR/O_2						7	26	**14**	**80**	140:20		
100	2:20	AIR						15	25	28	372	443:00	4	
		AIR/O_2						15	25	**14**	**95**	167:20		
Exceptional Exposure: SurDO_2 ---														
110	2:20	AIR						21	25	38	433	520:00	5	
		AIR/O_2						21	25	**19**	**105**	188:20		
120	2:00	AIR					3	23	25	47	480	580:40	5.5	
		AIR/O_2					3	23	25	**24**	**113**	211:00		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
130 FSW														
12	4:20	AIR									0	4:20	0	F
		AIR/O_2									**0**	4:20		
15	3:40	AIR									3	7:20	0.5	G
		AIR/O_2									**2**	6:20		
20	3:40	AIR									8	12:20	0.5	I
		AIR/O_2									**5**	9:20		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
25	3:40	AIR									17	21:20	0.5	K
		AIR/O_2									**9**	13:20		
30	3:20	AIR								2	32	38:00	1	M
		AIR/O_2								1	**17**	22:00		
35	3:20	AIR								5	44	53:00	1	O
		AIR/O_2								**3**	**23**	30:00		
40	3:20	AIR								6	66	76:00	1.5	Z
		AIR/O_2								**3**	**30**	37:00		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
45	3:00	AIR							1	11	84	99:40	1.5	Z
		AIR/O_2							1	**6**	**33**	49:00		
50	3:00	AIR							2	20	118	143:40	2	Z
		AIR/O_2							2	**10**	**36**	57:00		
55	3:00	AIR							4	28	146	181:40	2	Z
		AIR/O_2							4	**14**	**40**	67:00		
60	3:00	AIR							12	28	170	213:40	2.5	Z
		AIR/O_2							12	**14**	**46**	81:00		
Exceptional Exposure: In-Water Air/0$_2$ Decompression ------------- SurDO_2 Required--														
70	2:40	AIR						1	26	28	235	293:20	3	
		AIR/O_2						1	26	**14**	**63**	117:40		
80	2:40	AIR						12	26	28	297	366:20	3.5	
		AIR/O_2						12	26	**14**	**79**	144:40		
90	2:40	AIR						22	25	28	375	453:20	4	
		AIR/O_2						22	25	**14**	**95**	174:40		
Exceptional Exposure: SurDO_2 --														
100	2:20	AIR					6	23	26	38	444	540:00	5	
		AIR/O_2					6	23	26	**20**	**106**	204:20		
120	2:20	AIR					17	24	27	57	534	662:00	6	
		AIR/O_2					17	24	27	**29**	**130**	255:20		
180	2:00	AIR				13	21	45	57	94	658	890:40	9	
		AIR/O_2				13	21	45	57	**46**	**198**	418:00		

***Table 9-9.** Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
140 FSW														
10	4:40	AIR									0	4:40	0	E
		AIR/O_2									**0**	4:40		
15	4:00	AIR									5	9:40	0.5	H
		AIR/O_2									**3**	7:40		
20	4:00	AIR									13	17:40	0.5	J
		AIR/O_2									**7**	11:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
25	3:40	AIR								3	24	31:20	1	L
		AIR/O_2								**2**	**12**	18:20		
30	3:40	AIR								7	37	48:20	1	N
		AIR/O_2								**4**	**19**	27:20		
35	3:20	AIR							2	7	58	71:00	1.5	O
		AIR/O_2							2	**4**	**26**	36:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
40	3:20	AIR							4	7	82	97:00	1.5	Z
		AIR/O_2							4	**4**	**33**	50:20		
45	3:20	AIR							5	18	114	141:00	2	Z
		AIR/O_2							5	**9**	**36**	59:20		
50	3:20	AIR							8	27	145	184:00	2	Z
		AIR/O_2							8	**14**	**39**	70:20		
55	3:00	AIR						1	15	29	171	219:40	2.5	Z
		AIR/O_2						1	15	**15**	**45**	85:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
60	3:00	AIR						2	23	28	209	265:40	3	
		AIR/O_2						2	23	**14**	**56**	109:00		
70	3:00	AIR						14	25	29	276	347:40	3.5	
		AIR/O_2						14	25	**15**	**74**	142:00		
80	2:40	AIR					2	24	25	29	362	445:20	4	
		AIR/O_2					2	24	25	**15**	**91**	175:40		
Exceptional Exposure: SurDO_2 --														
90	2:40	AIR					12	23	26	38	443	545:20	5	
		AIR/O_2					12	23	26	**19**	**107**	210:40		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
150 FSW														
8	5:00	AIR									0	5:00	0	E
		AIR/O_2									**0**	5:00		
10	4:20	AIR									2	7:00	0.5	F
		AIR/O_2									**1**	6:00		
15	4:20	AIR									8	13:00	0.5	H
		AIR/O_2									**5**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
20	4:00	AIR								2	15	21:40	0.5	K
		AIR/O_2								1	**8**	13:40		
25	4:00	AIR								7	29	40:40	1	M
		AIR/O_2								**4**	**14**	22:40		
30	3:40	AIR							4	7	45	60:20	1.5	O
		AIR/O_2							4	**4**	**22**	34:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
35	3:40	AIR							6	7	74	91:20	1.5	Z
		AIR/O_2							6	**4**	**30**	44:40		
40	3:20	AIR						2	6	14	106	132:00	2	Z
		AIR/O_2						2	6	**7**	**35**	59:20		
45	3:20	AIR						3	8	24	142	181:00	2	Z
		AIR/O_2						3	8	**12**	**40**	72:20		
50	3:20	AIR						4	14	28	170	220:00	2.5	Z
		AIR/O_2						4	14	**14**	**46**	87:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required--														
55	3:20	AIR						7	21	28	212	272:00	3	
		AIR/O_2						7	21	**14**	**57**	113:20		
60	3:20	AIR						11	26	28	248	317:00	3	
		AIR/O_2						11	26	**14**	**67**	132:20		
70	3:00	AIR					3	24	25	28	330	413:40	4	
		AIR/O_2					3	24	25	**14**	**85**	170:00		
Exceptional Exposure: SurDO_2 ---														
80	3:00	AIR					15	23	26	35	430	532:40	4.5	
		AIR/O_2					15	23	26	**18**	**104**	205:00		
90	2:40	AIR				3	22	23	26	47	496	620:20	5.5	
		AIR/O_2				3	22	23	26	**24**	**118**	239:40		
120	2:20	AIR			3	20	22	23	50	75	608	804:00	8	
		AIR/O_2			3	20	22	23	50	**37**	**168**	356:20		
180	2:00	AIR		2	19	20	42	48	79	121	694	1027:40	10.5	
		AIR/O_2		2	19	20	42	48	79	**58**	**222**	538:00		

Table 9-9. ***Air Decompression Table (Continued).***

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
160 FSW														
7	5:20	AIR									0	5:20	0	E
		AIR/O_2									**0**	5:20		
10	4:40	AIR									4	9:20	0.5	F
		AIR/O_2									**2**	7:20		
15	4:20	AIR								2	10	17:00	0.5	I
		AIR/O_2								**1**	**6**	12:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
20	4:00	AIR							1	4	19	28:40	0.5	L
		AIR/O_2							1	**2**	**10**	18:00		
25	4:00	AIR							4	7	35	50:40	1	N
		AIR/O_2							4	**4**	**17**	30:00		
30	3:40	AIR						2	6	7	62	81:20	1.5	Z
		AIR/O_2						2	6	**4**	**26**	42:40		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
35	3:40	AIR						4	6	8	89	111:20	1.5	Z
		AIR/O_2						4	6	**4**	**34**	57:40		
40	3:40	AIR						6	6	21	134	171:20	2	Z
		AIR/O_2						6	6	**11**	**38**	70:40		
45	3:20	AIR					2	5	11	28	166	216:00	2.5	Z
		AIR/O_2					2	5	11	**14**	**45**	86:20		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
50	3:20	AIR					2	8	19	28	207	268:00	3	
		AIR/O_2					2	8	19	**15**	**55**	113:20		
55	3:20	AIR					3	11	26	28	248	320:00	3	
		AIR/O_2					3	11	26	**14**	**67**	135:20		
60	3:20	AIR					6	17	25	29	291	372:00	3.5	
		AIR/O_2					6	17	25	**15**	**77**	154:20		
Exceptional Exposure: SurDO_2 ---														
70	3:20	AIR					15	23	26	29	399	496:00	4.5	
		AIR/O_2					15	23	26	**15**	**99**	197:20		
80	3:00	AIR				6	21	24	25	44	482	605:40	5.5	
		AIR/O_2				6	21	24	25	**23**	**114**	237:00		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
170 FSW														
6	5:40	AIR									0	5:40	0	D
		AIR/O_2									**0**	5:40		
10	5:00	AIR									6	11:40	0.5	G
		AIR/O_2									**3**	8:40		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
15	4:40	AIR								3	13	21:20	0.5	J
		AIR/O_2								2	**6**	13:20		
20	4:20	AIR							3	6	24	38:00	1	M
		AIR/O_2							3	**3**	**12**	23:20		
25	4:00	AIR						1	7	7	41	60:40	1	O
		AIR/O_2						1	7	**4**	**20**	37:00		
Exceptional Exposure: In-Water Air Decompression ------------ In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
30	4:00	AIR						5	7	7	77	100:40	1.5	Z
		AIR/O_2						5	7	**3**	**30**	50:00		
35	3:40	AIR					2	6	6	15	120	153:20	2	Z
		AIR/O_2					2	6	6	**8**	**37**	68:40		
40	3:40	AIR					4	6	9	25	158	206:20	2.5	Z
		AIR/O_2					4	6	9	**12**	**44**	84:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------ SurDO_2 Required--														
45	3:40	AIR					5	7	16	28	197	257:20	2.5	Z
		AIR/O_2					5	7	16	**14**	**53**	109:40		
50	3:20	AIR				1	5	11	23	28	244	316:00	3	
		AIR/O_2				1	5	11	23	**14**	**66**	134:20		
55	3:20	AIR				2	7	16	26	28	289	372:00	3.5	
		AIR/O_2				2	7	16	26	**14**	**77**	156:20		
60	3:20	AIR				2	11	21	26	28	344	436:00	4	
		AIR/O_2				2	11	21	26	**14**	**88**	181:20		
Exceptional Exposure: SurDO_2 --														
70	3:20	AIR				7	19	24	25	39	454	572:00	5	
		AIR/O_2				7	19	24	25	**20**	**109**	228:20		
80	3:20	AIR				17	22	23	26	53	525	670:00	6	
		AIR/O_2				17	22	23	26	**27**	**128**	267:20		
90	3:00	AIR			8	19	22	23	37	66	574	752:40	7	
		AIR/O_2			8	19	22	23	37	**33**	**148**	319:00		
120	2:40	AIR		9	19	20	22	42	60	94	659	928:20	9	
		AIR/O_2		9	19	20	22	42	60	**46**	**198**	454:40		
180	2:20	AIR	10	18	19	40	43	70	97	156	703	1159:00	11.5	
		AIR/O_2	10	18	19	40	43	70	97	**74**	**229**	648:00		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
180 FSW														
6	6:00	AIR									0	6:00	0	E
		AIR/O_2									**0**	6:00		
10	5:20	AIR									8	14:00	0.5	G
		AIR/O_2									**4**	10:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended --														
15	4:40	AIR							2	3	14	24:20	0.5	K
		AIR/O_2							2	**2**	**7**	16:40		
20	4:20	AIR						1	5	7	29	47:00	1	M
		AIR/O_2						1	5	**3**	**15**	29:20		
25	4:20	AIR						5	6	7	57	80:00	1.5	O
		AIR/O_2						5	6	**4**	**24**	44:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
30	4:00	AIR					3	6	6	7	95	121:40	1.5	Z
		AIR/O_2					3	6	6	**4**	**34**	63:00		
35	3:40	AIR				1	5	6	6	22	144	188:20	2	Z
		AIR/O_2				1	5	6	6	**11**	**41**	79:40		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
40	3:40	AIR				2	6	5	13	28	178	236:20	2.5	
		AIR/O_2				2	6	5	13	**14**	**48**	97:40		
45	3:40	AIR				4	5	10	20	28	235	306:20	3	
		AIR/O_2				4	5	10	20	**14**	**63**	130:40		
50	3:40	AIR				4	8	13	25	29	277	360:20	3.5	
		AIR/O_2				4	8	13	25	**15**	**75**	154:40		
55	3:40	AIR				5	11	19	26	28	336	429:20	4	
		AIR/O_2				5	11	19	26	**14**	**87**	181:40		
Exceptional Exposure: SurDO_2 --														
60	3:20	AIR			1	8	13	23	25	31	406	511:00	4.5	
		AIR/O_2			1	8	13	23	25	**16**	**100**	205:20		
70	3:20	AIR			4	12	21	24	25	48	499	637:00	5.5	
		AIR/O_2			4	12	21	24	25	**24**	**119**	253:20		

Table 9-9. Air Decompression Table (Continued).

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
190 FSW														
5	6:20	AIR									0	6:20	0	D
		AIR/O_2									**0**	6:20		
10	5:20	AIR								2	8	16:00	0.5	H
		AIR/O_2								1	**4**	11:00		
In-Water Air/O_2 Decompression or SurDO_2 Recommended ---														
15	4:40	AIR						1	3	3	16	28:20	0.5	K
		AIR/O_2						1	3	**2**	**8**	19:40		
20	4:20	AIR					1	2	6	7	34	55:00	1	N
		AIR/O_2					1	2	6	**4**	**17**	35:20		
Exceptional Exposure: In-Water Air Decompression ------------- In-Water Air/O_2 Decompression or SurDO_2 Required -----------														
25	4:20	AIR					2	6	7	7	72	99:00	1.5	Z
		AIR/O_2					2	6	7	**3**	**28**	51:20		
30	4:00	AIR				1	6	5	7	13	122	158:40	2	Z
		AIR/O_2				1	6	5	7	**7**	**38**	74:00		
Exceptional Exposure: In-Water Air/0_2 Decompression ------------- SurDO_2 Required---														
35	4:00	AIR				4	5	6	8	26	165	218:40	2.5	Z
		AIR/O_2				4	5	6	8	**13**	**45**	91:00		
40	3:40	AIR			1	5	5	8	17	28	217	285:20	3	
		AIR/O_2			1	5	5	8	17	**15**	**58**	123:40		
45	3:40	AIR			2	5	6	12	24	29	264	346:20	3.5	
		AIR/O_2			2	5	6	12	24	**15**	**71**	149:40		
50	3:40	AIR			3	5	10	17	26	28	324	417:20	4	
		AIR/O_2			3	5	10	17	26	**14**	**85**	179:40		
Exceptional Exposure: SurDO2 --														
55	3:40	AIR			4	8	10	24	25	30	397	502:20	4.5	
		AIR/O_2			4	8	10	24	25	**15**	**99**	204:40		
60	3:40	AIR			5	10	16	24	25	40	454	578:20	5	
		AIR/O_2			5	10	16	24	25	**20**	**109**	233:40		
90	3:20	AIR		11	19	20	21	28	51	83	626	863:00	8.5	
		AIR/O_2		11	19	20	21	28	51	**41**	**178**	408:20		
120	3:00	AIR	15	17	19	20	37	46	79	113	691	1040:40	10.5	
		AIR/O_2	15	17	19	20	37	46	79	**55**	**219**	551:00		

Table 9-9. *Air Decompression Table (Continued).*
(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop									Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			100	90	80	70	60	50	40	30	20			
200 FSW														
Exceptional Exposure														
5	6:40	AIR									0	6:40	0	E
		AIR/O_2									**0**	6:40		
10	5:40	AIR								3	8	17:20	0.5	H
		AIR/O_2								**2**	**4**	12:20		
15	5:00	AIR						2	3	5	19	34:40	0.5	L
		AIR/O_2						2	3	**3**	**9**	23:00		
20	4:40	AIR					2	4	6	7	43	67:20	1	O
		AIR/O_2					2	4	6	**4**	**20**	41:40		
25	4:20	AIR				1	5	6	6	7	85	115:00	1.5	Z
		AIR/O_2				1	5	6	6	**4**	**32**	64:20		
30	4:20	AIR				4	6	5	7	19	145	191:00	2	Z
		AIR/O_2				4	6	5	7	**10**	**42**	84:20		
35	4:00	AIR			2	5	5	6	13	28	188	251:40	2.5	
		AIR/O_2			2	5	5	6	13	**14**	**51**	106:00		
40	4:00	AIR			4	5	5	11	21	28	249	327:40	3.5	
		AIR/O_2			4	5	5	11	21	**14**	**68**	143:00		
45	3:40	AIR		1	4	5	10	14	25	28	306	397:20	3.5	
		AIR/O_2		1	4	5	10	14	25	**14**	**81**	168:40		
50	3:40	AIR		2	4	8	10	21	26	28	382	485:20	4.5	
		AIR/O_2		2	4	8	10	21	26	**14**	**97**	201:40		
210 FSW														
Exceptional Exposure														
4	7:00	AIR									0	7:00	0	D
		AIR/O_2									**0**	7:00		
5	6:20	AIR									2	9:00	0.5	E
		AIR/O_2									**1**	8:00		
10	5:40	AIR							2	3	9	20:20	0.5	I
		AIR/O_2							2	**2**	**4**	14:40		
15	5:00	AIR					1	3	3	6	24	42:40	1	M
		AIR/O_2					1	3	3	**3**	**12**	28:00		
20	4:40	AIR				1	3	5	6	7	57	84:20	1	O
		AIR/O_2				1	3	5	6	**4**	**23**	47:40		
25	4:40	AIR				3	6	5	7	8	110	144:20	2	Z
		AIR/O_2				3	6	5	7	**4**	**38**	73:40		
30	4:20	AIR			2	5	6	6	6	26	163	219:00	2.5	Z
		AIR/O_2			2	5	6	6	6	**13**	**45**	93:20		
35	4:00	AIR		1	4	5	6	7	18	28	223	296:40	3	
		AIR/O_2		1	4	5	6	7	18	**14**	**60**	130:00		
40	4:00	AIR		2	5	5	7	11	26	28	278	366:40	3.5	
		AIR/O_2		2	5	5	7	11	26	**14**	**76**	161:00		
45	4:00	AIR		4	4	6	11	18	26	28	355	456:40	4	
		AIR/O_2		4	4	6	11	18	26	**14**	**91**	194:00		
50	3:40	AIR	1	4	5	10	12	23	26	36	432	553:20	5	
		AIR/O_2	1	4	5	10	12	23	26	**18**	**105**	223:40		

Table 9-9. *Air Decompression Table (Continued).*

(DESCENT RATE 75 FPM—ASCENT RATE 30 FPM)

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop 130	120	110	100	90	80	70	60	50	40	30	20	Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
220 FSW																	
Exceptional Exposure																	
4	7:20	AIR												0	7:20	0	E
		AIR/O_2												**0**	7:20		
5	6:40	AIR												3	10:20	0.5	E
		AIR/O_2												**2**	9:20		
10	6:00	AIR										3	4	10	23:40	0.5	J
		AIR/O_2										3	**2**	**5**	17:00		
15	5:20	AIR								3	2	4	7	28	50:00	1	N
		AIR/O_2								3	2	4	**4**	**14**	33:20		
20	5:00	AIR							2	4	6	6	7	70	100:40	1.5	Z
		AIR/O_2							2	4	6	6	**4**	**26**	54:00		
25	4:40	AIR						1	5	6	6	6	14	133	176:20	2	Z
		AIR/O_2						1	5	6	6	6	**7**	**41**	82:40		
30	4:20	AIR					1	4	5	6	6	10	28	183	248:00	2.5	
		AIR/O_2					1	4	5	6	6	10	**14**	**50**	106:20		
35	4:20	AIR					3	5	5	5	10	22	28	251	334:00	3.5	
		AIR/O_2					3	5	5	5	10	22	**14**	**68**	147:20		
40	4:00	AIR				1	4	5	5	9	15	26	28	319	416:40	4	
		AIR/O_2				1	4	5	5	9	15	26	**14**	**84**	183:00		
250 FSW																	
Exceptional Exposure																	
4	7:40	AIR												4	12:20	0.5	F
		AIR/O_2												**2**	10:20		
5	7:40	AIR												7	15:20	0.5	G
		AIR/O_2												**4**	12:20		
10	6:20	AIR								2	2	4	3	15	33:00	0.5	L
		AIR/O_2								2	2	4	**2**	**7**	24:20		
15	5:40	AIR						2	2	3	4	6	7	53	83:20	1	O
		AIR/O_2						2	2	3	4	6	**4**	**22**	49:40		
20	5:20	AIR					2	2	4	6	6	6	11	125	168:00	2	Z
		AIR/O_2					2	2	4	6	6	6	**6**	**39**	82:20		
25	5:00	AIR				1	4	4	5	6	6	10	28	189	258:40	2.5	
		AIR/O_2				1	4	4	5	6	6	10	**14**	**51**	112:00		
30	4:40	AIR			1	4	4	4	5	6	9	25	28	267	358:20	3.5	
		AIR/O_2			1	4	4	4	5	6	9	25	**15**	**72**	160:40		
35	4:40	AIR			3	4	4	5	5	10	19	26	28	363	472:20	4	
		AIR/O_2			3	4	4	5	5	10	19	26	**14**	**93**	203:40		

Bottom Time (min)	Time to First Stop (M:S)	Gas Mix	DECOMPRESSION STOPS (FSW) Stop times (min) include travel time, except first air and first O_2 stop												Total Ascent Time (M:S)	Chamber O_2 Periods	Repet Group
			130	120	110	100	90	80	70	60	50	40	30	20			
300 FSW																	
Exceptional Exposure																	
4	9:00	AIR											3	7	19:40	0.5	G
		AIR/O_2											**2**	**4**	15:40		
5	8:40	AIR										3	3	8	23:20	0.5	I
		AIR/O_2										3	**2**	**4**	18:40		
10	7:20	AIR						2	3	2	3	4	7	35	64:00	1	N
		AIR/O_2						2	3	2	3	4	**4**	**18**	44:20		
15	6:20	AIR			1	2	2	3	3	5	6	7	11	125	172:00	2	Z
		AIR/O_2			1	2	2	3	3	5	6	7	**6**	**39**	86:20		
20	6:00	AIR		2	2	2	4	5	5	5	6	16	28	219	300:40	3	
		AIR/O_2		2	2	2	4	5	5	5	6	16	**14**	**59**	137:00		
25	5:40	AIR	1	3	4	4	4	5	5	5	18	26	28	324	433:20	4	
		AIR/O_2	1	3	4	4	4	5	5	5	18	26	**14**	**85**	195:40		

ATTACHMENT 11

EQUIPMENT CHECKLISTS

This page intentionally left blank

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

PROJECT NAME: ____________________________________ **DATE:** ________________

General Dive Equipment

Item	Quantity	Inspected for operation and Loaded
DIVE FLAG (CIVILIAN AND CODE ALPHA)		
LOST DIVER BUOY		
TENDING LINES AND HARNESSES		
HANDHELD GPS		
BUDDY LINES		
DIVE SYSTEM(S)		
AIR SUPPLY/ BOTTLES		
CELLULAR PHONE (ON AND CHARGED)		
VHF RADIO		
DRINKING WATER		
PERSONAL DIVE GEAR		
DIVE OPS WORK PLAN		
DIVE SAFE PRACTICES MANUAL		
U.S. NAVY DIVE MANUAL		
EMERGENCY CONTACT LIST (POSTED)		
REQUIRED LINES, BUOYS, ANCHORS		

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

Medical Equipment

Item	Quantity	Inspected for operation and Loaded	
FIRST AID KIT/ TRAUMA KIT			
EMERGENCY OXYGEN SYSTEM		**PSIG**	**PSIG**
STRETCHER OR BACKBOARD			

Tools, UXO Related Equipment, Explosive Materials

Item	Quantity	Inspected for operation and Loaded

Loadout Checked (Name) _______________ Signature _______________

Diving Supervisor Name _______________ Diving Supervisor Signature _______________

ATTACHMENT 11

GENERAL DIVE EQUIPMENT LOADOUT

This page intentionally left blank.

ATTACHMENT 11

BOAT PRE-OPERATION CHECKLIST

Project Description:	**Date:**
Project Location:	**Job#:**

Step No.	**Description**	**Check Completed (Initials)**
1	**Inspect exterior of vessel** ☐ Inspect for visible damage ☐ Boat registration ☐ POL leaks ☐ Hull plugs in place ☐ Maintenance issues	
2	**Inspect propulsion system** ☐ a. Engine (propeller, oil, fuel level and extra fuel on board, hours since last maintenance, functional, and adequately secured to vessel) ☐ b. Steering system (functional, forward/reverse gears) ☐ c. Batteries (charged, water in cells, contacts clean)	
3	**Inspect all communication equipment** ☐ a. Perform VHF radio check with a base station ☐ b. Perform cellular phone check with a base station ☐ c. Perform dive communication check with radio and dive hats ☐ d. Have spare batteries charged and within reach of all comm. equip.	
4	**Inspect electrical systems and all other communication equipment** Ensure the following are on board and in work order ☐ a. Dive flags (Alpha and Recreational) and pole ☐ b. Sound signaling device (vessel horn, hand horn, whistle) ☐ c. Flares (rocket/parachute, hand held, smoke) ☐ d. Water dye canister, flash light, signaling mirror, EPIRB, and strobe lights for PFDs ☐ e. Deck and Navigation lighting (port, starboard, fore/aft, search, and cabin) ☐ f. Bilge pump	
5	**Inspect mooring systems** ☐ a. Anchor secured to line/chain and functional ☐ b. Line/chain in working order and ready for use ☐ c. Fenders secure and ready for use ☐ d. Extra line available for use	
6	**Ensure navigational equipment is functioning** ☐ a. GPS (locked on 4 satellites, correct datum, power source) ☐ b. Compass and binoculars ☐ c. Charts / maps	
7	**Place copies of the following in cabin near helm** ☐ a. Emergency procedures plan ☐ b. Safe diving practices and operations manual ☐ c. Air decompression tables	

ATTACHMENT 11

BOAT PRE-OPERATION CHECKLIST

Step No.	Description	Check Completed (Initials)
8	**Inspect lifesaving equipment** ☐ a. Ensure 1 PFD per person and 1 throw ring (USCG approved, in working order and properly fitted with strobe, whistle and knife attached) ☐ b. First aid kit (stocked, non-expired contents), First aid book, back board ☐ c. Fire extinguisher (charged, current inspection, accessible)	
9	**Inspect tool box** ☐ a. Spare parts for engine and other vessel systems ☐ b. Tools (clean and in working order) for repairing vessel systems and dive equipment	
10	**Alternate propulsion systems** ☐ a. Hand paddles (2) ☐ b. Spare outboard engine (complete, working, with spare fuel source)	
11	**Personal comfort equipment** ☐ a. Water ☐ b. Food ☐ c. Sunscreen/motion sickness medicine ☐ d. Clothing as required by conditions/locations (hard hat, sun glasses, ball cap, extreme weather, steel toed boots, change of clothes)	

<u>NOTES</u>:

1. File completed checklist in daily job log.
2. Record any maintenance issues in vessel log and report to Project Manager.
3. Complete dive boat safety checklist after completing this checklist.

ATTACHMENT 11

SCUBA CHECKLISTS

PROJECT NAME: ___________________________________ **DATE:** ________________

SCUBA EQUIPMENT INSPECTION

Cylinders				FFMs/ Regulators/ Gauges		Buoyancy Compensators	
Primary		Emergency Bail-Out					
Pre-Dive	Post Dive	Pre-Dive	Post Dive	Pre-Dive	Post Dive	Pre-Dive	Post Dive
Serial # Inspect	Clean and Charge (PSIG)	Serial # Inspect	Clean and Charge (PSIG)	Serial # Inspect /Test	Clean and Inspect	Serial # Inspect /Test	Clean/Inspect

Notes:

1. Fill-in and initial each block prior to and after each dive. Place PSI level in block as indicated.
2. Ensure cylinders are gauged at minimum 90% capacity ***(2700 PSI)*** following charge. *(**NOTE**: Gauge after bottles are cool).*

Specific Pre-Dive Procedures:

FFM

- Inspect – Nose pad/ one-way/ comms/ purge/ ABV/ seal/ straps/test breathe

Specific Post Dive Procedures:

Cylinders

- Rinse cylinders with fresh water.
- Leak check cylinders during charging.

Masks / Regulators / Gauges

- Rinse with fresh water and sterilize regulator.
- Inspect mask, regulator and hoses.
- Rinse & inspect gauges.

Buoyancy Compensators

- Rinse with fresh water and clean BC.
- Inspect BC inflation and dump valves.
- Empty any water in BC, Inflate and leave overnight for drying and leak check

______________________________ ______________________________

Diving Supervisor Name Diving Supervisor Signature

ATTACHMENT 11

SCUBA CHECKLISTS

PROJECT NAME: ________________________________ **DATE:** ______________

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 thru 4) and then turn in to the Diving Supervisor for his checks, review and signature.**

Set Number	Diver Signature	Dive Supervisor Signature

Initial	Procedure	Remarks
Air Cylinders		
	Cylinders – inspect for current hydro and visual	
	O ring and valve – inspect condition	
	Pressure – adequate for days operations	
	Bail-Out Bottles - *Repeat above steps	
Buoyancy Compensator (BC)		
	Straps / Buckles / Harness – inspect condition and adjust for fit	
	Air bladder – leak check	
	Cylinder and bail-out – mount securely	
	Inflator fitting and hose – inspect condition	
	Dump valves – check for proper function	
Regulator(s)		
	Hoses / Connectors – inspect condition	
	1st and 2nd stages – inspect condition	
	Cylinder yoke assembly – secure	
	Bail-out regulator(s) – repeat above checks	
	Regulator assemblies – attach to cylinders	
	Inflation whip – attach to BC	
	Valves – open / leak check cylinder O ring	
	Pressure gauge – reading properly	
	Dive Computer – inspect, check batt, function	
	BC inflation – check proper function	
	Primary regulator / bail-out regulator - test	
	Fittings - Check for leaks	
	FFM – Nose pad/ one-way valves / comms/ pp/ ABV/ seal/straps	
Notes:		

This page intentionally left blank.

ATTACHMENT 11

PRE-DIVE: SSA DIVE HELMET CHECKOFF SHEET

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

NOTE: ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **An initial for each completed and satisfactory check.**
2. **An N/A for each item not applicable to the Dive Helmet being pre-dove.**
3. **An "R" for any repairs made. A brief description in the remarks section. If more space required use the "notes" section for continuation.**
4. **When completed, person completing the checks will sign as appropriate (blocks 1 thru 4) and then turn in to the Diving Supervisor for his checks, review and signature.**

Helmet/Mask Type	Serial No.	Checked By:	Signature	Dive Supe Signature
1.				
2.				
3.				
4.				

	Procedure	1	2	Remarks		
1	Test non-return valve (suck and blow)					
2	Check helmet for damage / deterioration					
3	Check neck dam seal (lube if required)					
4	Check oral nasal mask					
5	Check side block assembly – ensure secure					
6	Check 2nd stage regulator					
7	Check inhalation diaphragm					
8	Check exhaust valve					
9	Check neck dam for damage					
10	Check neck dam assembly					
11	Check locking mechanism					
12	Check 1st stage assembly					
13	Check HP and LP hoses					
14	Check face plate secure and not damaged *(DO NOT use screwdriver)*					
15	Check harness assembly					
16	Check bailout PSIG *(2700 minimum)*			PSIG 1:	PSIG 2:	PSIG 3:
17	Check air spread OP's completed					
18	Check to ensure flow restrictor in place					
19	Stow flow restrictor plug in safe place					
20	Connect hoses					
21	Adjust dial-a-breath					
22	Check free-flow					
23	Check purge					
24	Check EGS valve					
25	Check communications OK					

Notes:

ATTACHMENT 11

POST-DIVE: SSA DIVE HELMET CHECKOFF SHEET

PROJECT NAME/NUMBER: ______________________ DATE: ______________________
TENDER/DIVER: ____

NOTE: ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **An initial for each completed and satisfactory check.**
2. **An N/A for each item not applicable to the Dive Helmet being pre-dove.**
3. **An "R" for any repairs made. A brief description in the remarks section. If more space required use the "notes" section for continuation.**
4. **When completed, person completing the checks will sign as appropriate (blocks 1 or 2) and then turn in to the Diving Supervisor for his checks, review and signature.**

Helmet/Mask Type	Serial No.	Checked By:	Signature	Dive Supe Signature
1.				
2.				
3.				
4.				

	Procedure	1	2	Remarks
1	Secure system and emergency air			
2	Bleed and disconnect hoses			
3	Make sure flow restrictor remains on helmet when using dry suit inflator whip			
4	Install flow restrictor plug			
5	Disconnect comms: 2-wire or MM plug			
6	Cap helmet and umbilical fittings			
7	Check helmet for damage			
8	Check neck dam O-ring for damage (lube)			
9	Check neck dam assembly for damage			
10	Check locking mechanisms for damage			
11	Remove head liner			
12	Check oral nasal mask			
13	Check side block assembly - secured			
14	Check 2nd stage regulator			
15	Check inhalation diaphragm			
16	Check LP and HP hoses (1st stage)			
17	Check face plate secure and not damaged *(DO NOT use screwdriver)*			
18	Wash with soap and water. Then dry.			
19	Disinfect with antibacterial wipes			
20	Open all valves – back of ¼ turn			
21	Remove covers from ear speakers / comms pod			

Notes:
Number of dives:

ATTACHMENT 11

PRE-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (FFM)

PROJECT NAME/NUMBER: ______________________ DATE: _____________________
TENDER/DIVER: ____

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 THRU 3) and then turn in to the Diving Supervisor for his checks, review and signature.**

Mask/ Type	Serial No.	Diver Signature	Dive Supervisor Signature
1.			
2.			
3.			

Initial	Procedure	Remarks		
	Ensure HP Air Bottles secured; Check cylinder pressures; Record cylinder pressures	#1:	#2:	#3:
	Ensure ACS on solid surface and secured			
	Inspect ACS condition			
	Check Umbilical condition and secured			
	Ensure all ACS valves are SECURED (closed); regulator valve low pressure (*all the way counterclockwise*)			
	Attach HP whips to bottles			
	Open bottles slowly; record HP Supply Pressure	1 HP PSIG:	2 HP PSIG:	
	Attach Divers supply/ pneumo hoses/ comm wires and mic to ACS			
	Open 1 HP supply (slowly)			
	Set required OB pressure on ACS	OB PSIG:		* *Initial set @ 135 PSIG*
	Check harness assembly			
	Check bailout bottle PSIG (90% @ min 2700)	PSIG DVR:	PSIG STBY:	
	Attach bailout first stage to pony bottle			* *Attach QD (first stage to KM block)*
	Check KM Manifold Block (*Suck and blow*)			
	Blow down diver's umbilical's			
	Connect umbilical hose to KM blocks			
	Connect comms (Hi-use connector)			* *Secure dummy plugs/ tape connector*
	Inspect Full Face Mask (FFM) - Nose pad/ one-way/ comms/ pp/ ABV/ seal / straps			
	Connect FFM to Block			
	Air to Masks			
	Check air to FFM; purge mask			
	Check comms – DV to console; DV to DV			
	Check pneumo for both umbilical's			
	Check all air spread OP's completed			

Notes:

ATTACHMENT 11

POST-DIVE: SURFACE SUPPLIED LIGHTWEIGHT (AGA)

PROJECT NAME/NUMBER: ______________________ DATE: ______________________
TENDER/DIVER: ____

ALL ITEMS WILL BE CHECKED IN APPROPRIATE BLOCKS AS FOLLOWS:

1. **ALL PERSONNEL MUST WEAR SAFETY GLASSES WHEN WORKING WITH HP AIR**
2. **Initial for each completed and satisfactory check.**
3. **When completed, person completing the checks will sign as appropriate (blocks 1 or 2) and then turn in to the Diving Supervisor for his checks, review and signature.**

Mask/ Type	Serial No.	Diver Signature	Dive Supervisor Signature
1.			
2.			
3.			

Initial	Procedure	Remarks
	Secure HP air; bleed down both HP whips and umbilical’s	
	Disconnect FFM air / comms	
	Check FFM for damage/ post dive	
	Disinfect with antibacterial wipes	*Note: Contact time is 5 minutes.*
	Wash with soap and water. Then dry.	
	Bleed down EGS; Disconnect QD	
	Remove B/O first stage from pony	
	Bleed and disconnect hoses from KM block, inspect block and harness	
	Cap all fittings on block and umbilical	** Use dummy plugs/ tape connector.*
	Remove umbilicals from ACS/ stow	
	Cap all fittings on umbilical and ACS	
	Remove mic from ACS/ stow	
	Ensure all air system fittings capped and valves are secured; regulator valve backed out; ACS power OFF	
	Place ACS on charge or stow	

Notes: