EPA Region 10 Surface Supplied Diving SOP
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1.0 OBJECTIVE

This standard operating procedure (SOP) states the United States Environmental Protection Agency (USEPA) policy concerning surface supplied diving operations. Procedures for general dive operations are specified the USEPA Diving Safety Manual. This SOP in not intended to be a substitute for actual hands-on training.

2.0 APPLICABILITY

Surface supplied diving applies to diving operations during which divers are supplied with breathing gas through an umbilical hose from the surface. These procedures apply to EPA employees and contractors working directly for EPA, that are engaged in surface supplied diving operations. This SOP presumes and requires prior training and experience with surface supplied diving.

3.0 DESCRIPTION

3.1 Certification and Physical Examinations

All divers must be dive certified and medically qualified to perform their diving duties, as specified in USEPA Diving Safety Manual.

3.2 General Dive Equipment and Safety Equipment

Each component of a diver's equipment shall be maintained in a safe operating condition, and shall be inspected, tested, serviced and logged as specified in the USEPA Diving Safety Manual. All appropriate safety equipment shall be available at the dive site as specified in the Dive Safety Plan and USEPA Diving Safety Manual.

3.3 Documentation

Project-specific Dive Plans and Dive Safety Plans shall be issued prior to performing dive operations, and all dives shall be logged as specified in the USEPA Diving Safety Manual. The Unit Dive Officer (UDO) shall maintain logs of each diver's certifications, medical clearance to dive, and all health and safety training (e.g., cardiopulmonary resuscitation [CPR], first aid and oxygen administration) as

specified in the USEPA Diving Safety Manual.

3.4 Surface Supplied Diving Equipment

3.4.1 Breathing Gas

The breathing gas may be air or enriched air (e.g., nitrox up to 39% oxygen) depending on the planned dive profile, if the control box and umbilicals are approved by the manufacturer for that usage and/or have been oxygen cleaned. Gas may be supplied by means of pressurized tanks, low pressure/high volume compressors or a compressor/tank system. All breathing gases must be either generated on-site with a compressor, or purchased through a reputable dive shop or commercial gas supplier. Dive shops and commercial suppliers are required to have their breathing gas analyzed for impurities regularly. Compressor-generated breathing gas is also required to be analyzed to CGA grade E standards at least once every six months. Dive operations shall not be initiated unless there is a sufficient supply of breathing gas for all divers, including stand-by divers and emergency reserve.

3.4.1.1 Compressed Gas Cylinders

All self-contained underwater breathing apparatus (SCUBA) tanks or other pressurized vessels used for breathing gases must be properly maintained, and undergo hydrostatic testing at a qualified facility at least every five years, and have an internal visual inspection by a qualified technician annually. The divemaster or designee shall check that each tank intended for dive operations has markings for current inspection and test dates. Prior to use, the yokes on all gas cylinders should be inspected for damage to the seat or O-rings. Gas pressure must not exceed the rated working pressure for any of the components of the entire diving gas supply system.

3.4.1.2 Compressors

All breathing gas compressors must be properly maintained, with regularly logged maintenance records. Compressors must be capable of supplying breathing gas at a satisfactory volume (at least double the volume required) and pressure (at least 25% greater than the maximum pressure requirement anticipated) for the number of divers potentially supplied at the deepest depth potentially encountered at a work site.

3.4.2 Surface Supplied Control Box

Surface supplied control boxes are capable of running two divers simultaneously on separate umbilicals, and can accept breathing gas either from compressed gas cylinders (working pressure can range from 3,000 pounds per square inch [psi] to 3,500 psi; check the manufacturer specifications for details) or from a low pressure/high volume compressor. Air is the only breathing gas approved by the manufacturer for use with some control boxes without special cleaning.

These boxes typically have an internal rechargeable 12-volt gel cell battery that must be charged prior to dive operations, and indicator lights that indicate the battery charge level. The box requires very little power, and a fully charged battery should last for up to 20 hours of continuous service. If the unit does not show full charge (all indicator lights lit) after an overnight charge, the battery may need to be replaced.

While using the control box plugged into an electrical source is possible, some manufacturers

cautions the user to never connect the charger during a dive due to the potential of electrical shock to the diver.

The surface supplied control box must be operated by a qualified technician. When there are one or more divers in the water on surface supplied air, the box operator can have no duties other than monitoring the breathing gas supply to the diver, maintaining communications with the diver, and logging the diver's bottom time and depth.

3.4.3 Diving Umbilicals

Surface supply umbilicals provide breathing gas, communications, the diver's depth and a strength member between the tender and the diver. Diving umbilicals may either be the sinking or floating type. The sinking type is negatively buoyant and more likely to snag on bottom obstructions or disturb contaminated sediments. The floating type is positively buoyant and more likely to be affected by surface current or vessel traffic. The buoyancy of the umbilical can be modified in the field by adding floats or weights as required.

Decontamination compatible floating umbilicals, ranging in length from 150 to 300 feet are typically used. The umbilicals are comprised of three separate spiral-wound hoses. This smooth polyurethane umbilical and twists, rather than tape, is ideal for operations in potentially contaminated water because it can be effectively decontaminated.

The primary hose is the diver's breathing gas supply hose. The 3/8 inch inner diameter breathing gas hose runs between the surface supply control box and the diver's emergency manifold block (see Section 3.4.4).

The second hose is the diver's hard-wired communication line (com line), which allows open, two-way communication between the diver and surface support personnel. The com line runs between the surface supply box and the diver's mask-integrated communication system (microphone and earphones). The com line is usually also equipped with a strength member capable of towing or lifting many times the diver's weight.

The third hose is the pneumofathometer (pneumo), a gas line that is open on the diver's end. The 1/4 inch inner diameter pneumo runs from the surface supply control box down to the diver, with its open end attached in the area of the diver's chest. The pneumo line is a simple capillary tube type of depth gauge, which allows surface personnel to monitor the diver's depth. The control box operator can open the pneumo valve to blow gas through the pneumo hose, and when the valve is closed, the water pressure will back up the hose allowing the pneumo gauge to read depth. In some instances, the diver can also use the pneumo as a tool to inflate a lift bag or to blow sediment out of a small work area. In the event of an emergency, some manufacturers suggest the diver can also use the pneumo as an alternative breathing gas supply .

For polluted water diving, configuration of the umbilical on the vessel should allow for easy decontamination of the hose in the "hot zone." Moving the umbilical into the contamination reduction zone should be avoided.

3.4.4 Gas Supply Manifold Block

The diver's harness-mounted manifold block typically has two ports for attachment of incoming gas supply, one port for the dry suit inflator hose, one port for attachment of the breathing regulator, and two low pressure ports for auxiliary equipment. The primary incoming port is for attachment of the umbilical breathing gas line. This port must have a functioning non-return valve to ensure that a loss of umbilical line pressure, combined with

depth pressure, won't suck the gas out of the diver's lungs or out of the emergency gas supply tank. This ensures that in the event of umbilical air supply loss, the diver will receive air from the emergency gas supply (EGS). Prior to attaching the umbilical hose to the manifold block, the non-return valve should be tested by blowing into the valve (air should flow freely through the valve), and then sucking on the valve (no air should come back through the valve).

The second incoming port on the manifold block is for attachment of the emergency gas supply (A "bail-out" bottle).

In the event of a loss of air from the surface, the manifold block has a knob that the diver turns to open the EGS. At the start of the dive, the knob must be in the closed position (fully turned clockwise). During the dive the diver should periodically confirm the knob is fully closed and the submerged pressure gauge (SPG) for the EGS is full. It should be noted that as little as a quarter turn may begin depleting the EGS. All divers must be aware of the operation and placement of the manifold block, so they can find it in an emergency. No other equipment may block the diver's access to the knob.

3.4.5 Emergency Gas Supply

While dive planning must involve provision of sufficient air for the dive operation including ascent and exigencies, independent emergency breathing gas (EGS) must also be provided for all surface supplied diving operations. The bail-out bottle should be a SCUBA tank ranging in size from a 19 cubic foot (cf) pony bottle to a 80 cf SCUBA tank. The bail-out bottle is typically mounted with the valve down which allows the diver to turn the tank valve on, should the knob be inadvertently closed. The larger the bail-out bottle, the longer the diver has to surface in the event of a loss of surface supplied gas. The deeper the diver is working and the more potential hazards present, the larger the bail-out bottle required. A SPG for the EGS must be accessible to the diver at all times. The first-stage regulator on the pony bottle must have an over-pressure relief valve.

Sometimes it is necessary to fill the bail-out bottle in the field. In those instances, a filling whip (a length of high pressure air hose with tank yoke fittings on both ends) is used to connect the bail-out bottle to a full SCUBA tank. The empty bail-out bottle valve should be completely opened, and then the full SCUBA tank valve should be opened very slowly so that the bail-out bottle does not heat up. Depending on the size of the bail-out bottle, it may be necessary to use several SCUBA tanks to get a satisfactory fill (greater than 2500 psi).

3.4.6 Breathing Regulator

EPA divers typically wear a full face mask (FFM) when using surface supplied gas, but diving helmets may also be used. Both the FFM and the helmet are equipped with communication equipment (microphones and earphones).

The decision to use either a helmet or full face mask depends on the resources and training available to each dive team, the dive objective, pollution/contamination level, or other environmental factors.

3.4.7 Diver Harness

A harness should be worn by the diver for all surface supplied dive operations. The harness is used as an attachment point for both the umbilical line and the diver's emergency breathing gas supply. The com line must be clipped to the diver's harness prior to the start of the dive.

This safety feature allows the diver to pull the umbilical along or for the diver to be towed back to the point of entry without straining any vital gas or communication links.

3.5 Surface Supplied Diving Operations

3.5.1 Surface Supplied Control Box Operations

The control box should be secured in an area where its presence, and that of the operator, will not impede operations of the surface support crew. The box should be held open and secured to a fixed object (e.g., boat rail or a dock piling). The breathing gas source should be within easy reach of the operator. In inclement weather, the box should be set up in an area out of the rain (e.g., in the boat cabin or under a tarp).

When the surface supply control box is set up, the main power switch should be turned on and the battery power checked. The gas outlets should be uncapped and the breathing gas line and the pneumo line should be attached. Since the two lines are different diameters, they can only be attached to their respective outlets. The control box has gas outlets for two sets of umbilical lines, one set is marked in red and the other is marked in white. The control box operator must be sure to attach both lines from one umbilical to either red or white. Each umbilical line (breathing gas and pneumo) has a bronze Joint Industrial Conference (JIC) hose fitting which screws onto its gas outlet. These fittings should be lightly tightened with a wrench to prevent gas leaks, but not tight enough to put torque on the fittings. Both the diver gas supplies (e.g. red and white sides) have a gate lever that can be opened or closed to allow gas flow to the outlets.

SCUBA tanks can be used as a source of breathing gas for surface supplied diving. The control box has a selector valve handle that is used to switch between two incoming gas lines. While the incoming lines are typically each attached to a single SCUBA tank, the team may opt to use a manifold block to attach several tanks to each incoming line. The tanks on both incoming lines must be open. After the gas tanks are attached to the system, the operator should blow out the breathing gas line by briefly opening the outlet gate to allow gas to blow out any dust or particles. The end of breathing gas line can then be attached to the diver's gas supply manifold block.

3.5.2 Communications

The control box communications system can be operated either with a microphone and the built-in speaker so all surface personnel can hear the diver or the box operator can wear headphones to block out external noise (e.g., machinery, wind, extraneous conversation). When using headphones, the operator may turn off the speaker switch so that only the box operator can hear the diver. When in this mode, the operator must relay information to dive tender and other surface personnel.

Prior to donning the helmet or FFM, the diver and control box operator must perform a communications check. The surface end of the com line is wired with connectors for attachment to the control box, and the diver end of the com line is wired to attach to the diver's communication line (microphone and earphones). The control box has adjustment knobs for surface-to-diver and for diver-to-surface volume. Proper two-way communications should be established prior to initiating dive operations.

In the event of loss of voice communications, the dive unit should practice backup line signals to ensure the dive can be safely and efficiently aborted. Example standard line pull signals are included below from the US Navy Dive Manual, revision 6, Table 8-3.

Example Emergency Line-pull Signals

Primary Diver to Tender:

2-2-2	*I am in a difficulty but I am OK, I need assistance, send the backup diver.*
.	
3-3-3	*I am entangled and OK, I am stopping to handle it myself but ready the backup diver*
4-4-4...	*I am not OK, I need immediate assistance.*

Primary Diver to Standby Diver:

Big Circular Motion:	*I am entangled here (indicate where the entanglement is by putting the backup diver hands on it).*
Tap Standby's Hand on Primary Divers Chest	*I am injured here (indicate the injury location).*
Tap Standbys Divers Hand to Primary Divers Second Stage	*I am running low on air.*

Standby Diver to Primary Diver:

Place primary's hand back on his carabineer and give three squeezes.	*I am leaving now but will be back. The standby diver back and return with additional air in order to have time* to *deal with the problem.*

USN Revision 6 Full Set of Line Pull Signals:

Table 8-3. Line-Pull Signals.

From Tender to Diver		Searching Signals (Without Circling Line)	
1 Pull	"Are you all right?" When diver is descending, one pull means "Stop."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Going Down." During ascent, two pulls mean "You have come up too far; go back down until we stop you."	1 Pull	"Stop and search where you are."
3 Pulls	"Stand by to come up."	2 Pulls	"Move directly away from the tender if given slack; move toward the tender if strain is taken on the life line."
4 Pulls	"Come up."	3 Pulls	"Face your umbilical, take a strain, move right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face your umbilical, take a strain, move left."
3-2 Pulls	"Ventilate."		
4-3 Pulls	"Circulate."		
From Diver to Tender		**Searching Signals (With Circling Line)**	
1 Pull	"I am all right." When descending, one pull means "Stop" or "I am on the bottom."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Lower" or "Give me slack."	1 Pull	"Stop and search where you are."
3 Pulls	"Take up my slack."	2 Pulls	"Move away from the weight."
4 Pulls	"Haul me up."	3 Pulls	"Face the weight and go right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face the weight and go left."
3-2 Pulls	"More air."		
4-3 Pulls	"Less air."		
Special Signals From the Diver		**Emergency Signals From the Diver**	
1-2-3 Pulls	"Send me a square mark."	2-2-2 Pulls	"I am fouled and need the assistance of another diver."
5 Pulls	"Send me a line."	3-3-3 Pulls	"I am fouled but can clear myself."
2-1-2 Pulls	"Send me a slate."	4-4-4 Pulls	"Haul me up immediately."
ALL EMERGENCY SIGNALS SHALL BE ANSWERED AS GIVEN EXCEPT 4-4-4			

3.5.3 Pre-Dive Operations

The area in which the diver dresses and then uses for access to the water should be kept clear of all debris and items that could present slip, trip or fall hazards to the diver. The tender should always be available to physically assist the fully dressed diver.

The tender should assist the diver in donning all equipment and ensure all belts, clips and harnesses are securely fastened. The dive tender and/or the box operator should ensure that all air systems and communications are functioning properly. The tender should complete all predive checks as specified in the Surface Supplied Air Checklist (Attachment 1).

3.5.4 Entering the Water

The tender should assist the diver with entering the water and always maintain a grip on the umbilical. If the diver jumps into the water, it is the tender's responsibility to ensure that there are no obstacles in the diver's landing area. The tender should also give the diver enough slack in the umbilical to get into the water just below the surface. Immediately after the diver has entered the water, the tender should pull the diver back to the surface. Once back at the surface, the diver should ensure that he or she is properly weighted, do another communication check, and the tender and the diver should assess the diver for leaks (bubbling, particularly around the mask). Once the diver is ready to submerge, the tender should give the diver enough slack to descend. Since the tender is usually in the best position to witness the diver submerging, the tender should also call out to the box operator

and/or divemaster when the diver has submerged so the submergence time can be recorded.

3.5.5 Depth Monitoring

When a diver is in the water, the box operator must maintain regular, open communication. Once the diver has descended to the work site, the operator should monitor the diver's depth using the pneumo. Using the correct pneumo gauge (red or white) for the diver's umbilical, the operator should open the pneumo valve below the gauge by turning it in a counter clockwise direction until the depth gauge reads a depth that is known to be deeper than the diver, or until the diver reports bubbles coming from the open end of the pneumo hose. The operator should then close the valve, monitor the depth gauge and record the diver's depth (measured in feet of sea water [fsw]) when the gauge needle stabilizes. The operator should monitor the diver's depth frequently, especially when the diver is moving around. The diver may also choose to use a computer or depth gauge to monitor their depth as a backup measure.

3.5.6 Umbilical Pressure

The control box operator should ensure that the diver is getting sufficient breathing gas pressure at depth. The umbilical pressure gauge on the control box should read between 115 psi and 225 psi depending upon the specifications of the mask or dive helmet being utilized, bottom depth, and particular control box instructions. Lower umbilical pressure results in more effort required on the diver's part to breathe. The USEPA typically maintains umbilical pressure at 150 psi for light to moderate work loads. If the diver is performing manual labor (e.g., pounding sediment cores or moving heavy objects) and is breathing hard, it may be necessary to increase the umbilical pressure by turning the umbilical pressure knob until the diver reports that gas flow is comfortable.

3.5.7 Breathing Gas Supply

The control box operator must maintain careful watch over the pressure gauge on the line that is supplying gas to the diver. When the gauge reads approximately 500 psi, the operator should flip the selector handle to the other incoming gas line. The selector handle must be turned all the way to its stop for breathing gas to flow properly. As soon as is practical, the operator, or designee, should replace the spent gas cylinder with a full cylinder. When using SCUBA tanks, the spent tank valve should be closed, and the pressure should be bled out of the hose between the tank and the control box using the bleed valve on the yoke. Upon removing the spent tank and replacing it with a full tank, the bleed valve should be closed and the tank valve should slowly be fully opened. The operator should ensure that the pressure gauge on the control box indicates a full tank. This procedure should be followed each time a spent tank is replaced. It is the responsibility of the control box operator to ensure that a sufficient gas supply is readily available for all diving.

Prior to switching the gas source, the operator should notify the diver to suspend the current activity, locate the EGS manifold block and be ready to switch to emergency gas. Once the diver has responded to the operator and has put a hand on the manifold block, the operator can switch the gas source. In the event that a gas line or a seal (O-ring or fitting) should fail upon changing pressure, the diver will be prepared to immediately switch to emergency breathing gas. If a seal should fail and gas pressure to the system is lost, the operator must switch back to the previous tank and inform the diver to be ready to switch to the EGS. The box operator should replace the failed tank with a new tank as quickly as possible and switch to the replacement tank. Once the situation has been resolved, it is the divemaster's decision to either continue or terminate the mission.

3.5.8 Emergency Gas Supply

It is the responsibility of the divemaster, the diver and the tender to each ensure that the valve of the bail-out bottle is opened after it is connected to the manifold block and that the manifold block knob is closed. The bail-out bottle pressure should be checked and recorded prior to every working dive. The EGS should be mounted upside down, and the divemaster should verify that the diver can reach the tank valve to re-open it, should it become closed.

3.5.9 Ending a Dive

At the termination of each dive, the operator should notify the surface support crew that the diver is ready to ascend. If conditions permit the diver to control the ascent, the tender should slowly pull in the slack from the umbilical as it becomes available. The umbilical should be coiled neatly in a pile either in its shipping box or on the deck/dock/ground behind the tender. The umbilical should be coiled in alternating over-under loops to facilitate the next deployment. If conditions do not permit the diver to control the ascent (e.g., low visibility or mid-water current), the tender should gently pull in all slack umbilical and the operator should have the diver swim on the bottom in the direction of the umbilical. Once the diver is close to or below the boat/platform, the diver should exhaust air in their suit to become negatively buoyant and the tender should use the umbilical to lift the diver up to the surface. The tender must maintain an ascent rate of no more than 30 feet per minute, and the operator must continually communicate with the diver to ensure that the ascent rate is not causing discomfort (e.g., reverse squeeze). The box operator can monitor the diver's rate of ascent simply by watching the pneumo gauge. The operator should warn diver if any surface hazards are present.

Once the diver is on the surface, the tender should call out to the divemaster or box operator who should record surface time on the dive log. Once at the dive platform, the tender should assist the diver exiting the water. When diving in contaminated water, proper decontamination methods should be utilized prior to undressing the diver.

3.5.9 Switching Divers

When switching divers, the same harness rig is typically worn but the next diver's personal FFM should be used. To switch FFMs, the box operator should close the gate on the umbilical gas outlet, and the tender should push the purge button on the first diver's FFM to bleed the pressure out of the breathing gas hose. The FFM should then be removed and the next divers mask put on the system.

3.5.10 Termination of Dive Operations

When the day's dive operations have been completed, the control box should be properly stowed. The main power switch should be turned off, and the battery power should be checked. If the battery is low , the box should be charged overnight prior to the next dive operation. The microphone should be disconnected and stowed in the battery compartment, and the com line connectors should be gently pulled. The gas supply tank valves should be closed and the bleed valves on the tank yokes should be opened to depressurize the supply hoses. The SCUBA tanks should be taken off the system, and any tanks that have not been exhausted should be capped for use on future dives. Tanks that have been exhausted should not be capped, and should be kept separate from the full tanks so that they can be refilled. The FFM purge button should be pushed to bleed the gas out of the umbilical. The gas supply gate should then be closed. Using a wrench, the umbilical lines (both breathing gas and pneumo) should be removed from the box. The breathing gas hose should be capped immediately upon being disconnected from the box. The gas outlets should then be capped,

finger-tight, with their brass caps. The control box should then be closed, and latched so that the o-ring seal on the lid makes the control box water-tight.

After decontamination, the umbilical should be coiled neatly in its shipping box. The harness should be disconnected by unclipping the umbilical and using a wrench to disconnect the breathing gas supply hose. The supply hose should be capped immediately after being disconnected. The pony bottle valve should be closed, and the valve on the manifold block should be briefly opened to bleed the hose pressure so that the regulator first stage can be removed from the bottle and capped. After all gear has dried, the umbilical, harness, pony bottle and regulator should be stowed in the umbilical shipping case, and all of the latches should be tightened. Prior to shipping the case by air, the pony bottle must either be removed or emptied.

3.6 Surface Supplied Air Equipment Maintenance and Storage

At the conclusion of daily dive operations, the panels of the control box should be wiped with a damp cloth. After the project is completed all equipment should be allowed to air dry prior to being stored.

The control box should be serviced by a qualified technician on an annual basis. All batteries used in the control box, should be maintained according to the manufacturers recommendations. When batteries no longer take a full charge or the battery life is diminished, they should be replaced according to the manufacturers procedures.

The breathing gas hose must be pressure tested to 1.5 times its working pressure by a qualified facility on an annual basis. The breathing gas hose must be kept clean, inside and out. It is important to ensure that both ends of the hose are properly capped when the hose is not in use to prevent dust and particulate contaminants from getting into the breathing system.

4.0 RESPONSIBILITIES

Each member of the surface supplied dive team will have the experience or training necessary to perform the tasks assigned to them in a safe and efficient manner. This experience and training will include the use of tools and equipment needed for the specified tasks and techniques required for surface supplied diving. Each member of the dive team will also have training in the emergency procedures required in the event of a diving accident. Each dive team member will only be assigned tasks in accordance with that person's training and experience.

A simple surface supplied diving operation (a single diver, shallow, short duration dives) requires a minimum of four people; a diver, a stand-by diver, a tender, and control box operator/divemaster. However, dive projects requiring multiple dives, depths greater than 30 feet, and multiple divers may require a larger minimum crew. If two divers are in the water simultaneously, the minimum of six people are required; two divers, two tenders, a stand-by diver, a control box operator/divemaster. These minimum numbers assume that all personnel, with the exception of tenders, are qualified divers who could switch duties from surface support to in-water operations. The responsibilities of the dive team are described in the EPA Diving Safety Manual, but those responsibilities specific to surface supplied diving follow:

4.1 Divemaster

The divemaster carries the overall responsibility for the safety and performance of the dive operation. On small operations, the divemaster may also assume the responsibilities of another surface support person or even perform in-water duties if there is a qualified divemaster available to assume the divemaster surface responsibilities.

4.2 Diver

Divers are primarily responsible for performing the in-water work. The diver is also responsible for ensuring all dive equipment is present, and in working order. While in the water, the diver is responsible to carry out work duties as instructed, and to maintain open communication with surface personnel. The surface supply control box operator and the Divemaster should be aware of the diver's status at all times. It is the diver's responsibility to ensure that he/she is clear objectives of the dive and is aware of all safety equipment and procedures that may be required.

4.3 Stand-by Diver

For all surface supplied diving operations, at least one qualified member of the team will be designated as a stand-by diver. The stand-by diver will be ready to enter the water promptly in case of an emergency.

4.4 Dive Tender

The primary responsibility of the dive tender is to assist the diver while preparing for, conducting, and recovering from in-water operations. The dive tender will maintain control of the surface supply air umbilical, ensuring that the diver has enough umbilical to work freely, but not so much umbilical that an entanglement hazard is posed. The dive tender will also be responsible for visually tracking the diver's location while in the water. The dive tender and all surface personnel are responsible for advising other vessels of the dive operation and warning off any vessels that may pose a hazard to the diver. Although the tender does not need to be a certified diver, the tender must be trained to perform the required duties and have an understanding of the equipment utilized by the diver.

4.5 Surface Supply Control Box Operator

A qualified and trained person will be dedicated to running the surface supply control box. This person shall have no other duties that may distract them from their primary responsibility of maintaining sufficient breathing gas delivery and communications with the diver. The dive control box operator in conjunction with the divemaster must be aware of the diver's profile (maximum allowable depth and bottom time) and actual bottom time and depth to ensure that all diving is performed in a safe manner and the diver does not exceed the no-decompression limits (NDL) or the dive-specific profile limits. The control box operator is directly responsible for the safety of the diver. In certain circumstances, at the discretion of the divemaster, the surface supply control box operator may also maintain the dive logs.

4.6 Boat Operator

The boat operator is responsible for all boat operations in support of the dive operation. The boat operator must have experience or training in operating the vessel during dive operations and performing emergency procedures that may be required. During the dive, if the boat is secured in position (anchored or docked), this person may also perform the duties of one of the surface support personnel. .

Disclaimer: *This SOP is an illustration of steps to be taken to conduct surface supplied diving operations and minimize the diver's exposure to polluted water conditions and is not the official view of the USEPA. Mention of any specific brand or model instrument or material does not constitute endorsement by the USEPA.*

5.0 REFERENCES

Diving Systems International (DSI). 1996. *Dive Control System - 2A, Operations and Maintenance Manual.*

Kirby Morgan Dive Systems Inc. 2009, Kirby *Morgan Air Control System 5 Operations and Maintenance Manual.*

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