Global
Underwater
Explorers

Standard Operating Procedures

Ver 2.0.2

R — Routine Operation Procedures

E — Emergency Procedures

U — Updates and Proposed Changes

GLOBAL Underwater Explorers

Global Underwater Explorers: Standard Operating Procedures by Dan MacKay

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1 Routine Diving Operations

Ascent Rates

The following are guides for use in calculating various ascent rates and profiles. Divers should be cautioned that the on-site environment will ultimately determine the final shape of the profile. This is a team process that all members must participate in. When feasible the last stop should be conducted at 6m/20ft followed by a slow ascent of 1m/3ft per minute to the surface.

Recreational

- Calculate 50% of the average depth of the dive
- Ascend at 9m/30ft per minute to the calculated depth
- Conduct a one minute stop for each remaining 10ft/3m interval
- One minute stops are executed as a 30 second stop and 30 seconds of movement to the next shallower interval

Tech 1

- Calculate 75% of the average depth of the dive
- Ascend at 9m/30ft per minute to the calculated depth
- Adjust ascent rate to 6m/20ft per minute thereafter until intercepting the gas switch or decompression profile which ever occurs first

Tech 2

- Less than 15 minutes bottom time:
  - ◊ Calculate 75% of the average depth of the dive
  - ◊ *Ascend at 9m/30ft per minute to the calculated depth*
  - ◊ Calculate 50% of the average depth of the dive
  - ◊ Adjust ascent rate to 6m/20ft per minute and ascend to the calculated depth
  - ◊ Once this depth is reached adjust ascent rate to 3m/10ft per minute thereafter until intercepting the gas switch or decompression profile which ever occurs first
- More than 15 minutes bottom time:
  - ◊ Calculate 75% of the average depth of the dive
  - ◊ *Ascend at 9m/30ft per minute to the calculated depth*
  - ◊ Calculate 50% of the average depth of the dive
  - ◊ Adjust ascent rate to 3m/10ft per minute and ascend to the calculated depth
  - ◊ Once this depth is reached adjust ascent rate to 1.5m/5ft per minute thereafter until intercepting the gas switch or decompression profile which ever occurs first

Bottle Rotation

Note that for this drill the SPG should be clipped at the top of the left hip 'D' ring with the stages clipped off in the middle and leash at the bottom

- Stabilize at chosen depth
- Clip light off and park in temporary position
- Unclip the tail of the bottle to be rotated back
- Unclip the leash and move forward
- Unclip the nose of the bottle to be rotated back
- Clip to leash
- Chose the bottle to be moved up
- Clip it to the left chest 'D' ring
- Clip the leash onto the left hip 'D' ring and push leashed bottles between your legs
- Clip the tail of the bottle that was moved up on to the left hip 'D' ring
- Replace light in primary position

Flow Check

This procedure was designed as a method to quickly confirm that all valves are in the correct position during the conduct of a dive. This procedure is a modified valve drill that is normally completed as part of the pre-dive sequence. When the diver is carrying stages, argon bottle and/or deco bottles the Flow Check is expanded to include these items as well.

A comprehensive Flow Check is be conducted as follows:

- Rotate the right post valve to ensure it is fully on
- Rotate the isolator valve to ensure it is fully on
- Rotate the left post valve to ensure it is fully on
- Keep working to the left and ensure any stages you have clipped off are pressurized and off

Gas Planning – Cave 1

Gas planning for cave diving presents some unique gas management issues. In general experienced divers, such as Cave 2/3 divers, employ the rule of thirds that they will modify to be as conservative as the environmental conditions demand. During Cave 1 dives however, it is believed that additional gas is needed while divers build their skills and awareness.

While the rule of thirds is adequate for divers with more experience this volume may not be sufficient for novice divers that encounter a problem. In order to ensure that adequate reserves are maintained all Cave 1 dive gas volumes will be calculated using the following formula:

- Dives must start with a minimum volume of 100 cu ft/2800L
- The diver will reserve 1/3 of this total gas as Minimum Gas (MG)
- The diver will subtract the MG from the total available gas
- Using the remaining volume from the preceding calculation 1/3 of this may be used for the penetration phase of the dive.
- Of course normal gas matching rules still apply for similar/dissimilar tank configurations.

Hypoxic Mix Protocol.

This protocol refers to hypoxic mixes, which can create a risk for the diver who may lose consciousness when breathed on or near the surface with an excessively low PO_2.

Definition: The hypoxic zone is defined as the area between the surface and 6m/20ft with any hypoxic gas from the GUE Standard Gas table.

When such a mix is used for a dive, the team must address the risk by defining the hypoxic zone while managing the risk with appropriate measures for both the descent and the ascent portion of the dive.

The hypoxic zone is calculated based on a PO_2 threshold of 0.15. Calculation is done based on the diver with the lowest oxygen content in the team.

Example for a 10% oxygen mix, the hypoxic zone will be from 6 meters to the surface.

Divers must recognize that a PO_2 of 0.15 can produce hypoxic symptoms if breathed under exertion and/or for prolonged periods of time. During these conditions a more conservative approach should be applied.

In such cases a mixture with a higher PO_2 will have to be used within the hypoxic zone. Such a mixture will usually be the deepest decompression gas carried for the dive. It is also important to ensure that the team accounts for additional gas reserves to ensure that any loss of decompression gas will not prevent a safe ascent with a proper gas mixture. This is usually accomplished by reserving additional gas (roughly 70bar/1,000psi) in each members decompression cylinder. During such dives it is advisable that support divers are used in order to manage the possibility of unconsciousness due to lack of oxygen.

The complete hypoxic mix protocol is as follows:

- The team will descent through the hypoxic zone using deepest deco gas available
- Stabilize the team at 9 meters
- Park the primary light in the temporary position
- Switch to back-gas and stow travel gas
- Pre-dive checks (situational dependent)
  - ◊ Modified valve drill
  - ◊ Modified 'S' drill
  - ◊ Bubble check including hip D-ring check for any potential cross linking of stage double enders
- Switch to Bottom Stage (or back gas)
- Light back to primary position

When ascending the team will travel through the hypoxic zone utilizing oxygen.

Loss of Buoyancy due to Equipment Failure

- Signal the team
- Detect the source of the auto-inflation
- If the power inflator is stuck on, dump gas from the corrugated hose while disconnecting the Low Pressure(LP) inflator hose
- If this isn't possible, shut the right valve down while dumping gas from the corrugated hose or the rear dump valve and switch to the necklace
- If your dry suit is self-inflating, disconnect the LP inflator hose while venting excess gas
- Re-establish position & control
- Fix the problem or call the dive

Navigation/Marking

- A guideline should always be traveled and referenced completely
- It is the teams' responsibility to always ensure that it is following a continuous guideline
- Typically divers should never be further than arm reach from the guideline
- Jumps, T's and change of directional markers are reinforced by all team members placing non-directional markers

- Non-directional markers do not need to be numbered
- Visual jumps, blind circuit/traverse and "trust me" dives are not acceptable

Safety or 'S' Drill

Both divers will face each other (or triangle up in a team of three) and establish a neutral base. It is important that all team members be included in any team decisions and team reformations. If there is a third team member involved in this drill then it is his/her responsibility to monitor the situation, including depth/time and environmental conditions, as well as be prepared to render appropriate assistance during a OOG scenario. When initiated, the drill is executed as follows:

Out Of Gas (OOG) Diver Action

- Signal distress with light (Optional if no primary light available)
- Indicate OOG by slashing the right hand across the throat
- Identify and move towards the Donor
- Do not remove the primary regulator from the mouth until Donor's regulator is available for exchange.

Donor Action

- With the right hand, locate and grasp the primary regulator, hose, taking care not to cover the faceplate (purge button) of the regulator
- With smooth action, yet decisive action, remove the primary regulator from the mouth, duck the head and deploy the long hose over the head. Present it mouthpiece down to the OOG diver.
- With the left hand locate the alternate regulator, taking care not to capture the long hose with the left arm, purge and place in mouth
- Be attentive to the (potentially) stressed OOG diver and a left post roll off

OOG Diver Action

- Grasp the donated regulator with the left hand
- Replace primary with the donor's regulator.
- Clip off the removed primary
- Secure the regulator

Both Divers

- Pause while donor ensures the OOG diver is OK via exchange of an OK signal from the OOG diver
- Clear the light cord from the long hose in a counter-clockwise manner
- Clear the long hose from the light canister
- Fully deploy long hose over the right shoulder
- Make a team decision on the action to be taken or direction to travel.
- Assume an appropriate team formation, routing the hose in the manner discussed above

Once the drill has been terminated both divers will face each other (or triangle up in a team of three) and establish a neutral base.

OOG Diver Action

- Locate, unclip and purge the primary with the right hand.
- Remove the donated regulator with the left hand and replace with own
- Retain possession of the donated regulator until donor cleans up
- Donor Action
- Recapture the long hose under the light canister
- Reroute the light cord around the long hose using a clockwise motion
- Obtain the your primary regulator from the OOG diver
- Purge and replace
- Check light cord is routed over the long hose.

Safety Drill (modified)

While this drill is incorporated into the GUE pre-dive sequence it is a stand-alone exercise that should be conducted any time a dive has adjusted his main equipment configuration. It should be conducted on the surface but may, depending on the environment, be done at a shallow depth. It is used to ensure that in the event of an OOG situation that the donors' long hose is readily deployable. Prior to conducting this drill it is preferable that all regulators have been breathed and tested wet in order to identify faulty membranes etc. Each diver will:

- Donate the primary
- Switch to alternate regulator
- Grasp the regulator with the left hand
- Clear the long hose from under the light canister (or free of the waistband if no light is being used)
- Clear the long hose from behind the wing and ensure visually that it is positioned over the right shoulder and has an unobstructed path to the primary regulator

Once a partner has confirmed that the long hose is indeed free and unobstructed, return the long hose to the stowed position.

Situational Awareness Check

The purpose of a Situational Awareness Check(Sit Check) is to gain a real-time snapshot of the current state of the dive. It is encouraged that a Sit Check be conducted at the start of the dive

and approximately every five minutes thereafter. The Sit Check should only take about 15 to 20 seconds and can be conducted 'on the fly'. A Sit Check should be conducted as follows:

- Initiate with a flow check
- Track exposure by checking bottom time and average depth
- Track gas consumption by checking the relevant SPG and noting the pressure
- Monitor your team looking for signs of stress/impairment or equipment related concerns
- Check the environment for:
  - ◊ any object/condition that may aid in navigation
  - ◊ any changes in conditions that might have potentially impact the dive such as changes in flow

Using the information gained during a Sit Check the diver should be able to:

- Ensure correct positioning of all valves
- Calculate current gas consumption
- Dynamically adjust dive parameters in real time based on actual gas consumption as compared to pre-dive calculations, estimate average depth hence decompression obligation and ascent profile
- Ascertain navigational accuracy
- Adjust the dive parameters based on the state of the environment

In this light this procedure is one of the most valuable tools in a divers toolbox during the in-water portion of a dive. Frequent use of the Sit Check in the manner described above allows the diver to quickly gauge consumption, comfort and planning accuracy as well as improve situational awareness.

Note: If using an RB80 the diver should also check the switch block to ensure that all valves are in the correct position and the proper gas is plugged in.

SMB Deployment

An SMB is primarily used as a signaling device so the surface support personnel can locate and recover a dive team. It can as well be used as a communication tool to indicate simply "we are OK" if team recovery is not the primary goal. The nature of the dive will determine when and how the SMB is deployed. It is conducted as follows:

- The team aligns in whatever the formation the environment dictates
- Team leader will indicate the diver that will deploy the SMB
- This diver will:
  - ◊ Stow the primary light
  - ◊ Locate the SMB and a spool of appropriate size (Note: If the spool and SMB have not been pre-attached then he will do so now using whatever method he chooses as per training)
  - ◊ Unclip the double ender and clip it to the right chest 'D' ring
  - ◊ Undo any elastic loop or Velcro closures that may constrain the SMB
  - ◊ Unspool enough line (12-18"/30-46cm) to ensure smooth operation of the spool
  - ◊ Re-spool the slack line entirely
  - ◊ Look up for any obstruction
  - ◊ With the left hand gather the spool and valve, remove the primary regulator from the mouth using the right hand and inflate the SMB with about ½ the capacity of your lungs
  - ◊ Replace the primary taking care not to breath as of yet
  - ◊ Move spool and SMB at arm's length from the body release the SMB and breath. Take care that the spool runs smoothly between the thumb and forefinger of your left hand held over the center hole of the spool
- When the SMB reaches the surface, re-spool any slack line, unclip the double ender and clip it to the spool in such a manner that it captures the up-line and a hole in the spool.
- Secure the up-line using a locked OK.
- As the team rises through the water column the diver in charge of the SMB will unclip and take in line on the ascent to match the rate of ascent as appropriate. The spool line must not be allowed to go slack during the ascent and the spool should be locked at every stop.

The above procedure describes the use of a closed circuit SMB. If the team is using an open circuit bag then the procedure is identical except for the method used to inflate the SMB. In this case air is introduced into the SMB from the exhaust bubbles of the primary regulator. The utmost care must be taken in order to control the line so that no entanglement occurs.

Switching to Back Gas

Divers' Actions

- Clip light off and park in temporary position (If the switch to back-gas has been forced by a stage failure, clipping the light at this point might not be desirable and can be performed at a later stage of this sequence)
- Grasp the Deco Regulator with left hand
- Locate, unclip and purge the Primary Regulator with the right hand
- In one smooth movement remove and replace regulators

- Fully close the decompression bottle valve
- Stow the decompression regulator

Buddy's Responsibility
- Watch buddy
- Monitor depth

Switching to Deco Gas

Divers' Actions
- Level off at switch Depth
- Clip light off and park in temporary position
- ID correct bottle (MOD and Content Label)
- Pressurize regulator but leave valve in the closed position
- Deploy second stage
- Trace the second stage back to the first stage
- Pressure interruption to confirm regulator selection and open valve fully
- Present MOD markings and ask for confirmation from buddy
- After confirmation confirm depth and switch to deco gas
- Clip off primary
- Replace light in primary position

Buddy's Responsibility
- Watch buddy
- When asked to confirm deco gas selection:
- Did the diver open the valve after the pressure interruption check
- Trace second stage back to first stage
- Check that depth matches MOD
- Signal the buddy to switch

Survey

- Typically conducted on the penetration portion of the dive
- The primary light can be temporary clipped while taking measurements
- The team can assist with lighting
- Basic measurements includes:
  - ◊ Depth
  - ◊ Distance; and
  - ◊ Azimuth
- Maintain a good pace and control
- The survey site should reflect capabilities of the dive team

Team Positioning

While the environment in which a particular dive is being conducted in will largely dictate dive characteristics such as team formation, separation distance and distance from a point of reference when failures or emergencies arise teams that are arranged in a single file (cave environment) or Wing Position (OW environment) can use these "fixed" buddy configurations to greatly reduce confusion thus reducing overall team stress. Using these two close quarters formations can for example:

- When experiencing failures in a cave environment reorder the team in the manner that best supports the diver with a problem
- Where the team members have lights of variable intensity the team can adjust to keep the brightest light in back. For example this diver would be placed in the third position on the way out an also take this position on the way back.

In practice it is very rare for a team to experience more than one major failure. Generally speaking it usually simple to reorganize the team in a manner that provides the maximum support for the stressed diver. The following guidelines should be considered when a situation forces a team to reorganize:

- The diver in the greatest difficulty is generally placed in the middle position
- Gas problems are assigned the highest priority
- Equipment issues can usually be readily dealt with, however, they must not be treated lightly and the team should reorganize to reflect a failure no matter how trivial
- No matter what the issue, the stressed diver is placed in protective custody until the dive is over or a higher priority situation arises.

Given the clearly impossible task of attempting to document and articulate all possible emergency scenarios, both single and multiple, it is of paramount importance that a great degree of flexibility be exercised by all team members as situations deteriorate. It is with this in mind that teams may be forced into using a great degree of creative thought based on the principles listed above

Valve Drill (Doubles)

This is used to ensure the correct positioning of all valves, confirming the diver´s capacity for operating the valves and the proper operation of the primary and secondary regulators. To master the valve drill a diver must first develop solid situational awareness accompanied with robust fundamental diving skills such as buoyancy control, trim and maneuvering techniques.

The team assumes a formation as dictated by the environment. The diver who is currently conducting the valve drill will signal

to one of his partners to watch him while he executes the drill. The partner will assume a ready state (be prepared to donate) and indicate OK.

The diver executing the drill will:

- Purge the alternate regulator to ensure viable gas source
- Reach up with the right hand and close the primary valve while signalling for attention with primary light!
- Breath the long hose dry
- Remove the primary from the mouth with right hand
- Place the alternate in mouth with the left hand
- Clip off the primary to the right chest 'D' ring
- Pause
- Reach back with the right hand, rotate the primary valve to the fully on position
- Locate the primary, unclip, purge, remove the alternate and replace it with the primary regulator
- Pause
- Signal for attention with primary light!
- Reach back with the right hand and rotate the isolator to the fully closed position and then rotate the it to the fully on position
- Pause
- Move primary light to a temporary hold in the right hand and signal for attention with primary light!
- Reach up with the left hand and fully rotate the alternate (left) valve to the closed position
- Fully purge the alternate regulator
- Reach back with the left hand, rotate the alternate valve to the fully on position
- Purge the alternate to ensure that it is functioning
- Move primary light back to normal position
- Final flow check including any additional tanks such as stages/deco/dry suit bottles/RB80 switch block

Valve Drill (Single)

This is drill is used to confirm that the single tank diver has the dexterity to manipulate the on/off valve in the situation of inadvertent closure. As the single tank diver only has one possible air source it is absolutely critical that at no time does the diver completely close the valve. This drill is used to confirm valve position as well as exercise the ability to accurately locate and rotate the valve to the on position.

The drill is conducted as follows:

- The team assumes a formation as dictated by the environment
- The diver who is currently conducting the valve drill will signal to one of his partners to watch him while he executes the drill
- The partner will assume a ready state (be prepared to donate) and indicate OK
- The working diver will:
  - ◊ Reach up with his right hand and locate the valve
  - ◊ Demonstrate the ability to manipulate the valve (flow check the valve, do not close)
  - ◊ Conduct a flow check
- The team will rotate responsibilities so that all divers on the team have an opportunity to conduct the drill

2 Emergency Procedures

Broken Guideline

- Stop and stabilize your position
- Signal the team
- Establish a line-to-line connection between loose end of the broken line and safety line
- Search for the other side of the line with the help of the team
- The guideline is likely to be near the bottom
- Fix the line permanently if time and conditions permit, if not secure both ends of the line and warn others entering the cave/wreck

Line Entanglement

- Stop and stabilize position
- Signal team members
- Make one attempt to free yourself
- Signal team members for assistance
- If guideline needs to be cut:
  - ◊ Position team on exit side of cut
  - ◊ Secure the line
  - ◊ Cut line and the free the diver
- Repair line if possible

If it is not possible to effect a repair, notify other divers entering cave/wreck

Lost Diver Drill

Stop and stabilize position

- Locate the line and reference the exit
- Search for team member's light, silt and bubbles
- Determine team member is truly lost
- Calculate available gas (1/3's) for search
- Conduct the search as follows:
  - ◊ Search on the line
  - ◊ Search off line if given probable cause
  - ◊ Place arrow on line
  - ◊ Utilize safety spool for search

If the buddy is not found leave all spools and penetration reel in place. As well add a back up light on and attached to the line. Place several line arrows as you are exiting.

Lost Line Drill

Stop and stabilize position

- Maintain position search for guideline
- Securely attach safety spool to fixed point
- Conduct one of the following search patterns:
  - ◊ Circular
  - ◊ Wall-to-wall
  - ◊ Shotgun

When line is found secure spool and place cookie on side to travel

Loss Of Visibility

- Stop, stabilize and reference the guideline
- With one hand secure the guideline with a locked OK
- All team members must have the same hand securing the line(all must use their right hands or all must use their left hand on the line) while the other hand is holding a team mate's arm or leg in touch contact communication
- Maintain good control(buoyancy and trim) as not to make a bad situation worse.
- Exit the cave in an expeditious manner

Loss of Visibility while Sharing Gas

- Stop, stabilize position and reference guideline
- With one hand secure the guideline with a locked OK
- If the guideline is on the right, the hose will feed straight from the regulator to the right hand, through the locked OK on the line

- If on the left, the procedure is reversed except the hose will go behind the OOG diver's neck and feed through the locked OK of the left hand
- In both cases both divers are responsible for controlling the excess long hose
- The Out Of Gas diver will always secure the long hose
- Establish touch contact communication with the remainder of the team
- Maintain control
- Maintain good control(buoyancy and trim) as not to make a bad situation worse.

Exit the cave in an expeditious manner

Primary Light Failure

During a primary light failure the assisting diver should ensure that the diver that has the failed light is comfortable and that the problem is properly managed. For example in the case of the assisting diver should ensure the diver does not trap to long hose with the light cord. It is marginally more efficient for the diver to avoid turning completely to face the diver; in this case they would face the line (as in an overhead environment) or the current (in the case of OW). If visibility is an issue then the team should arrange to face each other. The diver with the failed light will signal his team through touch contact if close enough, else through effective activation of a back-up light. The drill at this point is conducted as follows:

- Locate and remove a backup light from the stowed position. Leave the light clipped on.
- Rotate the bezel to the on position
- Signal the team
- Properly stow the primary
- Unclip the backup
- The team will regroup with the failed diver in between for a three man team and in the lead for a two man team

At this point the team will decide on and execute the appropriate course of action as dictated by the environment.

Unconscious Diver Rescue

This drill is the recommended method to ascend with an unconscious diver, a diver that is experiencing an oxygen toxicity episode, or a diver that is otherwise incapacitated and unable, themselves, to effectively complete a safe ascent for whatever reason. Due to the many environmental conditions that can possibly influence the execution of this drill, this outline is intended as a general guideline. Minor variations, such as using the BCD inflator mechanism to vent gas while in a more heads up posture—as in evacuation from a cave environment—or venting gas from the victim's dry-suit, should be mentioned, as well as taught, as conditions warrant. For the majority of OW training, the following method should be taught:

Rescuer

- Signal Team
- Approach the Unconscious Diver (UD)
- Attempt to elicit a response with a light signal (if available)
- Attempt to elicit a response by physical contact
- If the victim is unresponsive
  - ◊ Immediately secure the airway
  - ◊ If the diver is breathing and the regulator is in his mouth, secure the regulator
  - ◊ If the regulator is not in place—*do not attempt to replace*—continue with the drill
- Stow your light if not needed. If needed it can be placed over victim's left shoulder near the wing inflator.(be alert for entanglement hazards)
- While keeping the airway secure
  - ◊ Open your dry suit dump valve fully
  - ◊ Open the victim's dry suit dump valve fully
  - ◊ Remove all gas from your BCD/dry suit. It is important for the rescuer to understand that the rescue will be conducted by using the buoyancy system of the victim, primarily the BCD
- While holding the victim in a head-high posture, vent all the gas possible from his/her dry suit
  - ◊ Either reach over the victim's right shoulder or under the right arm to secure the airway/regulator
  - ◊ Place your Centre of Gravity over the valves of the victim
  - ◊ With the left hand, reach over/under the victim's left arm and gently inflate the BCD to the point that buoyancy using breath control can initiate the ascent
- The victim should be secured in a horizontal position (where possible) with the rescuer's left hand securing the victim's rear dump valve/BCD to maintain close contact
- Gas is dumped from the victims BCD as required to arrest the ascent
- Maintain a level of control that enables you to conduct a safe ascent as well as stop and maneuver as required
- Anticipate surface - from 10' start to move unconscious diver into face up position adding gas during last couple of feet to help this so when breaking the surface victim's mouth is highest point out of water

The remaining team members should place themselves in a manner that they can assist the rescuer at any time during the ascent. This procedure should be using in conjunction with the changes to this outlined in Annex A.

Valve Failures

The majority of failures occur in the first stages as opposed to the valves themselves. The following two generic procedures are to be used by the affected diver as well as the team during the trouble-shooting phase of valve failures. Extreme care should be taken during all phases of team interaction so that when executing this drill the regulator a teammate is breathing off is positively identified in order to avoid inadvertently shutting down that regulator

Upon discovery of a loss of gas problem Diver Response:

1. Signal your team and attempt to determine where the leak is occurring
2. Close that valve
3. Purge and/or breath dry, switch regulators, and clean up if required
4. STOP and LISTEN
5. If the bubbles have stopped then the problem has been isolated to a failed or loose regulator; communicate to your teammate to come and investigate
6. If the bubbles have not stopped, then they are not going to at this point so it is time to move into gas preservation mode; isolate and ask your teammate for assistance[1]

Partner (Team) Response:

1. Form up on the distressed diver as dictated by the environment and be prepared to donate
2. Observe the diver as they attempt to isolate the issue. In reality, if you are paying attention, you will likely know exactly what the issue is by the time they ask for help, thus speeding up the process, .
3. When you are motioned to come in and help solve the problem, make sure you trace the regulator that the diver is breathing to the manifold.
4. Confirm the position of the isolator and the valve on the side the diver is ***not breathing from***.
5. Begin the troubleshooting process.

It is imperative that the diver who is troubleshooting ***not manipulate the valve*** the distressed diver is breathing from.

Complete documentation of all valve failures is detailed in the *GUE Valve Manual* available on the GUE web site.

1 At this point all available options have been exhausted. Even in the event of an error, and the problem is actually on the left side, half of the gas supply is secured. The team member will discover the problem and safely execute the procedure to re-establish use of the primary and then proceed to rectify the real issue if possible.

3 Updates and Changes

In order to rationalize differences between the Cave and Tech curricula the following minor changes are being introduced to the Safety Drill and Light Head management procedures.

Light Head Management

As a guideline there will be four positions for the light head:

- Normal Position - light head held in the left hand
- Temporary Position - light momentarily held in right hand
- Temporarily Clipped – light clipped with double ender attached to loop at the rear of the light head. Stow the light cord behind the long hose and under the waist band when practical
- Permanently Clipped - light switched off, clipped using permanent bolt-snap and light cord stowed behind the long hose and under the waistband.

This has the ramification that during open water ascents the normal position (left hand) should be preferred rather than temporarily clipped position. The light should be temporarily clipped during bottle rotations, gas switches, SMB deployments, and the like, but the diver should redeploy the light to the normal position, once the drill has been completed, in order that its value as a communication tool is not diminished.

Remember that when a light has been clipped off or deployed, the diver must check:

- When light is clipped off - long hose integrity (hand following long hose down under light canister)
- When light is deployed – light cord integrity (hand following the light cord down to the light canister lid)

Safety or 'S' Drill

A change to the Safety drill has been adopted that harmonizes the cave and OW versions of this procedure. The cave version will not change. The OW version will change as follows:

- When following a guideline, the long hose will be held in the hand in such a manner that the lead diver will capture both the long hose and the guideline with a locked OK.
- If the guideline is on the right, the long hose will feed straight from the regulator to the right hand, through the locked OK on the line.
- If on the left, the procedure is reversed except the hose will go behind the OOG diver's neck and feed through the locked OK of the left hand.
- The donor in both cases is responsible for controlling excess long hose in the same manner as the OOG diver.

While swimming side by side in an OW environment with no guideline, the same procedure is followed. In discussions with our cave-adapted brethren, the law of primacy is proving to be problematic in regards to this drill: Apparently it is difficult to break the habit of grasping the long hose next to the regulator.

The major change in this procedure is the situation when the divers are on an ascent facing each other or line abreast. In this case, the OOG diver should be encouraged to hold the hose in a relaxed position at arms length, rather than the current practice of holding it with the right hand close to the regulator. This has the additional benefits of allowing the OOG diver to reference his/her instruments and providing a more relaxed position in the water column.

Unconscious Diver Rescue

Managing an unconscious diver while under water is a problematic scenario. It is clear that a range of nuances create some doubt about the perfect management. Furthermore, different scenarios likely result in additional complexity; it is impossible to craft a strategy that operates independently of these variables. Yet, it is nearly impossible to revive an unconscious diver while at depth, making it likely that an efficient ascent will be the most successful strategy. Very calm and proficient rescuers may be able to manage multiple aspects of a rescue without compromising an efficient ascent. However, most rescuers should focus on a few important points, ensuring they do not sacrifice safety or efficiency. We would argue that three areas should be the rescuers' primary focus:

- Maintaining control
- Keeping an open airway
- Ensuring a smooth ascent
- Failure to properly manage any of these areas is likely to result in a failed rescue.

Upon reaching an apparently unconscious diver, the rescuer should evaluate the environment and the victim. This ensures that the diver is, in fact, unconscious, and also provides an opportunity to evaluate any associated risks, including loss of visibility, lost direction, current, depth, and equipment. After evaluating the victim and environment, the rescuer should prepare the victim for ascent. It is preferred to manage the ascent using only the victim's buoyancy compensator. This reduces the number of variables to be considered. Both dry suit and BCD OPV valves should be identified, left open, and oriented to allow venting. The rescuer's BCD should be empty, though in some cases the victim's BCD might not provide sufficient lift. In this case, some gas is left in the rescuer's BCD. Ideally' the rescuer will "ride" the slightly positive victim slowly to the surface; the negative ballast of the rescuer acts to trap the victim, keeping the victim roughly horizontal. In some environments (e.g., cave or wreck), this horizontal position is very useful to facilitate an exit that is not vertical in nature. Of course, where direct ascents are needed this aspect is less important. Yet, it is usually easier to maneuver with a victim in the recommended horizontal position.

While managing the victim during ascent it is usually easier for the rescuer to use the right hand to keep the airway open. The regulator is left in place (if the regulator was originally found in the mouth, then it is kept in this position; otherwise it is left out of the mouth). The rescuer's right arm is often able to assist in stabilizing the victim; for example, trapping the victim's right tank valve in the crook of the arm can do this. The rescuer's left hand is also used for stability, usually by grasping the victim's BCD near the OPV; this hand is also used to adjust buoyancy (adding gas or dumping from the OPV/deflator). The hand positioning as indicated allows the rescuer significant latitude in managing various scenarios (overhead, slow diagonal ascent, etc.). However, the most important factors remain the need to maintain control, keep an open airway, and ensure a smooth ascent. If the rescuer is in doubt over a change to procedure, the maintenance of these priorities always takes precedence. It is possible to rescue a victim with countless procedures that span the management of dozens of variables. Yet, one must remember that an unconscious diver has precious little time and failing to bring a victim to the surface will result in certain death. Given these options, it is incumbent upon the rescuer to be as efficient as possible with the nuances of a rescue, but to remain aware of the main priority: bringing the victim to the surface during a controlled ascent.

Ventilating An Unconscious Diver

The ventilation of an unconscious at the surface diver is usually accomplished in the same manner as for most non-breathing victims. The preferred method is mouth-to-mouth breathing. It is possible to ventilate a victim using a scuba regulator; however, this is not preferred, unless the environmental conditions make it difficult to ventilate without getting water in the victim's mouth. Regulator ventilation is not preferred as it creates several problems, including:

- Difficulty in creating a proper seal between the regulator and the mouth
- Difficulty in preventing gas from venting out the exhaust diaphragm (instead of entering the lungs)
- The likelihood of sending gas into the stomach (again instead of into the lungs)
- Finally the potential problem of over-inflating the lungs

However, regulator ventilation is a consideration where conditions might make mouth to mouth impractical such as from heavy surf conditions.

It is also possible to use a regulator for under-water ventilation, though this is generally not recommended. There are few situations in which this might be useful; moreover, few rescuers are likely to be successful in managing the added complexity of under-water ventilation. However, rescuers trying to remove a victim where the ascent is likely to be notably delayed (such as while removing an unconscious diver from a cave) might consider the use of a regulator for under water ventilation. In this and similar situations the severity of the situation, as well as the low probability of victim survival, justify consideration of this procedure. Ventilation of the victim is least dangerous while traveling at a relatively constant depth; very experienced divers on a protracted ascent are the only individuals that should consider this technique. Of course the biggest problem with ventilation while underwater is the risk of over-inflating the lungs. Embolism of an unconscious diver would negatively impact the likelihood of survival.

Toxing Diver Rescue

The management of an oxygen toxicity incident while under water is very similar to the management of an unconscious diver, as discussed above. The primary peculiarity relevant for a toxing diver is the potential increased risk of embolism, due to oxygen toxicity seizures (during the toxic phase). In this case, it is recommended that the rescuer allow the seizure to cease prior to surfacing with the victim. It is hoped that this seizure will last less than one minute, though some complications may be present[1]. Should the seizure continue, or the conditions degrade, the rescuer is obliged to take the risk of a controlled ascent to the surface. The risk of death is certain while under water, making a controlled ascent, followed by surface management of the victim, a high priority.

1 Some issue could be made regarding complexities associated with oxygen toxicity; namely, that this reaction can be considered in two parts: tonic (rigid phase while glottis is obstructed) and clonic (jerking phase where glottis may or may not open spontaneously). As the seizure continues, excess oxygen is metabolized; over time (perhaps 1 - 3 minutes), these seizures will cease. It is conceivable that a victim might still be in the tonic phase; yet, this may be difficult to identify due to stress, dive gear, etc. Furthermore, it is conceivable that a victim with significant O_2 and/or CO_2 accumulation might continue to experience ongoing symptoms. This seems unlikely in most diving scenarios, and, in any case, is not something with a practical solution while diving. In the end, the rescuer will have to judge a time of least risk, ascending slowly, and hoping to do no greater harm. Continued in-water immersion is tantamount to certain death when not breathing, while embolism may or may not be present.

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