U.S. Antarctic Program
Scientific Diving Standards

1. Purpose and Scope

1.1. Diving is an activity that carries some risk, which can be mitigated through training and experience. Diving in Antarctica carries additional risks associated with the environmental conditions and the often-remote diving locations, where diving support, medical support, and life-support infrastructure are limited or absent. This policy and these standard operating procedures are intended to provide a framework by which underwater diving for both operations and maintenance (O&M) and scientific purposes can be conducted safely.

1.2. The Office of Polar Programs (OPP) within the Geosciences Directorate of the National Science Foundation (NSF) provides support for scientific diving associated with the research activities it funds. The OPP Scientific Diving Standards are developed to ensure that all scientific diving is conducted in a manner that will minimize scientific divers' exposure to risk for accidental injury or illness associated with diving, while optimizing the researchers' ability to conduct research. These Standards are modeled after the American Academy of Underwater Sciences (AAUS) Standards for Scientific Diving, a document that has provided a template for scientific diving at most academic and research institutions in the United States over the last fifty years. The AAUS approach has been recognized by the Occupational Safety and Health Administration (OSHA) as an effective method for protecting scientific divers. While OSHA does not have jurisdiction in Antarctica, Code of Federal Regulations, 29.1910 Subpart T, which governs diving safety in the U.S., provides a framework for USAP diving along with these USAP Scientific Diving Standards. Development of these standards allows home institution Dive Safety Officers (DSOs) to evaluate divers from their institutions, who participate in USAP diving, using criteria similar to their own organization.

2. References

- 29 CFR 1910.401-440 and Subpart T
- AAUS Standards for Scientific Diving

3. General Requirements

3.1. There are inherent risks in diving and doing so in Polar Regions involves additional risks because of the environmental conditions and remoteness. These standards provide a structure within which to manage those risks and allow underwater diving in support of the scientific enterprise to proceed safely. Each scientific diver should acknowledge those risks and commit to conducting their underwater diving activities in accordance with this policy and directed procedures.

4. Responsible Authorities and Personnel

4.1. Safety and Occupational Health Officer (SOHO): The SOHO is responsible for the safety of all USAP participants and is the administrative position to which the Dive Safety Officer reports. The SOHO has ultimate responsibility over all phases of the dive program and its management. The DSO exercises responsibility over all technical components of the scientific diving program.

4.2. OPP Dive Safety Manager: A direct contract position with OPP SOH. Colloquially known as the OPP DSO to align with the science diving community nomenclature, the OPP DSO acts as a liaison between the SOHO and the research divers. The DSO has the authority to act on behalf of the SOHO in all diving matters, pending concurrence of the SOHO. The DSO typically represents OPP in technical matters concerning diving operations, diving safety, or projects utilizing diving as a tool in their research. The DSO has the responsibility to:

- 4.2.1. Review and recommend approval by the SOHO, all divers, diving plans, and diving locations submitted by the various research projects.
- 4.2.2. Evaluate and recommend equipment for polar diving use.
- 4.2.3. Recommend facilities to support scientific diving in polar regions.
- 4.2.4. Recommend new diving techniques or procedures to further scientific diving as a research tool in Antarctica.

4.3. Home Institution Diving Safety Officer: The home institution DSO oversees diving safety at the home institution, usually that of the principal investigator (PI), to which the scientific divers are affiliated. The home institution DSO acts in an advisory capacity to the OPP DSO, provides information on current scientific diver status under AAUS standards, and ensures that specialized training is provided to prepare individual divers for diving in Polar Regions. The home institution DSO certifies that the diver is current according to the most current version of AAUS standards.

4.4. Contractor Supervisor of Dive Services (SDS): The SDS is responsible for maintaining the OPP-owned dive equipment provided on-site, conducting diving pre-season orientations,

orienting new science teams to conditions on-site, providing supervision and instruction on USAP techniques during local familiarization dives, and generally supporting all scientific diving activities. The SDS has the authority to suspend diving operations if in his or her opinion they are unsafe or unwise, pending review by the DSO. Other oversight duties, authorities, and responsibilities may be assigned this individual by the OPP DSO or the SOHO.

4.5. Principal Investigator (PI): Generally, the PI acts as the lead diver, unless that authority is assigned to another more experienced diver in the project. The PI is responsible for ensuring all divers meet this policy's requirements and the operational requirements of the project.

4.5.1. The PI is responsible for ensuring maintenance of all project-provided scuba equipment within 12 months of deployment to Antarctica and specifically for the following items (unless they are provided by OPP):

- Buoyancy compensator
- Dry suit

4.6. A project's lead diver is the person who has the diving experience, competency, responsibility, and reliability to conduct polar diving operations, and who has been designated responsible for managing the daily dive operations of the science team. The lead diver ensures that all divers in the team follow the procedures established in this policy and SOP.

4.7. Divers are the individuals having the experience, training, and authorization necessary to dive under the auspices of the OPP.

4.8. Tenders and surface support personnel are individuals who are trained to assist divers in their diving activities. They have no direct responsibility to intervene in diving operations. Tenders are assigned and trained by the SDS and/or project's PI or lead diver.

5. Scientific Diving Program Administration

5.1. The Diving Safety Officer (DSO) has been contracted to assist OPP by providing the technical expertise necessary to operate a scientific diving program in support of OPP's polar research mission.

5.2. Diving Eligibility. OPP-funded or sanctioned research projects or related educational outreach activities can request underwater diving privileges under the auspices of the OPP scientific diving program. Diving may be authorized if the dive project meets the definition of scientific diving (see below), the dive plan follows this policy and directed SOPs, the participating divers are authorized to dive, and the operational requirements of the dive project can be met within the resources available.

5.3. The OPP DSO will determine whether the dive plan and divers meet the requirements stipulated in this policy and SOP and can be authorized to dive. The NSF OPP Safety Officer and programs, operations, and logistics managers will determine whether the overall operational support requirements of the specific research project (including the underwater component) can be met within current resource constraints.

6. Diving Control

6.1. Diving Approval: Upon the recommendation of the SDS, the DSO determines whether a specific project's dive plan is consistent with the requirements of this policy and SOP, based on the information submitted by the PI, and if so, recommends approval the dive plan. Likewise, the DSO reviews each diver's credentials and recommends approval or disapproval of the diver, as appropriate.

6.2. All divers must meet the following criteria:

- Certified for one year, including rescue diver training
- 50 Open water dives
- 25 drysuit dives
- 10 drysuit dives within twelve months of Antarctic dive operations.
- Minimum AAUS depth certification (or equivalent experience) of 100 feet of sea water (fsw) for the McMurdo area and 60 fsw for Palmer and research vessels, with at least one dive to the diver's maximum certification depth within twelve-months of deployment to Antarctica
- Current certification in first aid, CPR, and oxygen administration

6.3. Rebreather Diving: For diving using rebreathers, divers must meet these additional criteria:

6.3.1. Trained in the use of nitrox.

6.3.2. Certified for one year on a rebreather, with a minimum of 25 open-water rebreather dives and a minimum of 25 hours underwater time.

6.3.3. Certified on the type of rebreather to be used.

6.3.4. A minimum of 10 open-water rebreather dives and a minimum of 10 hours underwater time on the rebreather to be used, while using a drysuit, in the past year.

6.4. Checkout Dives

6.4.1. Divers may be required to successfully complete checkout dives with a party designated by the OPP DSO before deployment.

6.4.2. Diving approval may be revoked for any diver who does not demonstrate proficiency during the in-situ familiarization dives conducted by the OPP DSO or SDS in the field.

6.5. Oversight of Diving Activities: The OPP DSO and the SDS have the authority to suspend the diving privileges of any divers or dive team if, in his or her opinion, the divers are conducting themselves in a manner that is unsafe or inconsistent with this policy and SOP. Temporarily suspended diving privileges can be reinstated by the OPP DSO, subject to review and ultimate approval by the OPP SOHO.

6.6. Consequences of Violating Regulations: Failure to comply with this policy and SOP may be cause for revocation or restriction of a diver's authorization to dive anywhere in the OPP's area of responsibility and authority.

7. Policies and Regulations

7.1. Diver Qualifications

7.1.1. In no case will individuals be allowed to dive under OPP auspices unless they are trained and proficient in the type of diving they plan to do and familiar with the equipment that they plan to use.

7.1.2. Each diver shall have experience or training in the following:

- The use of instruments and equipment appropriate to the diving activity to be conducted
- Dive planning and emergency procedures
- CPR, diver rescue techniques, oxygen administration, and diving-related first aid
- Diving-related physics and physiology and the recognition of pressure-related injuries
- Any supplemental qualifications the DSO may impose (e.g., the number of dry suit dives or other qualifications not required by AAUS)

7.2. Diver Health: No dive team member shall be permitted to dive for the duration of any known condition likely to adversely affect the safety and health of the diver or other dive team members.

7.3. Solo Diver Prohibition: All dives conducted under OPP auspices shall be executed in such a manner as to ensure that every diver involved maintains constant, effective communication with at least one other certified scientific diver in the water, except as permitted in Section 7.8. This buddy diver system is established to provide mutual assistance, especially in the case of an emergency. Dives should be planned around the competency of the least experienced diver. If effective communication is lost within a buddy team, then all divers in the team shall ascend and reestablish contact.

7.4. Diving Under Ceilings

7.4.1. The dive access hole must be clearly marked by deploying a secured downline with flags and strobe lights, and the opening must be maintained to allow a normal exit from the water. If additional holes are required, they must be similarly marked and maintained.

7.4.2. Untethered diving is to the buddy system, and provided diving is conducted in clear water with adequate visibility to permit clearly seeing the access hole or its downline from anywhere the divers will be during the course of the dive permitted provided a downline is deployed and divers adhere

7.4.3. The use of a tendered tether is required when visibility restricts the diver from clearly seeing the access hole or downline, when shallow water restricts the diver's ability to see the entry hole, or if a danger is present.

7.4.4. Divers must carry with them two independent regulators: a primary and a backup.

7.4.5. These regulators may be attached to the same or to separate air sources. Diver carried bailout will be of sufficient volume to allow for a normal ascent and safety stop from any point in the planned dive.

7.4.6. A buoyancy compensator in conjunction with a dry suit is not required when diving with a downline that reaches the bottom at a diveable depth.

7.4.7. There must be surface support personnel at the planned entry/exit point for all dives. Additionally, during periods of darkness, at least two lights powered by independent sources must be in the hole.

7.5. Dive Computers and Pressure Gauges: All members of the diving team shall use an OPP-issued dive computer and a submersible, cylinder pressure gauge on all cylinders carried. Divers shall read and acknowledge understanding of the computer's manual, and all dives shall be planned and conducted within the computer's no-decompression limits.

7.6. Depth Limits

7.6.1. The diving certification issued by the diver's home institution will authorize the holder to dive to, but not exceed, his or her authorization depth.

7.6.2. Individuals are authorized to dive to either their depth certification from their home institution or to a depth specified by the OPP DSO, whichever is shallower. Minimum depth certification for the McMurdo area is 100 fsw and for Palmer and research vessels is 60 fsw.

7.6.3. An OPP-authorized diver may only exceed his or her depth certification by one step under the following conditions:

- If supervised by a diver certified to a greater depth.
- If an emergency situation makes this necessary.

7.7. Staged Decompression. Dives that require staged decompression are not authorized.

7.8. Diver Recall: A method of recalling the divers must be available at each dive site and understood by all divers and tenders.

7.9. Tended Diving with Communications: Solo divers using surface-supplied, or tethered-scuba modes of diving may be deployed, provided the following requirements are met:

- A full-face mask or helmet is utilized
- The system has a positive, two-way, voice-communication link
- The system has a tether, air supply hose (if appropriate), and communication line
- The diver has received a dive plan authorization number from the OPP DSO for this mode of diving to be used
- A stand-by diver who is able to enter the water expeditiously is present

7.10. Special authorization by the OPP DSO is required for:

- Surface-supplied diving
- Tethered scuba diving
- Blue-water diving
- Rebreathers (see Rebreather Standards, above, and Rebreathers, below)
- Mixed gases/oxygen enriched air (Nitrox)

8. Diving Operations and Plans

8.1. Working versus Scientific Diving: The USAP DSO or designee shall be responsible for determining whether dive operations are to be conducted as OSHA subject working dives or OSHA exempt scientific dives based on review of the dive plan. Questions such as those listed below will be used to determine the type of dive. Any negative answers would require the task to be conducted as a working dive.

8.1.1. Can the tasks be accomplished using simple hand tools (e.g. small hammers, pliers, chisels, wrenches, cameras, measuring tapes, collection bags and jars)?

8.1.2. Do the tasks require the expertise of a scientist or scientist-in-training?

8.1.3. Can the tasks be accomplished with minimal physical exertion?

8.1.4. Are the tasks limited solely to the observation of natural phenomena or responses of natural systems and/or gathering of data for scientific analyses?

8.1.5. If any object is to be lifted or moved, is its weight underwater <100 pounds?

8.1.6. Will the tasks result in the advancement of science?

8.2. Pre-dive Information: Dive Plans. Before conducting any diving operations, the PI must provide the following information in POLAR ICE or other communication option, as appropriate:

- The names of participating divers, their qualifications, and their depth certifications.
- The name, telephone number, and relationship of the person to be contacted for each diver, in the event of an emergency.
- The approximate number of proposed dives.
- The locations of proposed dives.
- The estimated depths and bottom times anticipated
- The proposed work, the equipment and/or boats to be employed, whether repetitive dives will be required, and details on any hazardous conditions anticipated

8.3. Lead Diver. For each dive, one individual shall be designated as the lead diver. He or she shall be at the dive site during the diving operation. The lead diver shall be responsible for:

8.3.1. Coordinating diving with other known activities in the vicinity that may interfere with the diving operation.

8.3.2. Briefing the dive team members on:

- Dive objectives
- Any unusual hazards or environmental conditions likely to affect the safety of the diving operation
- Any modifications to diving emergency procedures necessitated by the specific diving operation
- The need to report immediately any physical problems or adverse physiological effects, particularly symptoms of pressure-related injuries

8.3.3. Planning the diving operation, which shall include considerations of the safety and health aspects of the following:

- Diving mode
- Surface and underwater conditions and hazards
- Breathing gas supply
- Thermal protection
- Dive equipment
- Dive team assignment
- Residual inert gas status of dive team members
- Decompression schedule and altitude corrections
- Emergency procedures
- Hazardous marine life
- Currents

8.4. Surface Support: All dives conducted under the auspices of OPP shall be supported by personnel who shall remain on-site and at the surface during the course of the dive, and who are trained to support that specific type of diving activity. At a minimum, these personnel must

be aware of emergency response procedures for the specific dive site, diver recall procedures, methods of extracting an unconscious diver from the water, and the location and use of the emergency oxygen kit.

8.5. Pre-Dive Checks: Each diver shall conduct a pre-dive functional check of his or her diving equipment in the presence of the dive buddy or tender. This functional check shall include, but not be limited to, confirming that:

- The cylinder valve positively opens and closes
- The submersible pressure gauge works and registers the expected amount of air in the cylinder
- The in-line shut-off valve on the primary regulator is in the open position
- There is adequate air delivery and an absence of free flow (by inhaling but not exhaling on both primary and backup regulators)
- The dry suit inflator valve delivers air without free flow, and the dry suit exhaust valve vents air when open
- If used, the buoyancy compensator inflator valve delivers air without free flow, and the exhaust valve vents air when open
- Any other gear operates according to specifications or expectations

8.6. Refusal to Dive: It is the diver's responsibility and duty to refuse to dive if in his or her judgment conditions are unfavorable, or if he or she would be violating the precepts of his or her training, USAP diving standards, or his or her home institution's diving manual.

8.7. Agreement to Dive: No dive team member shall be required to be exposed to hyperbaric conditions against his or her will, except when necessary to prevent or treat a pressure-related injury.

8.8. Terminating the Dive

8.8.1. A diver may terminate a dive at any time if he or she feels it would be unsafe to continue. Divers should begin terminating their dives by notifying their buddies of the termination, stopping work, and commencing ascent. Divers must be at their safety stops with no less than 20 cf of air (see Table 1) and must have exited the water with no less than 10 cf.

8.8.2. Examples of situations necessitating dive termination include:

- Environmental conditions that become unsafe
- One or more divers becomes chilled
- Cylinder gas volume approaches 20 cubic feet
- Dive profiles approach required stage decompression

- Equipment failure that immediately or potentially jeopardizes the safety of the dive

Table 1: Minimum reserve pressures for selected cylinder configurations

Cylinder Type (Ft^3)	Pressure at 20 Ft^3 (psig)	Pressure at 10 Ft^3 (psig)
Single Steel 95.1	600	300
Single Steel 110	500	250

8.9. Equipment Requirements

8.9.1. A functional oxygen kit shall be present at the dive site for every dive, and all participating divers and tenders shall be trained in its use.

8.9.2. Each diver shall have a submersible pressure gauge that measures scuba cylinder pressure and can be monitored by the diver during the dive.

8.9.3. Each diver shall have the capability of achieving and maintaining positive buoyancy.

8.10. Post-Dive Safety Checks. After completing a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions to the lead diver, PI, and the SDS.

8.11. Emergencies - Deviation from Regulations: Any diver may deviate from the requirements in this policy and SOP to the extent necessary to prevent or minimize a situation that is likely to cause death, serious physical harm, or major environmental damage. A written report of such actions must be submitted to the OPP SOHO, DSO and SDS within 48 hours explaining the circumstances and justifications for such action.

8.11.1. Potentially dangerous diving conditions must be communicated to the on-site divers as soon as possible.

9. Dive Record Requirements

9.1. Personal Diving Log: Each diver shall log every dive. Completed log sheets shall be submitted to the SDS or other approved representative, who will forward them to the DSO. If an emergency causes a diver to incur a staged decompression obligation, this shall be noted in the log. The log shall be in a form specified by OPP and shall include at least the following:

- Dive date
- Names of diver and buddies
- Total dive time
- Maximum depth attained
- Location of dive
- Dive computer used
- Regulator used

- Mixed gas composition and tables, if used
- Mode of diving (scuba, surface supply, rebreather)
- Safety stop depth and time
- Any accidents, equipment failures, or dangerous incidents occurring during the dive

9.2. Record Maintenance: The SDS and USAP shall maintain records for each authorized scientific diver, including these items for at least the specified period:

- Record of dive - one year, but five years if there has been a pressure-related injury.
- Pressure-related injury assessment - five years.
- Records of hospitalization - five years.
- Equipment inspection and testing records - current entry or tag, or until equipment is withdrawn from service.

9.3. Availability of Records: Institutional DSOs are required by AAUS standards to maintain certain permanent records. Divers must agree to the release of that information deemed necessary for the OPP DSO to make a reasonable safety and health judgement regarding the diver's qualifications to dive. Failure to provide sufficient information may result in the denial of the OPP diving authorization.

10. Dive Accident Reporting

10.1. The diving program has an official and valid interest in all diving incidents and accidents. Analysis of incidents is important so that causes can be determined and corrected to prevent future occurrences and/or injuries that may impact diving readiness and authorizations.

10.2. The SDS and/or McMurdo or Palmer Station medical personnel shall report to the DSO any diving-related injury or illness that requires any dive team member to use therapeutic surface oxygen, any barotrauma, or any episode of unconsciousness related to diving activity. The circumstances of the incident and the extent of any injuries or illnesses shall be specified to the extent allowable by patient privacy regulations, taking into account the program's legitimate requirement to know the physical readiness of all divers to safely dive.

10.3. The DSO shall maintain these records, which shall also contain:

- A description of symptoms - including depth and time of onset
- A description and results of treatment
- A printout of the relevant dive computer profile(s)
- A dive history for the previous seven days
- Any history of flying within those seven days

- The SDS and the DSO shall prepare a report of any diving accident requiring recompression or resulting in a serious injury, e.g., decompression sickness or gas embolism, and shall notify the OPP SOHO and the diver's home institution DSO
- Incidents that do not involve injuries, e.g., free-flows and other equipment malfunctions, shall be recorded in the dive log

11. Diving Equipment

11.1. Mandated USAP Equipment: USAP provided scuba regulators and dive computers must be used by all USAP divers.

11.2. Equipment Maintenance

11.2.1. The PI is responsible for ensuring that all grantee-provided scuba equipment has been provided regular maintenance within the past 12 months.

11.2.2. USAP issued equipment will be maintained by SDS or designee.

11.2.3. All equipment shall be maintained according to manufacturer's specifications

11.3. Equipment Inspection

11.3.1. All inspections, tests, maintenance, and record keeping referred to in this section must be performed by the SDS or other approved individual.

11.3.2. Any equipment that fails inspection criteria shall be removed from service until it can be brought into compliance.

11.4. Equipment Records: Each equipment modification, repair, test, calibration, or maintenance service shall be logged for the equipment listed below. The logs shall include the date and nature of work performed, serial/identification number of the item, and the name of the person performing the work.

Compressors	Submersible pressure gauges
Regulators	Depth gauges
Scuba cylinders	Cylinder valves
Diving helmets	Dive computers
Gas control panels	Air storage cylinders Air filtration systems

11.5. Breathing Masks and Helmets: Breathing masks and helmets shall have:

- A non-return valve at the attachment point between helmet or mask hose, which shall close readily and positively.
- An exhaust valve.
- A minimum ventilation rate capable of maintaining the diver at the diving depth.

11.6. Rebreathers

11.6.1. Only those models of rebreathers specifically approved by the DSO shall be used.

11.6.2. Current service records of the rebreather must be submitted to the DSO.

11.6.3. Divers must carry sufficient bailout, configured in a way to make it available to self or buddy, to allow egress from the water from any point in the planned dive.

11.6.4. Oxygen partial pressures shall not exceed 1.4 atmospheres at depths greater than 30 fsw, or 1.6 at depths less than 30 fsw.

11.6.5. All dives will be within the no-decompression limits of the unit.

11.6.6. CO2 scrubbers will only be used for a maximum of one-half the manufacturer's recommended time limit.

11.7. Scuba Air Cylinders

11.7.1. Shall be designed, constructed and maintained in accordance with provisions of the applicable Unfired Pressure Vessel Safety Orders.

11.7.2. Must be hydrostatically tested in accordance with Department of Transportation (DOT) standards.

11.7.3. Must have an internal visual inspection before they are issued for use, and thereafter at intervals not to exceed 12 months, or sooner if they are suspected of having internal moisture.

11.8. Cylinder valves shall be functionally tested at intervals not to exceed 12 months.

11.9. Backpacks and weight systems shall be regularly examined by the persons using them. When used in open water, all weight systems and scuba backpacks worn by the diver shall be equipped with quick release devices designed to permit jettisoning of the gear. The quick release device must operate easily with a single motion from either hand.

11.10. Pressure Gauges shall be inspected and tested annually, and thereafter as necessary.

11.11. First Aid Supplies: Both oxygen and a first-aid kit adequate for the diving operation shall be available at the dive location. When used in a hyperbaric chamber or bell, the first-aid kit shall be suitable for use under hyperbaric conditions.

11.12. Underwater Tools: Hand-held electrical tools and equipment used under water shall be specifically approved for this purpose, and they shall not be supplied with power until requested by the diver.

11.13. The use of specialized equipment, such as listed here, must be approved by the USAP DSO:

- Lift bags
- Underwater power tools
- Air lifts
- Come-alongs
- Underwater propulsion vehicles (DPV)
- Any equipment connected to the surface with an air-line or load line

11.14. Oxygen cylinder filling for rebreathers requires special training from the diving supervisors.

12. Breathing Air Standards

12.1. Breathing air for scuba shall meet Compressed Gas Association (CGA) Grade E air quality standards.

12.2. Compressor Systems

12.2.1. Low pressure compressors used to supply breathing air shall be equipped with a volume cylinder, with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.

12.2.2. Compressed air systems over 500 psi shall have slow-opening shut-off valves.

12.2.3. All air compressor intakes shall be located away from areas containing exhaust or other contaminants.

12.3. Compressor Operation and Test Records

12.3.1. Gas analysis and air tests shall be performed on breathing air compressors by the SDS or other approved representative at regular intervals of not more than 100 hours of operation or 6 months, whichever occurs first. The results of these tests shall be entered in a formal log and be maintained by the SDS.

12.3.2. A log shall be maintained by the SDS or other approved representative showing any operation, repair, overhaul, filter maintenance, or temperature adjustment for each compressor.

12.4. Oxygen Safety

12.4.1. Equipment used with oxygen or mixtures containing over forty percent (40%) oxygen by volume shall be designed and maintained for oxygen service.

12.4.2. Components (except umbilical) exposed to oxygen or mixtures containing over forty percent (40%) oxygen by volume shall be cleaned of flammable materials before being placed in service.

12.4.3. Oxygen systems over 125 psig shall have slow-opening shut-off valves.

13. Construction or O&M Diving

13.1. Background: Though not as frequently executed as scientific diving, there are occasions where O&M or even construction diving is required. This type of diving presents additional hazards as compared to scientific diving, such as underwater welding, crane hazards, electrical hazards, and pressure differentials that create sucking forces, among others. Many of these hazards require lockout/tag-out procedures.

13.2. Procedures

13.2.1. Compliance is required with all requirements in 29 CFR 1910.410.

- Commercial SCUBA air diving with one diver in the water requires a minimum of three dive-team members: a designated person-in-charge (DPIC) (see 29 CFR 1910.410(c)), a standby diver (see 29 CFR 1910.424(c)(1)), and a line-tended diver (see 29 CFR 1910.424(c)(2)). Commercial SCUBA diving with two divers in the water requires a minimum of four dive-team members: a DPIC (see 29 CFR 1910.410(c)), a standby diver (see 29 CFR 1910.424(c)(1)), and two divers (see 29 CFR 1910.424(c)(2)).
- Commercial surface-supplied air diving to 100 feet with one diver in the water requires a minimum of three dive-team members: a DPIC (see 29 CFR 1910.410(c)), and a diver “who shall be continuously tended [by a tender other than the DPIC] while in the water” (see 29 CFR 1910.425(c)(1)). For surface-supplied air diving that is 100 feet or less and does not involve planned decompression, a standby diver is not a specified requirement for every dive. We operate with a three-person team: One DPIC (Diving Supervisor), one suited standby diver, and one working diver.

13.2.2. All administrative steps required for scientific diving shall also be complied with for O&M and construction diving, to include submission of a dive plan to the OPP Diving Safety Officer for review and acceptance before the dive. A job hazard analysis (JHA) shall be completed for each working dive and shall be reviewed by the dive supervisor on-site before the dive. All members of the dive team shall sign the JHA, indicating they understand the hazards and the controls that will be utilized to mitigate risk. For emergent diving needed asap due to severe risk to life, life critical property, or severe environmental loss, a JHA shall be developed and provided to the local safety office, the NSF Rep, and NSF Station Manager for awareness. If none of those parties are available, the Dive Log, JHA,

and short justification statement shall be emailed into the NSF OPP Diving Safety Officer as soon as reasonably possible after the dive for an after- action review.

13.2.3. Safety training, as required by OSHA for specific activities, such as welding and lockout/tag-out, shall be provided to dive team members as needed, and it shall be documented. In addition, the divers must have experience performing similar types of underwater work in the past, e.g., welding.

14. Definitions

American Academy of Underwater Sciences (AAUS): The national association of scientific diving scientists, diving technicians, and diving safety officers that is generally responsible for setting standards for scientific diving.

Buddy diver: Second member of the dive team.

Certified diver: A diver who holds a current certification from an AAUS scientific diving program or nationally recognized certifying agency.

Closed-circuit rebreather: A type of scuba equipment that recirculates all of the exhaled breathing gas.

Cylinder: A pressure vessel for storage of gases.

Decompression sickness (DCS): A condition with a variety of symptoms that may result from gas and bubbles in the tissues of divers after pressure reduction. DCS can be caused by exceeding no-decompression limits or exceeding the prescribed rate of ascent.

Depth: The dive log should denote the maximum depth of the dive.

Depth Certification: The depth to which a diver is certified to dive.

Dive: A descent into the water, an underwater activity utilizing compressed gas, an ascent, and return to the surface.

Dive computer: An electronic device for tracking depth and time and computing inert gas uptake and off-gassing.

Dive Safety Manager: A contract position within the OPP Safety and Occupational Health (SOH) office that advises OPP on diving related matters. Colloquially known as the OPP DSO to align with the science diving community nomenclature.

Dive site: The physical location of a dive.

Dive table: A profile or set of profiles of depth-time relationships, including their ascent rates, for particular breathing mixtures, to be followed after a specific depth-time exposure or exposures. (Synonymous with Decompression Table.)

Dive team: Divers and support individuals who are exposed to or control the exposure of others to hyperbaric conditions.

Diver: An individual in the water who uses an apparatus that supplies breathing gas at ambient pressure.

Diving mode: A type of diving requiring specific equipment, procedures, and techniques; for example, scuba, surface-supplied air, or mixed gas.

Diving Safety Officer (DSO): Individual with scientific diving expertise responsible for advising their institutions on scientific diving matters, authorizing dive plans, and authorizing divers to dive under institutional auspices.

Dry suit: An exposure suit with airtight seals at the neck and wrists, which allows the introduction and exhaust of compressed air through valves and keeps the diver dry during the dive.

Hyperbaric: A condition defined by pressure greater than one atmosphere at sea level.

Lead diver: A certified scientific diver with the experience and training to lead the diving operation.

Mixed-gas diving: A diving mode in which the diver is supplied in the water with a breathing gas other than air.

No-decompression limits: The maximum depth and time parameters of a decompression algorithm for which staged decompression is not required.

Open water: Water not covered by a ceiling, ice or otherwise.

Principal investigator (PI): The scientist in charge of a science project, usually the senior scientist.

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, and barotrauma.

Recompression chamber: A pressure vessel for treating pressure-related dive accidents, such as cerebral arterial gas embolism (CAGE) and DCS. (Synonymous with Hyperbaric Chamber).

Regulator: A device for delivering air from high pressure to ambient pressure, usually for breathing purposes.

Scientific diving: All diving performed by individuals necessary to and part of a scientific research or educational activity, in conjunction with a project or study under the jurisdiction of any public, private, or educational institution or similarly recognized organization, department, or group. To further clarify, OPP requires that:

- The underwater diving activity is an integral and essential part of the project.
- The project is a scientific, research, or educational activity consistent with OPP' s mission to foster research and education in the sciences and engineering,
- The specific tasks that the diver performs under water are observational or involved in data gathering, rather than tasks usually associated with commercial diving; and;
- The work products of the diving activity are available to the public for review or examination.

Scientist: An individual who dives to conduct scientific operations which require specific knowledge and expertise in which the individual is fully qualified.

Scientist-in-Training: An individual who dives to conduct scientific operations which require specific knowledge and expertise, but whose science activities and diving are conducted under the direct or indirect supervision of a Scientist.

SCUBA diving (scuba): A diving mode independent of surface supply in which the diver uses an open-circuit, self-contained, underwater breathing apparatus.

Supervisor of Dive Service (SDS): Individual with scientific diving expertise and logistical responsibilities, employed by the USAP Antarctic support contractor. He or she coordinates closely with the USAP DSO and safety and health officer to manage the USAP scientific diving program.

Surface-supplied diving: A diving mode in which the diver in the water is supplied from the surface with compressed gas for breathing, either from an air bank or from a compressor with volume cylinder.

Tender: A qualified person on the surface who is responsible for assisting and communicating with divers during a dive by various means, including a tether.

Tether: A line attached to a diver(s) to prevent their becoming lost underwater or under ice due to poor visibility or swift current. This is also a means of diver-to-surface communication.

Total Dive Time: Time from leaving surface to arriving back on surface. This is the time recorded in the USAP dive logs.

U.S. Antarctic Program (USAP): An organization of the U.S. government made up of scientists and support personnel who carry out research that can only be done or best be done in

Antarctica. The program comprises research by scientists selected from universities and other research institutions and operations and support by a contractor and other agencies of the U.S. Government. The National Science Foundation (the U.S. Government agency that promotes the progress of science) funds and manages the program through its Geosciences Directorate, Office of Polar Programs.

Working dives: Commercial diving as defined by OSHA under 29 CFR 1910, Subpart T, which involves tasks such as inspection of pipelines and outfalls, underwater welding, lifting heavy objects, and diving in contaminated water.