



U.S. FISH & WILDLIFE SERVICE



DIVE OPERATIONS HANDBOOK

(Established by 241 FW 10)

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Foreword

This handbook represents the minimum dive safety standards for the U.S. Fish and Wildlife Service (Service) at present. As scientific diving progresses, the Service's National Diving Control Board (NDCB) will update this handbook to reflect the best safe diving practices.

Service Manual chapter [241 FW 10](#), Diving Safety, establishes the *Dive Operations Handbook* and requires its use. We intend for the policies, procedures, and standards in the handbook to govern the training and dive operations of all Service personnel authorized to participate in dive operations.

Scientific Diving Definition

Scientific diving is defined ([29 CFR 1910.402](#)) as diving that personnel perform solely as a necessary part of a scientific research or educational activity to accomplish scientific research tasks. Scientific diving **does not include** performing tasks usually associated with commercial diving, with emphasis on construction and the use of construction tools such as heavy equipment, power tools, explosives, welding equipment, and burning equipment. As mandated by the Department of the Interior (DOI, Department) in [485 Departmental Manual \(DM\) 27](#), all Service scientific diving operations must follow the requirements of "scientific diving" programs in order to receive an exemption from the Occupational Safety and Health Administration (OSHA) commercial diving regulations (see [Appendix 3](#)).

The Service's diving activities all fall under the umbrella of scientific diving. Scientific diving must be conducted in accordance with [29 CFR 1910.401\(a\)\(2\)\(iv\)](#); [29 CFR 1910 Subpart T, Appendix B](#); and the community standard for scientific diving as reviewed and approved by the NDCB; so the Service limits the purposes of its dives to:

- (1) *Natural Resource Management* – Dives involving the protection, monitoring, inventorying, documentation, and survey of natural resources.
- (2) *Cultural Resource Management* – Dives involving the protection, monitoring, inventorying, documentation, and survey of cultural resources.

Scientific Diving - OSHA Exemption

OSHA has granted an exemption for scientific diving from commercial diving regulations under the following conditions ([Appendix B of 29 CFR part 1910, Subpart T](#)):

- 1) The Service must have a National Diving Control Board (NDCB), the majority of whose members must be active scientific divers. The NDCB must have autonomous and absolute authority over the scientific diving safety program's operation.
- 2) The NDCB must have, at a minimum, the authority to approve and monitor diving projects, review and revise the diving safety handbook (i.e., this handbook), ensure compliance with the handbook, certify the depths to which a diver has been trained, take disciplinary action for unsafe practices, and ensure adherence to the buddy system (i.e., a diver must be accompanied by and is in continuous contact with another diver in the water) for Self-Contained Underwater Breathing Apparatus (SCUBA) diving.
- 3) The NDCB must keep an up-to-date diving safety handbook (i.e., this handbook), which must include, at a minimum, procedures covering all diving operations specific to the program,

including procedures for emergency care, recompression and evacuation, and the criteria for diver training and authorization.

- 4) The purpose of projects using scientific diving is the advancement of science; therefore, information and data resulting from the projects are non-proprietary.
- 5) The tasks of a scientific diver are those of an observer and data gatherer. Based on the nature of their activities, scientific divers must use scientific expertise in studying the underwater environment.

Chapter 1 – Authorities, Scope, and Implementation

1.1 Introduction

The Service manages many wildlife areas and natural resources requiring underwater diving operations. Dive operations are essential to the protection of these resources, as well as the management of National Wildlife Refuge System (NWRS) resources and visitor protection. Service personnel conduct such dives to protect and record submerged natural, cultural, historical, and scientific resources.

1.2 Authorities

- A. Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters ([29 CFR 1960](#)).
- B. Commercial Diving Operations ([29 CFR 1910, Subpart T and Appendix B, Guidelines for Scientific Diving](#)).
- C. [Departmental Occupational Medicine Program Handbook \(485 DM\)](#)
- D. [Departmental Personnel Bulletin 17-15](#), Drug-Free and Alcohol-Free Workplace Plan.
- E. [Executive Order 12196](#), Occupational Safety and Health Programs for Federal Employees.
- F. [Executive Order 12564](#), Drug-Free Federal Workplace.
- G. Medical Qualification Determinations ([5 CFR 339](#)).
- H. Occupational Safety and Health Act, Section 19, Federal Agency Safety Programs and Responsibilities ([Public Law 91-596](#)).
- I. Privacy Act of 1974 ([5 U.S.C. 552a](#)).
- J. Rehabilitation Act Regulations ([29 CFR 1614.203](#)).
- K. Rehabilitation Act of 1973, as amended ([Public Law 93-112](#)). See also [29 U.S.C. 791\(g\)](#) and [794\(d\)](#) (incorporating standards of the Americans with Disabilities Act into the Rehabilitation Act).
- L. [485 DM 27](#), Underwater Diving Safety.

1.3 Scope

This *Dive Operations Handbook* and [241 FW 10](#) cover management and safe diving practices for Service divers and Service dive operations. Both documents apply to all Service employees, volunteers, and cooperating personnel who engage in or oversee diving activities on behalf of the Service.

The following types of diving are **not** covered by this handbook and [241 FW 10](#):

- *Recreational diving within refuge areas.* Compatibility of recreational diving in the NWRS is determined on a site-by-site basis. See Service Manual chapter [603 FW 2](#) for more information on compatibility.
- *Commercial diving operations* involving private salvage, marine construction, and industrial inspection.
- *Non-Service divers conducting dive operations outside the oversight and responsibility of the Service.*

1.4 Requirements

All Service diving activity must be conducted in accordance with [29 CFR 1910, Subpart T](#); [485 DM 27](#); this *Dive Operations Handbook*; and [241 FW 10](#).

The Regional Dive Officer (RDO), with the concurrence of the NDCB, must approve any deviations from operational procedures that this handbook or the accompanying chapter requires. The request for a variance with RDO approval and NDCB concurrence must be in writing (see [section 8.2](#)).

1.5 Procedure of Change

The NDCB may revise this handbook as needed. The NDCB will ensure that any record of changes to the handbook are distributed electronically to the Joint Administrative Operations (JAO) Safety program and all Service units with dive programs as those changes are implemented.

1.6 Implementation

The Service manages its diving safety program using this handbook and a diving safety control board model (i.e., the NDCB) for scientific diving that contains the elements described in [29 CFR 1910.401\(a\)\(2\)\(iv\)](#).

The responsibility for implementation and program accountability rests with the Director, Regional Directors, or other Regional managers as the NDCB requires. When a Project Leader/Project Manager/supervisor decides to implement a diving program, that individual must manage it according to this handbook.

The Service considers all diving that is necessary to and part of scientific research, or an educational activity in conjunction with a project or study under the jurisdiction of the Service, to be scientific diving. Service scientific diving operations are those that involve the following:

1.6.1 Service Personnel

- (1) Service employees or authorized volunteers, where such people are acting within their official capacity as a Service affiliate or are engaged otherwise in Service scientific diving operations.
- (2) Individuals whose diving activities are in support of a research or educational project that the Service has approved.
- (3) Individuals from other organizations who are engaged in scientific diving operations under Service management.

- (4) People who are visiting and engaged in diving with the approval of the Service.

1.6.2 Service Equipment

Service “equipment” refers to equipment that the Service owns, purchases, rents, charters, or otherwise provides. It includes diving equipment, vessels, and motor vehicles used for diving operational support, and compressors, compressed air, and other scientific supplies or equipment used to meet the diving objectives.

1.6.3 Service Funding

Scientific diving activities are supported in whole or in part by Service-administered funds. All research and training proposals that include scientific diving operations must have dive modes that the RDO or the NDCB, or both, have approved.

1.7 Department of the Interior Underwater Diving Safety

The guidelines in this handbook abide by all safety procedures and guidelines in DOI’s policy at [485 DM 27](#) [Safety and Occupational Health Program (Part 485), Underwater Diving Safety (Chapter 27)]. The guidance in this handbook is more comprehensive and unique to the types of diving activities that Service personnel conduct.

Chapter 2 – Operational Control

2.1 Organizational Level /Positions and Functions

2.1.1 Assistant Director – Management and Administration

The Assistant Director – Management and Administration is responsible for providing overall direction for the administration and implementation of an effective diving safety program.

2.1.2 Chief, Joint Administrative Operations (JAO), Division of Safety Operations

The Chief, Safety Operations is responsible for interpreting this handbook’s requirements to resolve Servicewide issues and questions about the diving safety program. The Chief may also bring any issues to the NDCB so that they can revise the handbook as a means of resolution.

2.1.3 National Dive Control Board

The NDCB provides administrative oversight of the Service’s diving safety program to ensure compliance with OSHA, Departmental, and Service requirements. The NDCB, with representation from the JAO Safety Program, has authority over the scientific diving safety program's operations.

The NDCB consists of Regional Dive Officers or their representatives and the Chief, Safety Operations (or designee), who is a non-voting member. The NDCB may also appoint other qualified individuals as non-voting members. NDCB members may designate alternates to act on their behalf. The NDCB selects a chair, whose term is for 2 years. They also select a vice chair every 2 years, at which time the former vice chair moves on to take over the chair position as long as they have the approval of the NDCB, and the chair resumes regular membership.

Meetings are held annually, or more often when necessary. A quorum consists of three voting NDCB members. Decisions are approved by majority vote when at least a quorum is in attendance. When a vote is tied, the motion will fail.

The Regions are responsible for funding the activities of their NDCB representatives.

The NDCB must have the following members, the majority of whom must be active divers:

- (1) Regional Dive Officers or representatives,
- (2) Chief, Safety Operations, or designee (non-voting), and
- (3) Other qualified individuals approved by the NDCB. NDCB members may designate alternates to act on their behalf.

The NDCB has autonomous and absolute authority over the scientific diving safety program's operation. Specifically, the NDCB must:

- (1) Develop and maintain liaisons with other organizations that have diving programs.
- (2) Review and revise this handbook, as needed.
- (3) Ensure compliance with this handbook.
- (4) Take disciplinary action for unsafe practices. Disciplinary action is limited to diving-related measures. If further action is necessary, it must be conducted through regular administrative procedures.
- (5) Act as a board of appeal to consider diver-related problems and adjudicate appeals from divers whose diving authorization has been denied or suspended.
- (6) Suspend diving operations that are unsafe or unwise.
- (7) Recommend new equipment or techniques.
- (8) Periodically review RDOs and their Regional and field dive programs' performance and assess their training needs. The NDCB also has the authority to make recommendations to the appropriate Regional Director on whether or not to allow an RDO to continue in that appointment.
- (9) Serve as a board of investigation to inquire into the nature and cause of diving accidents or violations of this handbook.
- (10) Review requests for variance from the diving safety requirements in this handbook, as submitted in writing through the RDO.

2.1.4 Regional Directors

The Regional Directors who have divers within their areas of responsibility appoint a Regional Dive Officer (RDO). The Regional Director must approve the appointment of the RDO in writing. Regional Directors must ensure that sufficient resources and support are in place to implement the requirements of this handbook. The Regions are responsible for funding the activities of their NDCB representatives.

2.1.5 Regional Dive Officer (RDO)

The RDO must be an active Service diver and have broad technical and scientific expertise in research-related diving. The Regional Director must approve the appointment of the RDO in writing. The RDO

directs, coordinates, and advises on all phases of the Regional diving safety program. The RDO must demonstrate the ability to administer a safe and efficient diving program by documenting dive history, Dive Safety Plans, dive operation status, diver qualifications, and diver fitness.

To qualify for appointment as the RDO, the RDO must have:

- (1) Completed Rescue Diver and an advanced dive leadership course (i.e., Dive Master, Assistant Instructor, or Open Water SCUBA Instructor) from a nationally recognized diving organization or Government equivalent;
- (2) Completed a minimum of 100 dives;
- (3) Have a minimum of 5 years diving experience; and
- (4) Have at least 1 year of experience diving in the conditions found in the geographic area that they represent.

As an alternative to the advanced diving leadership course requirement, the candidate may be vetted through the NDCB based on experience and technical diving skills that qualify them to lead their dive team.

The RDOs must:

- (1) Review all diving-related activities within their Regions to ensure compliance with this handbook and all national and Regional diving program policies, procedures, and standards. The RDO must notify the appropriate Project Leader and the NDCB of any deficiencies.
- (2) Periodically inspect diving equipment storage and any existing dive facilities. This duty may be delegated to a Field Diving Officer.
- (3) Plan and coordinate diver training programs to meet the Regions' diving needs.
- (4) Maintain files of Regional diving activities, including current diver qualifications.
- (5) Investigate any incidents that result in property damage to Government-owned equipment, injuries, and any equipment failure or problems. Ensure that all reporting is entered into the Safety Management Information System (SMIS). The RDO must notify all Regional divers and the NDCB of all incidents and necessary actions.
- (6) Promote Regional diving operations and assist Project Leaders in ascertaining how the Regional diving safety programs can help meet their objectives. The RDO may help Project Leaders assess the need to establish a diving program.
- (7) Nominate Field Diving Officers to assist administratively and operationally in managing the diving safety programs within their geographic areas on an as-needed basis. Line management must approve the nominees.
- (8) Keep abreast of technological advances and problems with diving equipment and diving methods and advise divers within their Regions and the NDCB of this information.
- (9) Coordinate and authorize diving activities and proficiency standards with other cooperating agencies with whom we may conduct joint operations.

- (10) Issue initial diving authorizations and annual reauthorizations in accordance with the requirements in this chapter. The RDO may delegate this task to the Field Diving Officer.
- (11) Coordinate and/or conduct qualification/training dives with prospective Service divers.
- (12) Report any dive-related accident that occurs in their geographic areas to the responsible JAO Safety Manager and assist with followup investigations and reports.
- (13) Serve as the chair of the NDCB when called upon to do so.
- (14) Suspend diving operations that they consider to be unsafe or unwise.

2.1.6 Field Diving Officer (FDO)

The FDOs must be active Service divers and have broad technical and scientific expertise in scientific research diving. The FDO assists the RDO, as requested, with duties that are within the individual's capability. The RDO and the Field Supervisor/Project Leader must appoint the FDO in writing. If a fully qualified candidate is not available, the RDO may nominate the best-qualified diver in the geographic area to an "acting" capacity until a fully qualified candidate is available or until that diver undergoes a training program developed by the NDCB/RDO to upgrade their abilities. The FDO must be an active, authorized Service diver; must have completed Rescue Diver training; have a minimum of 100 dives; and have at least 1 year of experience diving in the conditions found in the geographic area they represent.

FDO duties that the RDO may assign include:

- (1) Evaluating field diving operations within an assigned geographic area to determine if they are conducted in a safe and efficient manner and in accordance with this handbook and all national and Regional policies, procedures, and standards. The FDO must bring any deficiencies or potential problems to the attention of the RDO and appropriate line management.
- (2) When assigned by the RDO, the FDO may conduct proficiency training dives and review mastery of individual diver skills. FDOs may only do this if they have a minimum of 100 dives, 5 years of diving experience, and mastery of dive skills in the dive environment and equipment for which they are authorized.
- (3) Ensuring that all divers understand procedures for routine and emergency measures prior to any diving activities.
- (4) Ensuring that authorization, training, and proficiency requirements and records for all active divers within their geographic areas are maintained and providing the active divers' required certification documentation to the RDO.
- (5) Immediately reporting any Service dive-related incident/accident that occurs in their geographic areas to the RDO and the responsible JAO Safety Manager and assisting with followup investigations and reports.
- (6) Maintaining records of all dive logs for their geographic areas.

2.1.7 Field Supervisors/Project Leaders

The Field Supervisors/Project Leaders who have divers within their areas of responsibility must ensure that sufficient resources and support are provided to implement the requirements in this handbook.

Field Supervisor/Project Leader responsibilities include:

- (1) Ensuring that:
 - a. Divers within their jurisdictions conduct operations in accordance with the requirements in this handbook and encourage staff participation commensurate with workload and budgetary constraints.
 - b. Dive teams submit a Dive Safety Plan (DSP) to the RDOs and FDOs, as appropriate.
 - c. Only authorized divers participate in diving activities.
 - d. Divers have the necessary time, equipment, and training to meet and maintain authorization standards, including up to 3 hours per week for aerobic exercise and strength building. Line management supervisors are responsible for authorizing the time, resources, and hazard duty payment necessary for divers to meet minimum proficiency standards.
- (2) Providing funding for physical examinations, first aid and cardiopulmonary resuscitation (CPR) training, equipment, oxygen administration, and any additional standard diver training that may be required for a diver to maintain diving authorization.
- (3) Supporting a continuing education plan developed by the RDO for each diver to meet the dive-related training requirements of 40 hours every 3 years.
- (4) Responding in a timely fashion to reports or requests from RDOs or FDOs.
- (5) Relying on the diver's professional judgment as to whether dive conditions are unsafe or unfavorable and would violate the dictates of their training or this handbook.
- (6) If an accident/incident involving personnel under their responsibility occurs, ensuring that a report is completed electronically using the Department's SMIS and the responsible JAO Safety Manager is notified immediately. SMIS is the Department's internet-based system for reporting accidents and injuries. See [section 7.2](#) for more information about reporting accidents.

2.1.8 Service Lead Diver

For each dive plan, in consultation with the RDO/FDO, one diver must be selected as the Service Lead Diver. The Service Lead Diver cannot be a volunteer and must be an authorized diver. The Lead Diver must have experience and training in the conduct of the assigned diving operations, and the skill level appropriate to the dive environment and/or dive technique being used. The Service Lead Diver must be at the dive location during the diving operation.

The Service Lead Diver is responsible for:

- (1) Dive operation coordination, including with other known activities in the vicinity that are likely to interfere with diving operations.

- (2) Ensuring all dive team members possess current certification and are qualified for the type of diving operation.
- (3) Dive planning.
- (4) Pre-dive briefing and Go/No Go Risk Assessment Worksheet.
- (5) Emergency procedures.
- (6) Suspending diving operations if in their opinion conditions are not safe.
- (7) Reporting any incidents or accidents to the FDO and RDO.

The Service Lead Diver has full authority to institute a mandatory day of rest (i.e., 24 hours without diving or strenuous activity) for individual divers or the entire dive team, if, in the Lead Diver's opinion, continued diving would compromise the safety of the divers.

2.1.9 Service Diver

A Service diver is a diver meeting and maintaining all Service Dive Card requirements outlined in [section 3.4.1](#) pending authorization to dive from the RDO.

Service divers must be trained for the diving classifications, modes, equipment, and breathing gases used; the tasks they are expected to perform; the diving environments and conditions in which they are expected to operate; and the diving-related responsibilities they are expected to fulfill.

The responsibilities of a Service diver include:

- (1) Ensuring that their diver training certification, medical examination, CPR, first aid, and oxygen administration training requirements are current and that appropriate documentation and training records are on file with the RDO or FDO, as applicable.
- (2) Maintaining a dive log and submitting it annually to the RDO.
- (3) Maintaining an appropriate level of physical fitness to ensure full capability to dive. If a diver has any change in physical ability to dive, the individual must notify the FDO or the RDO, or both.
- (4) Reporting any dive-related accident or injury immediately to the supervisor, FDO, or RDO.
- (5) Maintaining equipment in accordance with manufacturers' instructions and equipment maintenance records as required.
- (6) Determining if they can accomplish a dive within their abilities and in a safe manner. The primary responsibility for diver safety lies with the individual diver. **Each diver** must exercise the responsibility and privilege **to refuse** to dive if, in the diver's judgment, conditions are unsafe or unfavorable and would exceed the diver's training or this handbook's requirements. **A diver must not attempt to dive if the individual is not in the proper mental or physical condition for diving.**
- (7) Notifying their Field Supervisor/Project Leader, supervisor, FDO, or the RDO if they are

experiencing any adverse health effects.

- (8) Participating in the Department's random drug testing program.

2.2 Reciprocity and Visiting Scientific Diver

Non-Service divers may participate in Service diving activities, and Service divers may participate in non-Service diving activities, through reciprocity agreements. Scientific reciprocity divers working under Service-managed dives must follow the standards outlined in this handbook, including all requirements and training established for Service-authorized divers.

Service reciprocity agreements:

- 1) Allow non-Service divers to participate in Service diving activities, and vice-versa, with minimal administrative requirements;
- 2) Are established with other organizations only after it is determined that their diving programs are equivalent to the Service's diving operations;
- 3) Are only applicable to personnel employed and covered for medical treatment, workers compensation, and liability claims by the reciprocity organizations. Reciprocity divers in good standing with their organizations who are not employees and are not covered for medical treatment, workers compensation, and liability (e.g., students) can only be accepted as volunteers if permitted through their signed volunteer service agreement;
- 4) Are not transferable to other agencies or institutions with whom Service reciprocity partners have separate reciprocity agreements; and
- 5) Expire on December 31 of the year in which they were established. Service reciprocity agreements must be re-established annually.

Joint Diving Activities Between Two or More Scientific Diving Agencies

When two or more scientific diving agencies engage jointly in diving activities, or engage jointly in the use of diving resources, one agency must be designated as the lead diving agency. The Service's NDCB must have a reciprocity agreement in place with the visiting agency. A listing of current reciprocity agreements is maintained by the Chair of the NDCB.

The reciprocity agreement between two or more scientific diving agencies must include a review of the visiting agency's scientific diving program to evaluate its compliance with [29 CFR 1910.402](#) and its compatibility with Service dive operations.

Letter of Reciprocity Requirement:

Non-Service reciprocity divers wanting to dive with the Service must present a signed Letter of Reciprocity (LOR) from their organization's Diving Safety Officer verifying that the diver is in current authorized status with their organization (see [Appendix 6](#)) to the appropriate RDO. The LOR must indicate the diver is covered for medical treatment, included in their organization's workers compensation policy, and covered for liability claims.

Letter of Reciprocity for Visiting Scientific Diver with No Reciprocity Agreement in Place:

If a reciprocity agreement is not in place and a scientific diver from another agency requests permission to dive under the management of the Service, the visiting diver must submit to the RDO an LOR containing all the information described in the LOR in [Appendix 6](#) and signed by the Diving Safety Officer with whom the visiting diver work. The visiting scientific diver may be asked to demonstrate their knowledge and skills for the planned diving operation. If reciprocity is denied to a visiting scientific diver, the RDO must notify the visiting scientific diver and their Diving Safety Officer and explain the reason(s) for the denial.

Requirements of Visiting Scientific Divers

All visiting scientific divers must:

- 1) Demonstrate their knowledge and skills for the planned diving operation, if requested;
- 2) Follow the rules and policies under the Dive Safety Plan (DSP) initiated by the Service;
- 3) Notify the Service Lead Diver of any policies that differ from the visiting agency policies, which may contradict the DSP, so the appropriate dive planning may occur;
- 4) Follow the requirements described in this handbook and seek clarification, if needed, from the Service RDO or NDCB; and
- 5) Adhere to the responsibilities described in [section 2.1.9](#).

Reciprocity Diver's Equipment

- 1) Non-Service reciprocity divers must be outfitted with personally supplied diving equipment equivalent to that of the Service diver for the planned dive operation.
- 2) The Service Lead Diver for the DSP will inspect the reciprocity diver's diving equipment for proper operating condition. Upon inspection and with verification of the appropriate training, the Service may temporarily provide Service equipment to replace items not considered compatible to the operation.

Service Diver's Request for Reciprocity with a Non-Service Organization

A Service diver may request that formal diving reciprocity be established with non-Service organizations when no such agreement exists. Such requests, along with a copy of the candidate organization's diving standards and safety handbook, must be forwarded through the appropriate RDO to the NDCB for review.

If deemed equivalent to Service diving standards, reciprocity may be established for the current calendar year. The NDCB reviews reciprocity agreements at the end of the calendar year, and those agreements may be renewed at the request of the sponsoring Service diver.

LORs for Service Divers:

- 1) Per the terms of the reciprocity agreements, any Service diver wanting to dive with a reciprocity organization must request an LOR from the NDCB or the RDO. The RDO will work with the NDCB to develop the LOR, verifying they are an authorized current Service diver, and send it to the Diving Safety Officer of the receiving organization. Only currently authorized Service divers may request an LOR.
- 2) The RDO will ensure copies of the LOR are sent to the Service diver and the NDCB.
- 3) Liability information:
 - a. LORs for Federal full-time employees will state the diver is covered under the Federal Employee Compensation Act, [5 U.S.C. 8101 et seq.](#), for injuries that may be sustained as the result of an accident occurring during the scope of any official dive, as well as by the provisions of the Federal Tort Claims Act, [28 U.S.C. 1346, 2671 et seq.](#)
 - b. LORs for Service contract employees must state that the diver is not a Federal employee, so the diver is not covered by the Service for injuries that may be sustained as the result of an accident occurring during the scope of any official dive; however, they are covered by their contract employer.
- 4) LORs only address a diver's credentials and status within the Service. It is the responsibility of the Service diver's RDO to determine if the specific work they will perform with a reciprocity partner is authorized from a programmatic standpoint.

2.2.1 Temporary Diver

Certain projects may benefit from the visit of a temporary diver on a dive site (i.e., VIPs). A temporary diver may only be authorized for a specific purpose for limited dive operations. Temporary diver status can be issued if the RDO verifies basic SCUBA certification and the diver is escorted at all times during a dive operation. The dive plan must account for this accommodation, and a statement of the temporary diver's qualifications must be submitted to the RDO as a part of the dive plan.

The temporary diver authorization is issued only following the documentation or demonstration of basic diving proficiency. The authorization is valid for a limited time as determined by the RDO. This authorization must not be used as a mechanism to circumvent existing standards in this handbook. The RDO may waive requirements in this handbook if the person in question has demonstrated proficiency

in diving and can contribute measurably to a planned dive or project. Temporary divers are restricted to the planned diving operation and must comply with all other requirements in this handbook, unless waived by the RDO, including medical requirements as appropriate.

2.3 Record Maintenance

The RDO or FDO must maintain permanent records for each individual scientific diver certified. The file must include evidence of certification level, log sheets, approval of current physical examination, waivers, reports of disciplinary actions by the NDCB, and other pertinent information deemed necessary. The Human Resources office maintains confidential medical records. Medical clearance to dive (without medical details) must be included in the file of each scientific diver.

2.3.1 Personal Diving Log

Each authorized Service diver must log every dive made under Service management, and we encourage them to log all other dives. Divers must submit log sheets to the RDO or FDO (verified through the RDO), on an annual basis. The dive logs ([Appendix 2](#)) are put in the diver's permanent file.

2.3.2 Availability of Records

- (1) Medical records requested during the designated retention time must be made available for the attending physician of a diver or former diver when released in writing by the diver.
- (2) The Service must retain records and documents required by this standard for the following periods:
 - a. Physician's written reports of medical examinations for dive team members for 5 years.
 - b. Handbook for diving safety retained as long as it is current and replaced as necessary.
 - c. Records of every diver for 1 year. If there is an incident of pressure-related injury, the records must be retained for 5 years after the incident (see (d) below).
 - d. Pressure-related injury assessment for 5 years.
 - e. The current entry or tag of equipment inspection and testing records must be retained until the equipment is withdrawn from service.

2.4 Consequences of Violation of Policy

Failure to comply with this handbook or [241 FW 10](#) may be cause for the revocation or restriction of a diver's authorization by action of the NDCB. The NDCB may recommend to the appropriate supervisor that an action is required to correct an unsafe working situation.

2.4.1 Violation Review Process

- (1) The RDO may stop and suspend a diver's authorization for cause, pending review by the NDCB. In the case of violations resulting in a risk to personnel safety, severe equipment loss or damage, or major environmental damage, the RDO must immediately suspend the diver's authorization, pending a review hearing by the NDCB.

- (2) The RDO must notify the diver in question, in writing (hard copy or electronic formats are acceptable), of the suspension and the date and time of the review hearing. The RDO must send a copy of the notice to each NDCB member and any appropriate administrative personnel.
- (3) The diver must be given the opportunity to present their case in writing for reconsideration and/or reauthorization. All such written statements and requests this section describes are formal documents and must become part of the diver's file that the Service maintains.
- (4) The NDCB chair must convene a review hearing at the next scheduled NDCB meeting, at which the diver will have the right to be present. If the violation requires expedited review, the NDCB chair may convene a review panel comprised of a subset of no fewer than five NDCB members, which must include the affected RDO.
- (5) The diver must not dive for Service-managed work during the period of review and appeal. If there is a letter of reciprocity as part of the diver's authorization, it will be retracted until the matter is resolved.
- (6) The NDCB chair or other appropriate authority must report, as required, violations that also violate Service policy, State or Federal law, or expose the Service to significant legal liability.
- (7) The NDCB has the final authority for all safety-related actions taken.

Chapter 3 – Service Diver Requirements

This chapter covers diver authorization and certification requirements common to all Service divers.

3.1 Introduction

All Service divers participating in scientific diving must meet the requirements for authorization (see [section 3.4](#)) and complete course work, receive on-the-job training that the NDCB has reviewed and approved, and/or hold documentation of Scientific Diving Certification from the American Academy of Underwater Sciences (AAUS). Divers must also complete practical training in scientific diving specific to the tasks they will perform at the individual refuge/program level, or demonstrate to the RDO knowledge in scientific diving methods, data gathering, and techniques specific to the required tasks through previous training/certification.

3.2 Variances from Requirements

The NDCB may grant a variance for specific requirements of training, depth authorization, and minimum activity to maintain authorization if safety is not compromised. To receive a variance, a diver must submit a request in writing through the respective RDO to the NDCB for consideration.

Inadequate funding or travel restrictions are not adequate justifications for variance of training or other requirements.

3.3 Service Diver Pre-Authorization Requirements

All prospective Service divers **must complete** a certified open water course from a national or international certifying agency, such as the Professional Association of Diving Instructors (PADI), National Association of Underwater Instructors (NAUI), Scuba Schools International (SSI), National

Oceanic and Atmospheric Administration (NOAA), or the Department of Defense. The Service may provide the necessary training and equipment needed to perform the requirement.

The administrative procedures for divers entering the Service dive program are as follows.

Complete Checklist of Requirements for Authorization of Service Divers ([FWS Form 3-2223](#)):

- (1) Provide evidence of having completed an open water diving certification program conducted by a national or international certifying agency (PADI, NAUI, SSI, NOAA, U.S. Navy, YMCA, etc.).
- (2) Provide copies of diving logs ([FWS Form 3-2221](#)) or other materials that indicate diving experience.
- (3) Undergo an initial diving medical examination upon entry into the program. See [section 3.5](#) for more information about the medical examination.
- (4) Take and pass a drug test administered in accordance with Departmental policy (see [DOI Personnel Bulletin 17-15](#)). Once authorized, divers are subject to the Department's random drug testing program.
 - a. Once examination is complete, the examining physician returns both necessary forms (see [section 3.5](#) for more information on the forms) to the employee, who gives the forms to the RDO. The RDO gives both forms to the reviewing physician.
 - b. The reviewing physician must be either board certified in occupational medicine or limited to practice in occupational medicine and trained in hyperbaric medicine. The reviewing physician reviews baseline and periodic physicals. The reviewing physician must complete both forms and return them to the RDO as part of the authorization package.
 - c. The RDO places a copy of [FWS Form 3-2224-A](#) in the diver's individual file and gives a copy to the diver. The RDO sends the entire package to the JAO Division of Human Resource Operations for inclusion in the employee's medical folder ([SF-66D](#)). Contact the JAO Division of Safety Operations for the appropriate mailing address.
- (5) Successfully complete a diving skills and physical fitness evaluation.
 - a. **Diving Skills Evaluation:** (Must demonstrate mastery of each skill.)
 - i. Enter the water in full gear demonstrating the various entry methods that are pertinent to the environment being dived (boat or shore).
 - ii. Demonstrate mask clearing.
 - iii. Breathe with an alternative air source with a buddy.
 - iv. Use underwater hand signals.
 - v. Equipment removal/replacement (doff/don).
 - vi. Demonstrate buoyancy control by hovering or some other predetermined method.
 - vii. Exit water using methods pertinent to the environment being dived (boat or shore).
 - viii. Emergency ascent.
 - ix. Self-rescue and buddy rescue – panicked diver, cramping.
 - x. Navigation – compass and natural aids.

xi. Dive planning – each diver must be able to pre-dive brief and dive plan.

b. Physical Fitness Evaluation:

i. 400-yard swim – The swimmer must swim 400 yards without stopping using no swimming aids and using any stroke or combination of strokes desired. ***(If a swimmer stops, the exercise is incomplete and must be repeated.)***

- < 6:00 minutes = 5 points
- 6 – 8:00 minutes = 4 points
- 8 – 10:00 minutes = 3 points
- 10 – 12:00 minutes = 2 points
- > 12:00 minutes = 1 point

ii. 800-yard swim – The swimmer must swim 800 yards without stopping using a mask, fins, and snorkel. The swimmer may not use arms to swim. ***(If a swimmer stops, the exercise is incomplete and must be repeated.)***

- < 13:00 minutes = 5 points
- 13 – 15:00 minutes = 4 points
- 15 – 17:00 minutes = 3 points
- 17 – 19:00 minutes = 2 points
- > 19:00 minutes = 1 point

iii. 100-yard inert diver tow – The swimmer must swim in full SCUBA equipment pushing or pulling an inert diver in full SCUBA at the surface for 100 yards without stopping. ***(If a swimmer stops, the exercise is incomplete and must be repeated.)***

- < 2:00 minutes = 5 points
- 2 – 3:00 minutes = 4 points
- 3 – 4:00 minutes = 3 points
- 4 – 5:00 minutes = 2 points
- > 5:00 minutes = 1 point

iv. 15-minute tread – The swimmer must stay afloat (treading water, bobbing, floating) without aids for 15 minutes, with hands out of the water for the last 2 minutes. ***(If a swimmer stops, the exercise is incomplete and must be repeated.)***

- Completed = 5 points
- Completed, but hands not out last 2 minutes = 3 points
- Touched sides/bottom no more than twice = 1 point

Notes:

- All swim skills must be completed and a minimum of 12 points combined are needed to pass the physical skills evaluation.
- Environmental conditions and specialized equipment requirements (e.g., dry suits) may interfere with the completion of these exercises and may be adapted by the RDO and administered by someone designated by the RDO.

(6) Provide current evidence of having completed CPR, basic first aid, automatic external defibrillator (AED), and emergency oxygen (O₂) administration courses. Training should be comparable to the standards that the American Red Cross or Divers Alert Network (DAN) have established. All applicants and authorized divers must provide current evidence of having completed a basic **first aid** course comparable to American Red Cross Multi-media.

We highly recommend that training is representative of Regional field conditions, subject to RDO approval.

- (7) The RDO must annually review each diver's authorization status and issue annual reauthorization. Diving authorization is contingent on the RDO receiving the following:
- a. Written request from the diver's supervisor identifying their interest/need for dive authorization.
 - b. Current medical form.
 - c. Verification of current CPR/first aid/AED/emergency oxygen administration training (e.g., course completion certificates or copy of their certification card).
 - d. Diving log.
 - e. Evidence of supplemental training.
 - f. Successful completion of annual diving skills and physical fitness evaluation.
 - g. Gear servicing records.

3.4 Service Diver Authorizations

Individuals who have successfully completed Service diver authorization requirements, documented by the RDO or FDO, are issued a Service Dive Card. The physical Service Dive Card is proof of the individual's initial authorization, but is not evidence of current authorization. To verify that a Service Dive Card is current, the RDO or FDO must have all records up to date and maintained in the diver's file and ensure that a current authorization has been issued to the diver.

The RDO, or FDO in consultation with the RDO, may revoke a Service Dive Card for cause. The RDO or FDO must document the cause for revocation or restriction and give it to the diver. The RDO must give the diver an opportunity to appeal this revocation to the NDCB through the RDO.

After a period of 1 year, a diver may reapply for authorization. Individuals applying for a Service Dive Card after revocation must meet all Service authorization requirements (see [section 3.3](#)).

3.4.1 Authorized Diver

Active Service divers who have met all of the requirements for dive authorization in [section 3.3](#) are considered to be authorized. Specialized dive environments and dive gear authorizations must be documented by the RDO and included in the diver's file. Divers will need to complete practical training using a particular diving mode specific to the tasks to be performed or demonstrate to the RDO knowledge in specific diving mode methods and techniques specific to the required tasks through previous training or experience. Training will be documented in accordance with [sections 3.3](#) and [4.1](#).

The NDCB encourages the use of gear that is familiar to divers and believes that a diver becomes more comfortable when the diver's gear is configured in a consistent, familiar fashion. To foster this comfort and to maintain the diver's proficiency, the Service authorizes an active Service diver to use Service-owned equipment for recreational use, if the recreational dives are within the scope of the Service diver's

authorization. If there are any questions on the scope of any recreational dives, the diver should consult the RDO or FDO. ***If a Service diver is not active in the program, Service-owned gear must not be used for recreational purposes.***

Authorized Divers (Active Status):

- (1) Must be active Service divers and make a minimum of 12 RDO-approved, logged dives per year.
 - a. Work Dives – Scheduled dives for completion of work assignments.
 - b. Training Dives – Scheduled dives to acquire new skills or training certifications, and which will contribute to the dive log minimum.
 - c. Proficiency Dives – Scheduled dives to maintain dive proficiency and contribute to the dive log minimum.
- (2) Receive 40 hours of diving-related training every 3 years (see [section 4.1](#))
 - a. Experienced divers may substitute instructing for the 40-hour training requirement upon approval of the RDO.
 - b. CPR/first aid/AED/emergency O₂ does not apply to continuing education.
- (3) Annually complete a re-authorization of the diver’s status. The re-authorization includes:
 - a. Written request from diver’s supervisor identifying their interest/need for dive authorization if not part of the diver’s position description.
 - b. Current medical form ([FWS Form 3-2224-A](#)), if expired since last evaluation.
 - c. Current CPR/first aid/AED/emergency O₂, if expired since last evaluation.
 - d. Diving log.
 - e. Evidence of supplemental training.
 - f. Successful completion of annual diving skills and physical fitness evaluation.

3.4.2 Conditional Diver

Service divers who have deficiencies related to annual authorization requirements will be placed on a “conditional status.” Divers placed on conditional status may continue to dive under restrictions that the RDO, with input from the FDO, has put in place. ***If a Service diver is not active in the program, Service-owned gear must not be used for recreational purposes.***

Conditional Divers (Active Status):

- (1) Must be accompanied by a Service-authorized diver on all work-related dives until they receive full authorization.
- (2) May not act as a Lead Diver in any Service or cooperating agency diving operation.
- (3) May not serve as a standby diver.

3.4.3 Non-Authorized Diver

Service divers who remain in conditional status for more than 2 years, allow medical examination requirements to lapse (see [section 3.4](#)), or have dive authorization revoked will be placed on “non-

authorized status” and may not dive to conduct Service-managed work. If the medical requirement has lapsed, the non-authorized status will remain in place until the diver obtains an approved diving medical exam and a clearance to dive from the examining physician. In addition, a diver may be placed on non-authorized status at any time for cause, as determined by the RDO and NDCB. All requirements in this handbook and any required mitigations imposed by the RDO or NDCB must be met for a diver to be reinstated to active status. ***All non-authorized divers must return Service-owned dive gear to their program supervisor or RDO/FDO until they are reinstated, and the gear must be serviced prior to being reissued.***

3.4.4 Depth Authorizations

Diving on air is not permitted beyond a depth of 130 feet. An authorized diver may exceed their depth authorization only if accompanied by a diver authorized to a greater depth. Under these circumstances, the diver may exceed their depth limit by one step or subject to RDO approval. **Altitude diving must account for changes in theoretical depths and associated depth authorizations.**

Following are the depth authorization levels, all of which are subject to RDO approval:

- (1) *Authorization 0 – 30 Foot Depth (0 – 9 meters)* - This is the initial depth authorization, which is approved when a diver completes Service authorization requirements (see [section 3.4.1](#)).
- (2) *Authorization 30 – 60 Foot Depth (9 meters – 18 meters)* - A diver holding a 30-foot authorization may be approved for a depth of 60 feet after successfully completing 12 logged dives to depths between 31 and 60 feet under direct supervision from an authorized diver for that step.
- (3) *Authorization 60 – 100 Foot Depths (18 meters – 30 meters)* - A diver holding a 60-foot authorization may be approved to depths up to 100 feet by logging 12 dives within the range and 6 dives near the maximum depth category under direct supervision from an authorized diver for that step. The diver must also demonstrate proficiency in managing basic decompression procedures in case the no-decompression limits are inadvertently exceeded.
- (4) *Authorization 100 – 120 Foot Depths (30 meters – 36 meters)* – A diver holding a 100-foot authorization may be approved to depths up to 120 feet by logging 12 dives within the range and 6 dives near the maximum depth category under direct supervision from an authorized diver for that step. The diver must also demonstrate proficiency in managing basic decompression procedures in case the no-decompression limits are inadvertently exceeded.

3.4.5 Dive Gear

All authorized Service divers will be provided with personal dive gear that is fully functioning and operational. All equipment must meet standards that the RDO and/or the NDCB establish, will be serviced annually, and should be replaced as needed based on changes in technology. **At a minimum, the Service will provide each diver with the following personal gear:**

- (1) Regulators (1st stage, 2nd stage, Alternate);
- (2) Buoyancy Compensator Device (BCD);
- (3) Quick Release Weight System;
- (4) Weights;

- (5) Exposure Suit (Wetsuit/Drysuit, Hoodie, Gloves, Booties);
- (6) Submersible Pressure Gauge (SPG);
- (7) Depth Gauge;
- (8) Dive Computer and/or a Dive Timing Device;
- (9) Mask (with corrective lenses, if required);
- (10) Snorkel;
- (11) Fins;
- (12) Two Cutting Devices;
- (13) Compass;
- (14) Signaling Devices (Surface Marker Buoy and Whistle);
- (15) Dive Light; and
- (16) Dive Gear Bag.

At each dive site:

The Service must provide an Emergency Oxygen Kit and a First Aid Kit that can accommodate the number of divers and the emergency dive plan. Although AEDs are not required at each dive site, they are highly recommended.

3.5 Medical

Every diver must undergo a diving medical examination, preferably from a physician familiar with diving physiology, before beginning diving, unless an equivalent initial medical evaluation has been given within the preceding 12 months. The reviewing physician must be either board certified in occupational medicine or limited to practice in occupational medicine and trained in hyperbaric medicine or undersea medicine. The reviewing physician reviews baseline and periodic physicals. The reviewing physician must complete both forms ([FWS Forms 3-2224](#) and [3-2224-A](#)) and return them to the RDO or the appropriate Service office as part of the authorization package. The RDO sends the entire package to the JAO Division of Human Resource Operations for filing in the employee's medical folder ([SF-66D](#)). For employees, the costs of all required medical examinations are paid for by the Service.

Medical examinations are required every 5 years for divers up to age 40, every 3 years for divers over the age of 40 until age 60, and every 2 years for those over 60, unless a more frequent interval is required by a licensed physician.

The diver, the FDO, or another appropriate person must inform the RDO after any ***illness or injury*** requiring hospitalization of more than 24 hours, after surgery, after an episode of unconsciousness, or after treatment in a hyperbaric chamber following a diving accident or any other serious illness. The Service diver must submit to a medical interview or examination appropriate to the nature and extent of the injury or illness, as determined by the examining physician, before resuming diving activities. The diver must have an undersea hyperbaric physician submit in writing a clearance of medical fitness to return to dive status.

3.6 Documentation of Training

All Service dive training must be documented. Records of successful completion of training must be put in the individual diver's file or recorded in the Departmentwide Learning Management System (i.e., currently DOI Talent), or both, as appropriate.

Chapter 4 – Dive Training and Operations Requirements

The safety of divers is the prime consideration in all diving activities. Supervisors and managers do not promote, nor should divers attempt, difficult or hazardous tasks that compromise diver safety. Divers must conduct diving operations in accordance with the requirements described in [29 CFR 1910, Subpart T](#); [485 DM 27](#); and this handbook. Divers must adhere to the diving safety requirements in this handbook (authorized by [241 FW 10](#)) during all diving operations.

Open circuit SCUBA using air (21 percent) is the baseline diving mode used by all Service divers. Certification in its use from a nationally recognized SCUBA certification organization, or Government equivalent, is required of all individuals prior to becoming a Service diver. Divers who plan to perform dives outside this scope should abide by the special procedures and the appropriate specialized dive mode that covers the operational scope of the dives.

All Service divers engaged in specialized diving modes must meet the requirements for Service dive authorization and the requirements included in the appropriate specialized diving mode section.

****See Chapter 5, [sections 5.1 – 5.2](#) for specialized dive equipment and environment requirements.**

4.1 Training Guidelines

Service divers are required to complete 40 hours of diving-related training every 3 years to maintain diver status. The training may include practical training using a particular diving mode specific to the tasks they will perform and may include any specialized dive mode at the request of the diver and with the approval of the RDO.

The training must be documented, and the RDO must review the documentation and confirm the validity, to receive training credit. Experienced divers may substitute instructing for the 40-hour training requirement, upon approval of the RDO. The diving emergency care (CPR/first aid/AED/emergency O₂) that is required to maintain diver status does not apply to the 40-hour supplemental training requirement, but more specialized training in these areas is accepted (advanced CPR, wilderness first aid, specialized training in emergency O₂ administration, or other emergency care training).

Training topics may include, but are not limited to:

- (1) Formal training in dive rescue and/or dive master skills;
- (2) Dive physics;
- (3) Dive physiology;
- (4) Decompression theory and its application;
- (5) Scientific diving regulations and/or history, including scientific dive planning, coordination with other agencies, or other appropriate Governmental regulations;
- (6) Scientific method and data gathering techniques specific to a position, such as transect sampling (quadrating), transecting, mapping, coring, photography, tagging, collecting, animal handling, archaeology, organism identification, site selection, specialized equipment for data gathering, and high-pressure cylinders;
- (7) Small boat dive operation;

- (8) Specialized breathing gases such as nitrox or mixed gas;
- (9) Specialized diving equipment: dry suit, full face mask, line tending, hookah, and rebreather (Rebreather: see Request for Variance, [Appendix 8.2](#)); and
- (10) Specialized environments: altitude diving, cold water diving, overhead environments, and river diving.

4.2 Dive Operations

4.2.1 Dive Rules

All Service divers must adhere to the following rules:

- (1) No Service diver may dive unattended (i.e., buddy diving is required).
 - a. All diving activities must ensure adherence to the buddy system (two comparably equipped scuba divers in the water in constant communication) for SCUBA diving. This buddy system is based on mutual assistance, especially in the case of an emergency.
 - b. Solo line-tended divers may dive in water less than 30 foot deep with a stand-by diver dressed and ready prior to the line-tended diver entering the water (must adhere to [section 5.1.4](#)).
- (2) No **decompression** diving is allowed without written approval of the NDCB.
- (3) All divers using specialized diving equipment ([section 5.1](#)) and/or environments ([section 5.2](#)) must have specific endorsements from their respective RDO.
- (4) Each dive team **must** have a pre-approved Dive Safety Plan ([section 4.3.1](#)) and perform a pre-dive briefing ([section 4.3.2](#)) prior to diving that day.
 - a. Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations under Service management, the lead diver for a proposed operation must formulate and have an approved dive plan.
 - b. If all diving operations are captured in the Dive Safety Plan and will not deviate, the plan can be reused throughout the dive season, but must be renewed annually.
- (5) All divers **must** be fully aware of hand signals.
- (6) All divers **must** perform a pre-dive equipment checklist.
- (7) All divers **must** follow the procedures established by the manufacturers of the dive computers that they are using, the standard U.S. Navy dive tables, or current recreational dive tables for the requirements of the dive profile.
 - a. If a dive computer malfunctions during the dive, the dive must be terminated and all further dives will need to be evaluated before they are completed. Dives following a computer malfunction may be completed only if the appropriate dive tables, timekeeping device, and depth gauge are available.
 - b. Two or more divers may not dive while using only one dive computer. **No sharing of dive computers.**
- (8) All dives must use a safety stop at approximately 15 feet for a minimum of 3 minutes where dive profiles allow. At depths greater than 60 feet, where applicable, a second safety stop

should be used at approximately half the distance of the deepest descent for 1 minute, prior to the 15-foot mandatory stop.

- (9) All dives must display a dive flag (Diver Down or Alpha).
- (10) An emergency oxygen administration kit (Emergency O₂) and First Aid Kit must be **readily available** at the dive site during all diving operations, and all divers must be trained in their use. *Although not required, an AED is strongly recommended at each dive site.*
- (11) Two-way communication adequate to summon emergency assistance must be available at the dive site.
- (12) Unless approved by the NDCB, a mandatory day of rest for each diver must be instituted after 10 consecutive days of open circuit no-decompression diving.
- (13) Divers must adhere to the minimum manning requirements (Table 1).

Table 1. Minimum Manning Requirements: OSHA-Exempt Dives

Personnel	Free swimming divers to < 60 fsw*	Free swimming divers to 60 - 100 fsw*	Free swimming divers to 100 - 130 fsw*	Line-Tended Divers 1 Diver / 2 Divers
Divers	2	2	2	1 / 2
Standby Divers	0	1	2	1 / 2
Topside Support	1	1	1	1 / 1
Total	3	4	5	3 / 5

*fsw = feet salt water

4.3 Dive Procedures

4.3.1 Dive Safety Plans

The Dive Safety Plan (DSP) must include the following:

- (1) Divers' qualifications and the type of certificate or certification held by each diver.
- (2) Approximate number of proposed dives.
- (3) Location(s) of proposed dives.
- (4) Estimated depth(s) and bottom time(s) anticipated.
- (5) Breathing gases used.
- (6) Decompression status and repetitive dive plans, if required.
- (7) Dive-proposed work, equipment, and boats to be employed.

- (8) Any hazardous conditions anticipated.
- (9) Any additional requirements requested by the RDO or NDCB, or both.

4.3.2 Pre-Dive Briefing

A pre-dive briefing and emergency plan must be filled out by the Service Lead Diver and be readily accessible at each dive site.

Lead Diver Responsibility:

- (1) The Service Lead Diver must perform a pre-dive briefing prior to the diving operations or as conditions change.
- (2) The Service Lead Diver will evaluate environmental conditions and prepare a Go/No Go Risk Assessment Worksheet to determine if it's safe for the planned operation.
- (3) The Service Lead Diver will evaluate each dive team member prior to operation.

Diver's Responsibility:

- (1) Each diver must conduct a functional check of their diving equipment in the presence of the diving buddy or tender to ensure it is in proper working order and suitable for the type of diving operation being performed.
- (2) Each diver must have the capability of achieving and maintaining positive buoyancy.
- (3) It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unfavorable, or if they would be violating the precepts of their training or this handbook.
 - a. The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever the individual feels it is unsafe for them to make the dive.
 - b. It must never be a requirement for dive team members to be exposed to hyperbaric conditions against their will, except when necessary to prevent or treat a pressure-related injury.
- (4) Dive team members must never be permitted to dive for the duration of any known condition that is likely to adversely affect the safety and health of the diver or other dive members.

4.3.3 Termination of the Dive

- (1) It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever the individual feels it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water.
- (2) The dive must be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including decompression time, or to safely reach an additional air source at the decompression station. Unless otherwise addressed in the dive plan of an operation, divers must plan to ascend so that a reserve tank pressure is **no less than 500 pounds per square inch (psi) at the surface.**

- (3) The dive team must terminate the dive before any single diver reaches the no-decompression limit based on the dive tables, air computer, or nitrox computer being used during the dive unless the dive plan allows for planned stage decompression that the RDO or NDCB, or both, have authorized.

4.4 Post-Dive Safety Checks

- (1) After a dive is complete, each diver must report any physical problems, symptoms of decompression sickness, or equipment malfunctions.
- (2) If a dive exceeds the no-decompression limits, the divers should remain awake for at least 1 hour after diving, in the company of a dive team member who is prepared to transport them to a hyperbaric chamber if necessary.

4.5 Ascending to Altitude after Diving

Ascending to altitude after diving can predispose a diver to decompression sickness, so it is necessary to spend certain intervals at or near sea level before flying or otherwise ascending to higher altitudes.

SYMPTOMS OF DECOMPRESSION SICKNESS CAN TAKE 24 HOURS OR MORE TO MANIFEST THEMSELVES.

Flying After Diving:

- (1) *Following a single no-decompression dive:* Divers should have a minimum preflight surface interval of 12 hours.
- (2) *Following multiple dives per day or multiple days of diving:* Divers should have a minimum preflight surface interval of 18 hours.
- (3) *Following dives requiring decompression stops:* Divers should have a minimum preflight surface interval of 24 hours.

Surface Travel After Diving:

Divers must wait an appropriate time interval before ascending to altitude after diving. According to the Diver's Alert Network, there are no data to support a guideline for conservative, safe surface intervals before ascending to intermediate elevations of 3,000 feet. Specific times are determined on a case-by-case basis, depending on the diving altitude and exposures involved. It is the recommendation of the NDCB that each diver should assess the day's diving conditions and altitude exposure and discuss the situation with the Lead Diver.

Divers should follow flying-after-diving guidelines (items 1–3 above) when ascending above 3,000 feet.

Chapter 5 – Specialized Dive Equipment and Environments

All Service divers using specialized diving equipment must meet the requirements for Service authorization (see [sections 3.3](#) and [3.4](#)) and complete course work specific to the equipment they will use. Divers must also complete practical training employing the specialized diving equipment specific to the tasks they will perform or demonstrate to the RDO the knowledge and skills in the use of the particular piece(s) of equipment specific to the required tasks through previous training or experience.

Training must be documented in accordance with [section 3.6](#). For each of the specialized equipment and environments listed below, divers must comply with all applicable sections of this handbook regarding scientific diver training and authorization, equipment inspection and maintenance, air quality testing, recordkeeping, and operational control.

5.1 Specialized Equipment – Training Requirements

5.1.1 Dry Suit

A dry suit, which is sealed with a watertight zipper and excludes water, is capable of providing thermal protection at depth. Service divers who want to use dry suits must complete formal training in the equipment from a recognized certifying agency, and their RDO must add a dry suit endorsement to their Service Dive Card. To get authorization from the RDO for a dry suit, divers must receive training on, or be able to demonstrate proficiency of, at least the following:

- (1) Academic Instruction
 - a. The theory of diving dry suits
 - b. Dry suit components and auxiliary equipment
 - i. Argon inflation system, if diving argon, and what are the advantages and disadvantages of using one.
 - c. Symptoms
 - i. Mild hypothermia is potentially a serious problem for SCUBA divers
 - ii. Carotid sinus reflex and how do you prevent it
 - d. Doffing and donning procedures
 - i. Adjusting a neck seal for a proper fit
 - ii. Eliminating excess air from your dry suit after you put it on
 - e. Weighting and buoyancy
 - i. Three ways to distribute weight evenly when diving in a dry suit
 - ii. Adjusting weight
 - iii. The recommended technique for maintaining positive buoyancy at the surface
 - iv. Technique for maintaining neutral buoyancy underwater
 1. When diving with a shell dry suit
 2. When diving with a neoprene dry suit
 - f. Planning, organization, and procedures of dry suit diving
 - g. Emergency procedures
- (2) Practical Training
 - a. Pool:
 - i. Equipment preparation
 - ii. Donning and doffing procedures
 - iii. Disconnecting and reconnecting dry suit inflator hose
 - iv. Buoyancy control
 - v. Emergency procedures
 1. Techniques for handling suit squeeze
 2. Handling excess buoyancy in a dry suit
 3. Handling an accidentally released weight system
 4. Technique for handling an inverted recovery
 - b. Confined Open Water:
 - i. Emergency management for excess positive buoyancy
 - ii. Ditching of weights
 - iii. Disconnecting and reconnecting dry suit inflator hose

- (3) Authorization – Dry suit authorization requires certification from a recognized certifying agency, and the diver must be able to show complete knowledge and mastery of skills in confined water. The diver must also have a minimum of two dives in their typical working environment (overhead, altitude, river, etc.) wearing a dry suit.

5.1.2 Nitrox

Oxygen-enriched air mixtures have become widely used for diving at intermediate depths (50-130 feet) to extend no-decompression bottom times, shorten required surface intervals, increase the physiologic safety with respect to decompression sickness, or shorten required staged decompression stops. Divers should follow these guidelines when using such mixtures, and only in no-decompression diving.

For the purposes of this handbook, nitrox is defined as breathing mixtures composed predominately of nitrogen and oxygen, most commonly produced by the addition of oxygen or the removal of nitrogen from air. The guidelines below supplement those specified previously in this handbook.

Required Training and Experience – The diver must hold a certification to use nitrox from a nationally or internationally recognized agency. After completion, review, and acceptance of application materials, and training and qualification per these guidelines, an RDO may authorize an applicant to use nitrox within their depth authorization, as specified in [section 3.4.4](#).

A diver must apply to the RDO, in writing, for authorization to use nitrox. The nitrox authorization request must include the necessary documentation.

To maintain authorization to use nitrox, a diver must log at least one nitrox dive per year. If a diver fails to meet this minimum activity level, the RDO may restrict or revoke the nitrox authorization.

5.1.3 Full Face Mask

All Service divers wanting to use full face masks must complete formal training on the equipment, and their RDO must add a full face mask endorsement to their Service Dive Card and dive records. Divers may obtain such training from a national or international certifying agency. Following is a typical outline of what needs to be included in full face mask training:

- (1) Academic Training
 - a. Full face components
 - b. Equipment preparation and maintenance
 - c. Bailout procedures
 - d. Clearing and equalization procedures
 - e. Emergency procedures
- (2) Practical Training
 - a. Pool:
 - i. Equipment preparation
 - ii. Donning and doffing procedures
 - iii. Flood and clear
 - iv. Bailout procedures
 - v. Alternate air share exercise
 - vi. Buoyancy control
 - vii. Emergency procedures
 - b. Open Water:

- i. Equipment preparation
 - ii. Donning and doffing procedures
 - iii. Flood and clear
 - iv. Bailout procedures
 - v. Alternate air share exercise
 - vi. Buoyancy control
 - vii. Emergency procedures
- (3) Authorization – To receive authorization from the RDO to use a full face mask, the Service diver must have certification on the use of a full face mask from a recognized certifying agency, and must show complete knowledge and mastery of skills in confined water. The diver must also have a minimum of two dives in their typical working environment (overhead, altitude, river, etc.) wearing a full face mask.

5.1.4 Line Tending

Line-tended diving is a specialized diving technique where divers are connected to the surface via a strength member (line) and are tended by a trained crew on the surface. When conducted correctly, line-tended diving is a safe method for bottom work in low visibility and/or river diving where maintaining position, navigation, and using the buddy system is difficult. Line-tended diving is an advanced diving mode that requires special training.

Required Training and Experience – To participate in line-tended diving, each diver must have completed advanced open water certification and a minimum of 25 logged SCUBA tank dives. Only an authorized Service diver qualified in line-tending operations (e.g., someone who has completed the Scientific River Diving Course offered by the National Conservation Training Center (NCTC)) may administer line-tending instruction for authorization and approval of the RDO. Line tenders do not have to be certified divers. However, all authorized line tenders must receive training to qualify as line tenders. Following is a typical outline of what needs to be included in line-tended diving training:

- (1) Orientation Training:
 - a. Equipment
 - i. Line tether
 - 1. Ultraviolet and abrasion resistant
 - 2. Neutrally buoyant
 - 3. High tensile strength (3/8-inch diameter)
 - 4. Synthetic (no natural fibers)
 - 5. Length: $L = (Ds + Dp) \times 1.5$ [L = Length; Ds = Distance; Dp = Depth]
 - 6. Marked at every 10- and 50-foot increment
 - ii. Harness
 - 1. Minimum lift 300 pounds
 - 2. D-ring support
 - 3. Adjustable
 - 4. Snap shackle (quick disconnect)
 - b. Procedures
 - i. Developing dive safety and field crew emergency and pre-dive briefing plans
 - ii. Dressing procedures
 - iii. Tether line set up
 - iv. Knot tying
 - v. Line tending signals

- vi. Ascent/descent procedures
- vii. Vessel operations
- viii. Emergency procedures

(2) Practical Training: Practical training should include instruction and mastery of the following skills in a controlled, open water setting. Divers and tenders will demonstrate proper techniques and procedures in their respective team roles while performing, or simulating, the anticipated working tasks.

- a. Classroom
 - i. Dressing procedures – equipment setup and pre-dive checks
 - ii. Tending procedures –
 - 1. Descents and ascents
 - 2. Buoyancy control using tether
 - 3. Knot tying
 - 4. Dive platform – secure diver
 - iii. Emergency procedures
 - 1. Resolving entanglement
 - 2. How to handle no line signals (loss of communications (comms))
 - iv. Line signals – practice on land (tender to diver and diver to tender)
- b. Confined Open Water – Dive 1
 - i. Dressing procedures – equipment setup and pre-dive checks
 - ii. Tending procedures –
 - 1. Descents and ascents
 - 2. Dive platform – secure diver
 - 3. Knot tying
 - 4. Buoyancy control using tether
 - 5. Line signals underwater from tender to diver
 - a. Stop? Ok?
 - b. Go Right
 - c. Go Left
 - d. Stop? Ok?
 - e. Go on Search
 - i. Go Right
 - ii. Go Left
 - iii. Stop Search
- c. Confined Open Water – Dive 2
 - i. Emergency procedures
 - 1. Resolving entanglement
 - a. How to handle no line signals (loss of comms)
 - b. Line signal diver to tender –
 - i. Fouled, but I can free myself
 - 2. Switching to alternate air source
 - a. Line signal diver to tender –
 - i. Haul me up now
 - 3. Switching to alternate air source
 - a. Line signal diver to tender –
 - i. I Need You
 - 1. Deploy standby diver
 - a. Switch to alternate air source
 - b. Detach from tether

c. Haul in standby and rescued divers

- (3) Tender Responsibilities
 - a. It is the tender's responsibility to ensure the diver receives proper care while topside and underwater.
 - b. While the diver is submerged, the tender handles the tending line and communicates with the diver via line-pull signals.
- (4) Line Signals: Line-tended divers and tenders may develop additional line pull signals, but all divers and tenders must know standard line signals adapted from the U.S. Navy. Pulls must be returned as received.
 - 1** = Stop, are you ok? Ok
 - 2** = Give Slack
 - 3** = Take Up Slack
 - 4** = Haul Me to Surface
 - 7** = Search; (On/Off); *Once on Search the following signals apply:*
 - 1** = Stop and Search
 - 2** = Give Slack; Adjust Search
 - 3** = Go Right
 - 4** = Go Left
 - 2-2-2** = I Need You
 - 3-3-3** = Fouled, but I can free myself
 - 4-4-4** = Haul Me Up Now

Line Tending Standards

- (1) Divers must be authorized to participate in tethered SCUBA and/or hookah by the RDO based on the above requirements.
- (2) Must have a separate DSP for tethered SCUBA and/or hookah diving that the RDO has approved.
- (3) Depth limit is 30 feet maximum unless the RDO has approved a greater depth in the DSP.
- (4) No dives may be conducted when the diver is unable to read air pressure gauges (analog gauges may improve readability in low visibility situations).
- (5) All tethered operations must have a crew of at least three. At a minimum, the crew will consist of two authorized divers and one trained line tender. Additional personnel and divers may be needed depending on the dive operation or as the DSP requires.
- (6) Each tether line must be tended by a separate trained tender at the surface.
- (7) When using a single diver down or two divers on two separate tethers that are not in constant visual contact with each other, an equipped standby diver must be ready at the surface.
 - a. If the standby diver is deployed, they must be tethered before entering the water and adhere to all safety standards. The standby diver must have a redundant air source (pony bottle) that can be left with a diver in need.
- (8) Line tenders must be trained in tethered diving techniques and in proper communications (i.e., line pulls, voice comms, diver recall).

(9) Vessel operations:

- a. All boat propellers must be deactivated prior to initiating dive operations.
- b. Dive boat must be securely anchored when divers are down.
 - i. Large rivers – multiple anchors may be needed to maintain boat position.
- c. The tender and other surface crew members must monitor anchors, boat position, boat traffic, weather conditions, and other hazards for the diver(s) at all times.

5.1.5 Hookah

Hookah diving systems are a form of light-weight, surface-supplied air diving technology involving a low pressure compressor (gasoline or battery), intermediate pressure hoses to the diver, and a second stage regulator held in the diver's mouth or full face mask. Advantages of hookah systems include increased gas supply and a physical connection to the surface. Disadvantages include possible entanglement, risk of gas supply loss, increased drag, and hindrance from hoses in the water column. Hookah diving is not "self-contained" like standard SCUBA, and the diver is reliant on an element outside of their immediate control for life support. Hookah diving requires special training and operational procedures.

Required Training and Experience – To participate in hookah diving, each diver must have completed advanced open water certification and a minimum of 25 logged SCUBA tank dives. Only authorized hookah divers with a minimum of 50 hookah dives or a certified hookah instructor appointed by the RDO may administer hookah instruction for hookah authorization. In addition, all personnel involved in the hookah dive must be trained in line tending (see [section 5.1.4](#)). Following is a typical outline of what needs to be included in training for hookah diving:

(1) Academic Instruction:

- a. Hookah components and rigging considerations
 - i. Compressor
 - ii. Air lines and tether rigging
 - iii. Regulators
 - iv. Accumulator tank
- b. Proper equipment preparation, set up, procedures, and maintenance
- c. Avoiding hazards, including carbon monoxide poisoning, entanglement, air delivery failures (e.g., hose, hose connections, compressor, and engine failure), and lung overexpansion injuries
- d. Line signals (see outline above for line tending, [section 5.1.4](#))
- e. Emergency air supply equipment, redundant air systems and usage
 - i. Accumulator tank
 - ii. Independent air source
 - 1. 19 cubic foot pony bottle minimum
 - 2. 1st stage, 2nd stage, and SPG
 - 3. Independent BCD power inflator
- f. Emergency procedures
 - i. Out of air – breathing remaining gas in line
 - ii. Alternate air exchange – 2nd stage pony bottle

(2) Practical Training: Will include instruction and mastery of the following skills in a confined open water setting and four checkout dives (two high visibility dives and two low visibility/blackout dives), while performing or simulating the anticipated working tasks.

- a. Confined Open Water – Dive 1 (high vis):

- i. Equipment preparation, setup, and pre-dive checks
 - ii. Resolving hose entanglement
 - iii. Line signals (see line tending [section 5.1.4](#))
 - iv. Buoyancy control
 - 1. Descent
 - 2. Ascent
 - b. Confined Open Water – Dive 2 (high vis):
 - i. Out of air – breathing remaining gas in line
 - 1. Diver response to engine or compressor failure: recognizing failure and breathing from accumulator tank air to surface
 - ii. Out of air – alternate air exchange
 - 1. Diver response to sudden out of air situation: switching to emergency air supply and surfacing.
 - 2. Hose bailout (e.g., diver response to unresolved hose entanglement): switching to alternate air source, disconnecting from hose/umbilical, and ascent.
 - c. Confined Open Water – Dive 3 (Low visibility/blackout)
 - i. Out of air – breathing remaining gas in line
 - 1. Diver response to engine or compressor failure: recognizing failure and breathing from accumulator tank air to surface
 - d. Confined Open Water – Dive 4 (Low vis/blackout)
 - i. Alternate air exchange
 - 1. Diver response to sudden out of air situation: switching to emergency air supply and surfacing.
 - 2. Hose bailout (e.g., diver response to unresolved hose entanglement): switching to alternate air source, disconnecting from hose/umbilical, and ascent.
- (3) Conditional Hookah Diver – Conditional authorization requires a minimum of four confined open water dives using a hookah system for a cumulative bottom time of at least 30 minutes. Conditional hookah divers **must** accompany fully authorized hookah divers for a minimum of 10 hookah dives to achieve full hookah dive authorization.
- (4) Fully Authorized Hookah Diver – has met all of the requirements above and has a minimum of 10 hookah dives in variable conditions.

Hookah Operation and Standards

- 1) The diver using the hookah mode must show knowledge and proficiency in the operation of this diving system to the RDO or designee before the RDO/designee may give the diver authorization.
- 2) All hookah dive operations must be documented in the DSP specific to the dive operation, which the RDO has approved.
- 3) The plan must include:
 1. Number of hookah divers
 2. Number of line tenders
 3. Safety diver considerations

4. Dive working environment

- 4) There **must not be more than** two hookah divers per compressor and **no more than one** compressor per vessel and/or dive team.
- 5) The maximum depth limit is 30 feet.
- 6) Hookah systems must be securely anchored to the vessel, except:
 - a. The hookah can be towed behind divers on a floating inner tube if divers are working in water shallow enough to stand up, emerge to breathe, and maintain position. Divers towing a compressor must have a BCD and alternate air supply.
- 7) Hookah divers must follow buddy diving protocols.
- 8) The dive team must establish effective communication signals between hose tenders and divers ([see section 5.1.4](#)).
- 9) Divers using the hookah mode must be equipped with a diver-carried independent reserve breathing gas supply that is connected to the BCD and is sufficient to return the diver to the surface at a prudent ascent rate if there is an air supply failure (19 cubic feet pony bottle minimum).
- 10) Each hookah dive team must be hose-tended by a tender while in the water. Each hookah diver must be equipped with a harness to which the hookah hose is anchored with a snap shackle.
- 11) The hookah compressor air supply must be sufficient to support all hookah divers in the water for the duration of the planned dive. All dives must have an accumulator tank in addition to each diver's reserve air supply.
- 12) Compressor fuel must be managed according to the dive profile.
- 13) The line tether to the BCD or chest harness must be slightly shorter than the air hose from the hookah to remove tension from the hookah air hose for tethered hookah diving. The tether is securely tied into the dive platform (e.g., boat, dock, or tree).
- 14) When diving in areas with boat traffic, additional dive flags and surface crew may be required to monitor surface activity and conditions. Propeller(s) of any boats associated with the dive operation must be deactivated prior to the divers entering the water for the duration of the dive.
- 15) Compressor air intakes must be located so as to avoid exhaust from compressor or boat engines.

5.2 Specialized Environments – Training Requirements

All Service divers diving in specialized environments must meet the requirements for Service authorization (see [sections 3.3](#) and [3.4](#)) and complete course work specific to the given environment. Divers must also complete practical training specific to the tasks they will perform for the specialized environment or demonstrate to the RDO knowledge in methods and techniques specific to the

particular diving environment through previous training or experience. Training must be documented in accordance with [section 4.1](#) and added to the divers Service Dive card

Specialized diving environments include, but are not limited to: altitude, extreme cold diving, overhead diving, and river diving.

5.2.1 Altitude

Diving in altitudes higher than 1,000 feet/300 meters above sea level requires specialized training. Service divers must develop the necessary diving skills, knowledge, and techniques to plan, organize, and execute no-decompression dives at altitude. To receive authorization from the RDO for altitude diving, divers must receive certification from a recognized agency and training on at least the following:

- (1) Academic Training
 - a. Physics and physiology review
 - i. Altitude-adjusted procedures
 - ii. Defining when altitude correction is needed
 - iii. Depth measurement at altitude
 - iv. Equilibration at altitude
 - v. Acclimatization to altitude
 - vi. Repetitive dives
 - b. Decompression calculation: dive table review, use of air tables with adjusted altitude correction, use of dive computers
 - c. Ascent to altitude after diving
 - i. Flying after diving
 - ii. Driving after diving
- (2) Confined Open Water Training
 - a. Dive planning
 - b. Adjusting dive computer and/or determining theoretical depths
 - c. Determining no decompression limits
 - d. Buoyancy checks and weight adjustments

Authorization – To receive authorization from the RDO, the diver must get certification from a recognized agency and perform a minimum of two checkout dives. The diver must demonstrate proper dive planning and adherence to policies and procedures for diving at altitude and/or ascending to altitude after diving. Subject to RDO approval, a non-authorized altitude diver can accompany an authorized altitude diver.

5.2.2 Extreme Cold Diving

There are special factors, training, and specifically designed equipment to consider when planning cold dives. Cold diving is defined as dives conducted in water temperatures colder than 59 degrees Fahrenheit (15 degrees Celsius). Pre-cold water proficiency dives and dry suit training is required. Surface weather conditions should also be considered, and the diver should be well rested. A diver should ascend from a dive as soon as the diver senses that cooling has impaired either dexterity or cognitive abilities. A diver should ascend from a dive before the diver chills to the point of shivering and must abort the dive immediately if shivering begins.

To receive authorization from the RDO for cold water diving, divers must receive training on or be able to demonstrate knowledge of or use of at least the following:

- (1) Dive planning should take into account cold water/weather variables and address the increased risks of equipment malfunction associated with diving in cold water during the pre-dive briefing.
- (2) Tasks to be performed under water must clearly be identified, practiced, and kept simple.
- (3) Address the needs for increased thermal protection.
 - a. Heavily insulated dive ware booties
 - b. Dry suit with hood and gloves
- (4) Use of environmentally sealed regulator designed for cold water and address the potential for regulator freeze up.
- (5) Avoid breathing from the regulator prior to immersion.
- (6) Never operate purge button unless underwater.
- (7) Use the purge button as little as possible. Never hold it down for more than 2 or 3 consecutive seconds; pressing it for longer may cause ice to form.
- (8) Breathe normally in order to minimize the cooling effect produced by the higher air velocity during over-breathing.
- (9) For repetitive dives, take particular care to ensure the SCUBA regulator is completely dry before starting the second dive.
- (10) Refill SCUBA cylinders only at filling stations equipped with an efficient filtering and moisture removal system, and SCUBA cylinders should be completely dry inside.
- (11) Diver should be able to recognize and understand the signs and symptoms of hypothermia.
- (12) Complete the required checkout dive where the diver must demonstrate:
 - a. Proper dive planning and adherence to policies and procedures for diving in cold water, and
 - b. Show competence in handling a free-flowing regulator with air sharing drills.

5.2.3 Overhead Diving

There are special considerations for a diving environment where the diver has interrupted or impeded access to the surface, and which could lead to equipment failure or a compromised breathing supply due to an overhead physical obstruction. We consider a dive team to be diving in “overhead obstruction” mode if at any time during the dive they find themselves in a position where they cannot complete an unimpeded ascent to the surface (e.g., ice, caverns, caves, culverts, vessel hulls, cages, or woody debris).

Diving in overhead environments in which structures, either natural or artificial, interfere with a diver making a direct vertical ascent to the surface presents unique risks and challenges. Most activities that take place in cave or cavern environments are beyond the scope of normal dive operations for Service divers. Conducting dives in these environments requires training and certification as cavern and/or cave divers. The NDCB must approve such training and subsequent dive operations, and it will do so on a case-by-case basis.

Limited exposure to overhead obstructions, such as movement under a dock to complete a survey, are often necessary to complete mission objectives, and the RDO may allow them if all criteria (listed below) are met to ensure diver safety. The degree of exposure determines the stringency of requirements. We’ve divided them into two sections below. Solo and tethered diving in overhead requirements must be addressed in the DSP and approved by the RDO.

Depth of Penetration (DOP) is defined as the distance from the edge of the overhead obstruction to the farthest point any portion of a diver's body reaches during the penetration.

Criteria for dives with a DOP of less than 6 feet:

- (1) The FDO and diver must determine that any planned overhead exposure does not present a significant risk to diver safety.
- (2) The FDO and RDO must consider risk mitigation strategies and alternatives to overhead exposure and include them in the DSP.
- (3) The RDO must concur with the assessment of minimal risk and approve any overhead exposure before the dive begins; divers may not enter an overhead environment if such action has not been approved.
- (4) No dives in overhead environments are permitted in depths exceeding 60 feet below the water surface.
- (5) Divers must always be able to visually identify the exit point(s). If visibility is insufficient to identify the exit point, or threatens to obscure the exit point, divers must exit the overhead environment.
- (6) No obstructions or entanglements should interfere with a diver reaching an exit point. At all points during a dive, divers should be able to swim a straight and unimpeded path to an exit point.
- (7) Tethered diving is permissible in overhead environments if lines do not present a significant entanglement hazard and the guidelines in [section 5.1.4](#) are followed.
- (8) Solo diving, unless tended, is not allowed in an overhead environment.
- (9) Additional training and protective equipment such as wetsuits, hoods, helmets, etc. may be required at the discretion of the RDO.

Criteria for dives with a DOP between 6 and 20 feet:

In addition to the criteria above, the following criteria must be met for overhead environment dives with a DOP of up to 20 feet. Dives with a DOP of greater than 20 feet require NDCB approval.

- (1) Divers must be certified to a level equivalent to the PADI advanced open water level, and certification must include training in night/limited visibility diving and underwater navigation.
- (2) Divers must each carry two light sources and a compass.
- (3) A safety diver must be on site, positioned either at the water surface or underwater at the entrance point to the overhead environment.
- (4) The DOP must not exceed the vertical space available under the obstruction. For example, dives under a 10-foot-high outcrop would be limited to a DOP of 10 feet, while dives under a dock 30 feet above the bottom would allow for a full 20-foot DOP.

5.2.4 River Diving

All river divers must hold authorizations in each of the equipment specializations when using specialized equipment (e.g., full face mask, dry suit, or hookah). When river divers cannot maintain visual contact and buddy diving is not possible, divers must use tethered diving operations and be trained in line tending. The NCTC Scientific River Diving course may be used to satisfy the river diving authorization.

Divers unable to attend the NCTC course must achieve, at a minimum, the knowledge/skills described in the following outline to receive RDO approval for river diving.

- (1) Line tending training
- (2) Low visibility training (blackout mask in confined water)
 - a. Confined water skills circuit
 - i. Transfer line to surface platform
 - ii. Alternate air source exchange and surface
 1. Secondary regulator
 2. Pony bottle exchange
 - b. Gear doff/don in water too deep to stand
 - i. Remove gear and replace
 - c. Underwater problem solving
 - i. Knot tying – bowline, square, figure eight
 - d. Entanglement training – two rescue divers on hand at all times
 - i. PVC 6-foot rectangle swim through with line
 - ii. Line wrapped around tank
- (3) Go/No Go model training (See [Appendix 7](#))
- (4) Dive gear streamlining
 - a. Finless diving protocols (See [Appendix 8.1](#))
- (5) Communication
 - a. Tactile (hand signals = palpable)
 - b. Line signals
 - c. Recall (surface to bottom) communication (emergency)
 - d. Communicating prior to diver deployment (diver to tenders)
 - e. Communicating with line signals (diver and surface)
 - f. Communicating with full face mask comms units (diver to diver, surface to diver)
- (6) River diver emergency response
 - a. Deploying a standby diver
 - b. Problem solving emergency situations
 - c. Unconscious over-weighted diver to the surface (fins/boots)

Chapter 6 – Dive Equipment Standards and Maintenance

Equipment must be serviced annually. Equipment that is subjected to extreme usage under adverse conditions may require more frequent testing and maintenance. The diver must examine all equipment before every dive. Dive gear that is not used on a regular basis or is used for training purposes may not need annual service. However, all dive gear must be serviced within 1 year prior to use.

6.1 Equipment Specifications and Maintenance

6.1.1 Regulators

- (1) Divers may only use equipment that the RDO and/or the NDCB approves.
- (2) Regulator sets must consist of a primary first and second stage, a secondary alternate air source (BC integrated or Octopus), a submersible pressure gauge, and a low-pressure inflator hose. “Spare Air” or similar small volume devices are not considered an adequate redundant air supply. These devices may be used only in addition to another alternate air source.

- (3) Scuba regulators, including first stages, second stages, and alternate second stage air sources, must be inspected and tested prior to first use. A certified technician must service all regulators annually unless more frequent service is necessary.
- (4) If divers use regulators with nitrox or breathing gas mixtures containing greater than 40 percent oxygen, they must clean and maintain them for oxygen service, and mark them, as necessary, to identify them for such use.

6.1.2 SCUBA Cylinders

- (1) SCUBA cylinders must be designed, constructed, and maintained in accordance with the applicable provisions of the [Unfired Pressure Vessel Safety Orders](#).
- (2) SCUBA cylinders must be hydrostatically tested every 5 years in accordance with Department of Transportation (DOT) standards.
- (3) SCUBA cylinders must have visual internal, external, and valve inspections at least every 12 months, or sooner if something happens that could compromise the integrity of the cylinder.
- (4) If SCUBA cylinders and valves are used in partial pressure enriched air nitrox (EAN) mixing during which oxygen concentrations greater than 40 percent are passed into the cylinders, they must be cleaned and maintained in an oxygen-clean and compatible state by a certified EAN technician.
- (5) Nitrox SCUBA cylinder identification marking:
 - a. Cylinders should be marked with "NITROX," "EANx," or "Enriched Air" per regional or industry standards.
 - b. Nitrox identification color-coding should include a 4-inch-wide green band around the cylinder, starting immediately below the shoulder curvature. If the cylinder is not yellow, the green band should be bordered above and below by a 1-inch yellow band.
 - c. The alternate marking of a yellow cylinder by painting the cylinder crown green and printing the word "NITROX" parallel to the length of the cylinder in green print is acceptable.
 - d. Other markings that identify the cylinder as containing gas mixes other than air may be used with the approval of the RDO and/or NDCB.
 - e. A contents label should be affixed and include the current partial pressure O₂, date of analysis, Maximum Operating Depth (MOD), and diver's initials.
 - f. The cylinder should be labeled to indicate whether it is prepared for nitrox or oxygen mixtures containing greater than 40 percent oxygen.
- (6) Oxygen SCUBA cylinder identification marking:
 - a. Cylinders should be labeled "OXYGEN," starting immediately below the shoulder curvature. This marking should be clearly visible and distinguishable.

- b. A contents label should be affixed and include the current percentage O₂, date of analysis, MOD, and diver's initials.
 - c. The cylinder should be labeled to indicate that the cylinder has been prepared for oxygen mixtures greater than 40 percent to follow standard oxygen cleaning protocols.
- (7) Mixed gas SCUBA cylinder identification marking:
- a. Cylinders should be marked to identify the cylinder as containing gas mixes other than air.
 - b. A contents label should be affixed, to include the current partial pressure O₂, partial pressure He, and date of analysis, MOD, and diver's initials.
 - c. The cylinder should be labeled to indicate whether the cylinder is prepared for oxygen or nitrox mixtures containing greater than 40 percent oxygen.

6.1.3 Weight Systems

- (1) Divers must be equipped with a weight belt or assembly capable of quick release.
- (2) Divers must also be equipped with enough weight to compensate for changes in buoyancy (wetsuit thickness, environment, dry suit, and currents).

6.1.4 Buoyancy Compensator Devices (BCD)

A BCD capable of providing neutral buoyancy at depth, a controlled ascent, and positive flotation on the surface is required.

- (1) These devices must be functionally inspected and tested by the RDO or FDO or their designee before the first use. Under normal use, these devices must be inspected and tested at 12-month intervals. Devices may not be used unless they have been inspected and tested within the previous 12 months.
- (2) All weight systems must be able to be ditched in emergency situations.
- (3) Divers must wear a separate BCD when diving in a dry suit.
- (4) A BCD may not substitute for additional line-tended harness requirements.

6.1.5 Full Face Masks

- (1) If a diver wears a full face masks utilizing a lower pressure system (i.e., hookah), they must have a redundant alternate air bailout system (pony bottle; see [section 5.1.5, 9](#)).
- (2) The full face mask must have an exhaust valve.
- (3) The mask must have a minimum ventilation rate capable of maintaining the diver at the depth to which the individual is diving.
- (4) A certified technician must service all full face mask regulators in accordance to manufacturer's requirements. Full face masks only need to be serviced before a use that appears in a DSP.

6.1.6 Gauges and Computers

- (1) Each diver must have an underwater timing device, an approved depth indicator, and a submersible cylinder pressure gauge.

- (2) A timekeeping device and depth gauge must be available at each diving location for each diver.
- (3) A certified technician must check all gauges (submersible pressure gauge, depth gauge) annually. Gauges that are providing inaccurate information should be repaired or pulled from service.
- (4) Dive computers may substitute for a timekeeping device and depth gauge. All dive computer batteries should be replaced according to the manufacturer's recommendations.

6.1.7 Hookah Systems

- (1) Divers must track the hours of use for the hoses, engine, and compressor for each hookah unit.
- (2) Divers or other technicians must perform maintenance on hookah compressors, engines, and components regularly, as recommended by the manufacturer, including rebuilding the compressor, carburetor, and hose fittings at regular intervals.
- (3) Hookah hoses and other components must be inspected and replaced as needed.
- (4) All back pressure valves, o-rings, and seals on air hose and accumulator tank connections must be inspected and tested and fully operational prior to use. Replace as needed.
- (5) Hookah low pressure regulators must be serviced annually.
- (6) All maintenance records of the items above must be kept in a file at the field station for each hookah unit to industry standards (e.g., In Line, Brownie).
- (7) All components must be visually inspected for wear and impurities.

6.1.8 Dry Suits

- (1) Rinse in fresh water after all diving.
- (2) Flush inflator and exhaust valves.
- (3) Dust seals with pure talcum powder or as directed by manufacturer.
- (4) Tuck latex seals into the sleeves/suit body, loosely fold valves out, and cap the inlet stem.
- (5) Place in sealed plastic bag to reduce exposure to ozone.
- (6) Store in a dark, cool, and dry area away from ozone and hydrocarbons.
- (7) Use paraffin zipper wax on the zipper.
- (8) Service inflators and exhaust valves annually.

6.1.9 Emergency Oxygen Systems

Equipment that divers use with oxygen or mixtures containing over 40 percent oxygen by volume must be designed and maintained for oxygen service.

Components exposed to oxygen or mixtures containing over 40 percent by volume oxygen must be cleaned of flammable materials according to oxygen cleaning protocols before they are placed into service.

Oxygen systems delivering 100 percent O₂ must have slow-opening/shut off valves and delivery should be at a rate of one psi/second or slower. This should include the following equipment: SCUBA cylinders, cylinder valves, SCUBA and other regulators, cylinder pressure gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

6.1.10 Oxygen Analyzer

Divers using a concentration higher than 21 percent O₂ must use an oxygen analyzer that is capable of determining the oxygen content in the SCUBA cylinder. We recommend having two analyzers available to reduce the likelihood of errors due to a faulty analyzer. The analyzer should be capable of reading a scale of 0 to 100 percent oxygen, within 1 percent accuracy. All diver and support equipment should be suitable for the partial pressure of oxygen PO₂ being used.

6.2 Breathing Air Standards and Compressors

Service divers and technicians must service and maintain all auxiliary equipment according to industry or manufacturer standards, and the RDO and/or NDCB must approve the types used.

6.2.1 Breathing Air Standards

Breathing air for SCUBA must meet the following specifications set by the [Compressed Gas Association \(CGA Pamphlet G-7.1\)](#).

Table 2. CGA Grade E Specifications

Component	Maximum Concentration
Oxygen	20-22%
Carbon Monoxide	0.001% (10 parts per million (ppm))
Carbon Dioxide	0.1% (1000 ppm)
Condensed Hydrocarbons	5 mg/m ³
Total Hydrocarbons as Methane	25 ppm
Water Vapor **	24 ppm (by moisture content)
Objectionable Odors	Absent
** For breathing air used in conjunction with SCUBA in extreme cold where moisture can condense and freeze, causing the breathing apparatus to malfunction, a dew point not to exceed -50°F (63ppm v/v) or 10 degrees lower than the coldest temperature expected in the area is required.	

6.2.2 Oxygen and Mixed Gas

Oxygen used for mixing Enriched Air Nitrox (EAN) or mixed gas must meet the purity levels for medical (U.S. Pharmacopeia, or U.S.P.) grade or “aviator grade” standards.

6.2.3 Air to Be Mixed with Greater than 40 Percent Oxygen

The following standards must be met for breathing air that is:

- (1) Placed in contact with oxygen concentrations greater than 40 percent, or
- (2) Used in EAN filling operations by the partial pressure mixing method, with greater than 40 percent oxygen as the enriching agent.

6.3 Compressor Systems Operations and Standards

The RDO and FDO must ensure the following features related to the design and location of compressor systems are present:

- (1) Low pressure compressors used to supply air to the diver equipped with a volume tank and a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.
- (2) Compressed air systems over 500 psi equipped with slow-opening shut-off valves.
- (3) Fill station controls located in a remote position, shielded from cylinders being filled to minimize risk of injury if there’s a cylinder failure.
- (4) Pressurized gas bank cylinders secured to prevent falling.
- (5) All high-pressure lines and fittings of appropriate rated working pressures and secured every 2 feet.
- (6) All air compressor intakes located away from areas containing engine exhaust or other contaminants.

6.3.1 Compressors for EAN Systems

- (1) We strongly recommend using an oil-free or oil-less compressor when blending or mixing nitrox using oxygen concentrations greater than 40 percent, to reduce the presence of oil mist and reduce the possibility for oxygen ignition of hydrocarbons. A hyper-filtered oil compressor for an EAN system must be checked frequently for oil and hydrocarbon contamination.
- (2) Components of cylinder filling stations exposed to oxygen or gas mixtures containing oxygen concentrations over 40 percent by volume must be cleaned and maintained for oxygen service, and equipped with oxygen-clean fill whips, gauges, valves, plumbing, etc. These measures are intended to maintain EAN system integrity.
- (3) The RDO and/or the NDCB must review and approve the design of EAN filling stations under Service control. Only those designs that the RDO and/or the NDCB approve may be used in Service-controlled filling operations.

- (4) Methods for producing EAN (membrane filtration, etc.) that do not require the addition to the SCUBA cylinder of oxygen concentrations above 40 percent are preferable over partial pressure mixing methods using high concentration oxygen.
- (5) Oxygen systems delivering 100 percent oxygen must have slow-opening/shut off valves and delivery should be at a rate of one psi/sec or slower.

6.3.2 Compressor Operation and Air Test Records

- (1) Gas analysis and air tests must be performed on each Service-controlled breathing air compressor at regular intervals of no more than 100 hours of operation or 6 months, whichever occurs first. The compressor operator must enter the results of these tests in a formal log that they also maintain, and they must provide the results to the RDO or FDO.
- (2) The compressor operator must maintain a log showing operation, repair, overhaul, filter maintenance, and temperature adjustment for each compressor, and they must provide the results to the RDO or FDO.
- (3) Personnel filling pressure cylinders from Service-owned compressors must receive training to be qualified in the operation of the fill station used. The RDO or FDO must document this training and keep it on file.

6.3.3 Production of Special Gas Mixtures

- (1) The RDO and/or the NDCB must authorize any production of special gas mixtures (EAN, Heliox, Trimix, etc.).
- (2) The RDO and/or NDCB will determine what training and qualification standards are necessary for any personnel involved in the production of EAN and mixed gas.

6.4 Gas Control Panels

- (1) Gas control panels must be maintained in accordance with manufacturer recommendations.

6.5 Air Storage Cylinders

- (1) Air storage cylinders must be hydrostatically tested in accordance with DOT standards (every 5 years), unless the construction of the cylinder exempts it from testing requirements and the exemption is documented.

6.6 Air Filtration Systems

- (1) Air filtration systems must be maintained in accordance with manufacturer recommendations.

6.7 Oxygen Cleaning and Maintenance Requirements

- (1) All equipment exposed to concentrations greater than 40 percent oxygen at pressures above 150 psi during the dive or cylinder filling process should be cleaned and maintained for oxygen service.
- (2) Equipment used with oxygen or mixtures containing over 40 percent by volume oxygen must be designed and maintained for oxygen service. Oxygen systems over 125 psig (i.e., gauge pressure) must have slow-opening shut off valves. This applies to the following equipment: SCUBA cylinders, cylinder valves, SCUBA and other regulators, cylinder pressure

gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

Chapter 7 – Emergency Procedures

Each Service diver and dive team member, crew, or field party involved on dive operations must be familiar with the emergency communication procedures. Any diver may deviate from the requirements of this handbook to the extent necessary to prevent or minimize a situation that is likely to cause death, serious physical harm, or major environmental damage. The diver or the FDO must submit a written report of such necessary deviations to the RDO and NDCB explaining the circumstances and justifications.

First aid supplies and emergency equipment are required on site. In addition:

- (1) A First Aid Kit adequate for the diving operation must be available at the dive location.
- (2) An emergency oxygen supply adequate for the diving operation must be available and set up prior to dive operations at the dive location.
- (3) Although not required, an AED should be made available and operational at the dive site.
- (4) Two-way communication adequate to summon emergency assistance must be available at the dive site.

7.1 Emergency Procedures

The following are the required emergency procedures. Divers must know the correct procedures and channels that the U.S. Coast Guard (USCG) monitors (VHF Channel 16 and CB channel 9) and the channel and frequency monitored by the local law enforcement agency.

- (1) When contacting the USCG on **Channel 16 VHF-FM** (156.8 MHz), the emergency radio call procedures are:
 - a. Make sure radio is on.
 - b. Select Channel **16**.
 - c. Press/hold the transmit button.
 - d. Clearly say: "**MAYDAY, MAYDAY, MAYDAY**" if the emergency is life threatening.
 - e. If the emergency is non-life threatening, say: "**PON, PON, PON.**"
 - f. Also give the vessel name (Fish and Wildlife Service Boat) and
 - i. Position and location
 - ii. Nature of emergency
 - iii. Number of people on board
 - iv. Description of vessel
 - g. Press/hold the transmit button.
 - h. Release transmit button.
 - i. Wait for 10 seconds and if NO response, repeat call.
- (2) Diver Alert Network (DAN): 1-919-684-9111 (emergency).
- (3) Diver recall system.
- (4) Dive plan and emergency plan.

7.1.1 Adverse Weather Conditions

- (1) Determine the nature, location, and direction of movement of the threat (lightning, rough water, high winds, etc.) and the best possible route to safety.
- (2) Retrieve the diver immediately.
- (3) Terminate dive.
- (4) Go to the nearest safe location.

7.1.2 Approaching Boat Traffic

- (1) Ensure that the approaching vessel operator sees dive flags (wave flag, if necessary). Use the marine radio to alert approaching vessel if diving in navigable water bodies.
- (2) Inform diver of approaching vessel and instruct diver of steps necessary to maintain safety (i.e., do not move until boat passes, or return immediately if approaching boat is a larger vessel).
- (3) Go to the nearest safe location.

7.1.3 Medical Illness and/or Injury to Diver

- (1) The diver should not panic.
- (2) The diver should assess injury, if possible.
- (3) Immediately return to surface, inflate BCD.
- (4) Notify standby diver, if required.
- (5) Send standby diver in for assistance/extraction of the diver, if required.
- (6) Administer first aid and, if necessary, oxygen.
- (7) Notify local emergency medical system, if required.
- (8) Terminate dive.
- (9) Notify management.

7.1.4 Medical Illness and/or Injury to Personnel Other than Diver

- (1) Determine extent of injury or illness.
- (2) Administer first aid.
- (3) Notify local emergency medical system, if required.
- (4) Retrieve divers, if required.
- (5) Terminate dive.
- (6) Notify management.

7.2 Incident/Accident

Divers or FDOs must report all diving accidents requiring recompression, resulting in moderate or serious injury, or resulting in death, to the RDO and NDCB. This information can only be released (e.g., to AAUS, the Divers Alert Network, or the National Underwater Accident Data Center) with the diver's/survivor's permission in writing. Divers and others must follow the Service's regular procedures for accident reporting ([see 054 FW 1, Serious Incident Notification Procedures](#), and [240 FW 7, Accident Investigation and Reporting](#)).

7.2.1 Incident/Accident Reporting

Reporting Accidents: Upon notification of a diving-related accident or incident, the diver's supervisor or Project Leader must enter all incidents and accidents into the Safety Management Information System (SMIS). If the accident/incident meets the definition of a serious accident "involving a death and/or one

or more persons hospitalized for amputation or loss of an eye and/or Departmental property loss in excess of \$250,000,” as described in [485 DM 7](#), the Assistant Director – Management and Administration, in consultation with the Chief, JAO Division of Safety Operations, appoints a serious accident investigation team (also see [054 FW 1](#)). For all other accidents/incidents, the responsible JAO Safety Manager/Specialist must provide guidance and support to the supervisor/Project Leader, FDO, and RDO in the conduct of an adequately scaled investigation.

Records Required for Reported Accidents/Near Accidents:

The RDO must record the following information with a record of the dive when there is an accident or near accident. The RDO must maintain it for a period of at least 5 years.

- (1) Names, addresses, and phone numbers of the principal parties involved.
- (2) Summary of experience of the divers involved.
- (3) Location and description of the dive site and a description of conditions that led to the incident.
- (4) Description of symptoms, including depth and time of onset.
- (5) Suspected causes and effects.
- (6) Diagnosis, treatment, and outcome.
- (7) Disposition of case.
- (8) Recommendations to avoid repetition of incident.

The collection and maintenance of records containing personal information (i.e., medical exam form, drug testing results, etc.) must be consistent with the provisions of [5 U.S.C. 552a](#) (The Privacy Act of 1974). This information is sensitive and protected. It is only available to staff on a need-to-know basis.

Personal information in electronic form must be protected using a password and only used in accordance with routine uses identified in “[OPM/GOVT-10, Employee Medical File System Records.](#)”

Use paper records similarly and protect them in a locked file and locked room that is available only to staff who have a need to know this information in accordance with OPM/GOVT-10. Those employees who store and maintain such records must read and be familiar with OPM/GOVT-10.

7.2.2 Incident/Accident Investigations

The RDO and responsible JAO Safety Manager must investigate and document any incident or accident and prepare a report for the NDCB.

Additional information deemed necessary may be required. In addition, the RDO must:

- (1) Record and report occupational injuries and illnesses in accordance with Service and DOI requirements.
- (2) Record the occurrence of any diving-related injury or illness that requires any dive team member to be admitted to the hospital, or after an episode of unconsciousness related to

diving activity, or after treatment in a recompression chamber following a diving accident. The report should specify the circumstances of the incident and the extent of any injuries or illnesses.

7.2.3 Incident/Accident Review

- (1) Divers must immediately report to their supervisor/Project Leader, FDO, and RDO, all diving-related injuries, accidents, near accidents, and equipment failures.
- (2) If an employee is hospitalized because of an accident, or the accident involves a fatality, divers must notify the responsible Safety Manager/Specialist immediately (see [054 FW 1](#)).
- (3) The employee's supervisor is responsible for completing an accident report using the SMIS. The report must describe the nature of operations, existing conditions, personnel involved, type of equipment used, nature of the injury or equipment failure, and recommendations for the prevention of similar accidents in the future. The responsible JAO Safety Manager will provide a copy of the SMIS report to the RDO. The RDO will confer with the NDCB as needed.
- (4) To facilitate accident investigations, the diver in charge of a dive operation must secure the accident site to the extent practicable and leave all equipment in the same configuration as at the time of the accident until they receive further guidance from the RDO.
- (5) If a diver is involved in a diving accident or near accident, the diver may be subject to a drug test.

Chapter 8 – Administration Procedures

8.1 Hazard Duty Pay

Divers are paid during dives while on duty subject to the conditions of the Hazard Duty Pay Schedule ([5 U.S.C. 5545\(d\)](#), [5548\(b\)](#); [5 CFR 550.901-906](#); and [225 FW 13](#)). Divers and their supervisors must document and compute hazard pay on [FWS Form 3-212 \(Hazard Duty/Environmental Claim\)](#) (*under development*). **Hazard pay is not discretionary and must be paid to qualifying divers as follows:**

- (1) Hazard pay is paid when dive conditions meet any one of the following:
 - a. At a depth of 20 feet or more below the surface,
 - b. Visibility is restricted,
 - c. Rapidly flowing water, or
 - d. Cold water.
- (2) Pay scale:
 - a. General Schedule (GS) employees:
 - i. The hazard pay differential is 25 percent of the basic hourly rate, which is applied to all hours in a pay status for the day in which the diving is performed.

- b. Wage Grade (WG) employees:
 - i. Divers in the WG series receive environmental differential pay, but the differential is not the same as for GS employees. WG employees who perform diving duties are paid 175 percent of the locality rate (WG-10, step 2) for all payable hours of the shift.
 - ii. WG divers who are performing the duties of a diver tender are entitled to hazard pay, which is 100 percent of the locality WG-10, step 2 rate. A diver tender is a trained diver (Service-authorized) whose surface responsibilities are essential to the dive, such as operating surface supply air systems, maintaining diver retrieval lines, maintaining direct communications with submerged divers, or as a diver who is fully suited and prepared to immediately enter the water in case of emergency (i.e., a standby diver) to be a dive tender. Dive tenders are only required on dives when the project Dive Safety Plan or commercial diving regulations ([29 CFR 1910](#)) require it.

8.2 Variances

The NDCB must approve any deviations from operational procedures (performing tasks, use of equipment, dive environments, etc.) not covered in the scope of this handbook. The request for a variance from the diving safety requirements in this handbook must be submitted, in writing, via the RDO to the NDCB.

A variance to the requirements in this handbook may be requested on a case-by-case basis. For example, if a project required diving in an overhead obstructed environment, the diver or the Project Leader would send to the RDO a variance request outlining the need to deviate from the handbook and explaining how the diver will still safely dive. The RDO must send the variance request to the NDCB.

The request for a variance and its approval or disapproval must be in writing.

Variance Implementation: A variance allows for an activity and provides the detailed protocols and support requirements. Written requests for variance must include:

- (1) A statement of the variance needed,
- (2) Discussion of why the variance is needed,
- (3) Whether it is Regionwide or just for one individual,
- (4) Whether it is permanent or temporary, and
- (5) Additional safety features that will be used to make the operation safe, which could include, but are not limited to, standard trainings or experience and equipment requirements.

Variance Approval: The variance request will be brought before the NDCB and the request reviewed. The NDCB will meet to discuss and voice questions or concerns. The NDCB will then vote on the specific case and the requested variance. Decisions are approved by majority vote when at least a quorum is in attendance. When a vote is tied, the motion will fail. Once approved, the variance should be revisited at a preset time interval.

Appendices

Appendix 1. Definitions

Accidents – Unplanned or unsought events that result in human injury, illness, or death to the people described in [29 CFR 1904.31](#), or result in property damage.

Active Diver – Someone who “dives” a minimum of 12 times a year with at least one dive in the previous 6-month period.

Advanced Diving Course – A course offered by nationally recognized diving organizations that instructs divers in topics beyond basic certification.

Buddy System – A system with two or more divers in the water and in contact with each other. The intent of the buddy system is to allow for a diver to respond to an emergency.

Buoyancy Compensator Device (BCD or BC) – A safety vest worn by the diver to control buoyancy while diving and to provide positive buoyancy while at the surface. The diver can inflate the BC orally or by a hose connected to the self-contained underwater breathing apparatus (SCUBA) cylinder.

Depth of Penetration (DOP) – The distance from the edge of an overhead obstruction to the farthest point any portion of a diver’s body reaches during the penetration.

Diving – Any activity taking place underwater using SCUBA or surface-supplied gas, including mixed gases, enriched air, or rebreathing apparatus, conducted in conditions acceptable to the RDO.

Dive Computer – An electronic, submersible, diver-carried meter based on an algorithm or dive table that computes the diver’s decompression status from time-depth inputs.

Dive Table – A table that contains a set of depth-time relationships that govern the amount of time a diver should spend at a specified depth, and any necessary safety stops recommended before ascending to the surface.

Diver Status – An authorized diver, conditional diver, or non-authorized diver.

- i. Authorized Diver - is an active diver who has complied with all Service requirements and has an authorization to dive signed by the appropriate RDO.
- ii. Conditional Diver - is a diver who has not performed 12 dives within the previous 12 months or a diver who has not completed a single dive within the past 6 months.
- iii. Non-Authorized Diver – is a diver who has had their Service Dive Card revoked, or is an inactive diver who has not maintained the necessary requirements (medical exams, swim tests, gear servicing, etc.), or a diver who has maintained

conditional status in over a 2-year cycle.

Diving Leadership Course – A course offered by nationally recognized diving organizations or a Government equivalent that teaches skills needed for planning and supervising diving operations (e.g., a Dive Master, Assistant Instructor, or Open Water Instructor course).

Dive Safety Plan (DSP) – A written plan that documents the planning and hazard analysis for a specific type of diving operation. The dive team conducting the diving operation must complete the plan and the RDO must approve it prior to diving. A DSP is not a substitute for a Field Crew Emergency Plan and Pre-Dive Briefing.

Emergency Oxygen Administration Course – A course that teaches how to treat diving-related accidents/injuries with oxygen, and the use, care, and maintenance of oxygen administering equipment.

Enriched Air Diving – An air supply where the oxygen content exceeds normal atmospheric oxygen content.

Field Crew Emergency Plan – A written plan that contains: the dive mission, an emergency evaluation plan, emergency contact information, a safety gear checklist to include communication equipment, and a list of the divers (authorized/conditional) participating.

Finless Diving – A river diver who has direct support via a tether to a dive platform (boat, dock, bank, etc.) that who is typically heavily weighted and needs to be on the bottom substrate. This method is used in lieu of fins to navigate muddy banks and obstacles in order to survey the river substrate (see variance - [Appendix 8.1](#)).

Hookah – A specialized form of surface-supplied air diving that comprises a small generator and air hoses supporting up to two divers.

Hyperbaric Medicine – The study of the medical aspects of sport, military, and commercial diving; medicine that improves the scientific basis of hyperbaric oxygen therapy; and medicine that provides sound treatment protocols and standards of practice for diving-related injuries and illnesses.

Incidents – Unplanned events that could have resulted in accidents, but did not. An incident is typically referred to as a “near miss,” and it is critical that they are investigated to determine contributing factors to ensure that an incident doesn’t turn into an accident with more severe consequences.

Line Tender – An individual who is trained as topside support to a line-tended diver.

Line-Tended Diver – A tethered diver trained in line tending diving that is connected to the surface via a strength member (line).

Line-Tended Diving – A specialized diving technique where divers are connected to the surface dive platform via a strength member (line) and managed by a trained line tender.

Logged Dive – A diver on life support, breathing underwater, within safe dive practices that has a dive separated by one or more of the following parameters: a minimum 10-minute surface interval, or

when working conditions require a series of repetitive dives in the same location without a minimum 10-minute surface interval, or when working conditions require a change in site locations via the surface without a minimum 10-minute surface interval.

Low Visibility – When visual contact with the dive buddy can no longer be maintained, or when the diver cannot see past a distance of 6 feet.

Maximum Operating Depth (MOD) – The diving depth at which the Partial Oxygen Content (PO₂) for a given mixture reaches a pre-determined level, not to exceed 1.4 atmospheres absolute (ata) in open circuit diving.

Mixed Gas Diving – A diving mode in which the diver is supplied with a breathing gas other than air.

Nitrox – A gas mixture of nitrogen and oxygen, containing between 21 percent and 40 percent oxygen by volume.

Nationally/Internationally Recognized Diving Certification Organizations – Organizations that offer diving certification; e.g., PADI, NAUI, YMCA, and the National Association of Scuba Diving Schools (NASDS). Dive training by a college, university, or Federal agency may be an acceptable substitute.

Over-Bottom Water Diving – A dive in which it is possible to lose orientation with the bottom or descend below safe levels. This generally occurs in deep water situations where there is no vertical reference.

Pre-Dive Briefing – A briefing to discuss the Field Crew Emergency Plan (including the manner in which the dive will be conducted, related safety measures, necessary contingency plans, current diver status for physical fitness, pre-dive equipment checklist, and in-water dive considerations for boat operators).

Proficiency Dives – Dives performed to maintain previously acquired skills that may be conducted on work time or recreational time and contribute to the 12-dive minimum dive log to maintain authorization.

Rebreather – A closed or semi-closed circuit SCUBA system.

Safety Stop – A planned stop at a specified depth, usually 15 feet for 3 minutes minimum, to help release dissolved nitrogen from tissues and reduce the chances of incurring decompression illness.

Shallow Water Blackout – A phenomenon that may occur to breath-holding (skin) divers in shallow water. Skin divers who have hyperventilated excessively before diving below the surface may reduce the level of carbon dioxide in their alveoli and bloodstream so low that their body may deplete oxygen to the point of unconsciousness before the carbon dioxide level in the blood builds up to sufficient levels to stimulate the nervous system to breathe again.

Snorkeling – The use of mask, fins, and snorkel at the surface or underwater (breath-holding dives).

Standby Diver – A diver at the dive location who is equipped and able to enter the water to assist a diver within 1 minute during no-decompression dive operations.

Surface Supplied Gas Diving – A diving mode in which the diver in the water is supplied with breathing gas via hose-to-surface cylinders or compressed air intake systems.

Appendix 2. Links to Forms

2.1 [Dive Log \(3-2221\)](#)

2.2 [Field Crew Emergency Plan and Pre-Dive Briefing \(3-2222\)](#)

2.3 Checklist Requirements for Authorization of Service Divers (3-2223)

2.4 [SCUBA Diving Medical Examination Form \(3-2224\)](#)

2.5 [Physician's Qualification Statement \(3-2224-A\)](#)

2.6 [Diving Authorization Card \(3-2225\)](#)

2.7 [Float Plan \(3-2227\)](#)

Appendix 3. Supplemental Material

3.1 Occupational Safety and Health Administration Instruction – 29 CFR Part 1910 – Commercial Diving

https://www.osha.gov/sites/default/files/enforcement/directives/CPL_02-00-151.pdf

3.2 Department of the Interior – Departmental Manual, 485 DM 27 – Underwater Diving Safety

<https://www.doi.gov/elips/browse>

Appendix 4. Diving Lock-Out Procedures

Dive Operations Conducted in Marinas and/or Boat Yards, with Diving Lock-Out Procedures

Electrical supply(s) to all docks and vessels within the marina must be turned off at source/supply (i.e., marina breaker box).

Once turned off, all electrical sources/supplies must be physically locked out (in a manner that they cannot be accidentally turned on) and labeled/tagged with a "lockout tag."

All divers must be accompanied by "surface support" personnel to ensure that no one is permitted on boats/docks while divers are working/inspecting under/around each boat/dock and the boats/docks adjacent to the boat/dock being inspected/worked on by the divers.

All "automatic" boat functions/systems must be turned off while divers are in the water, conducting boat/dock inspection/work (e.g., bilge).

All underwater/in-water construction occurring in the dive area must be stopped/discontinued while divers are in the water. This would include any construction/maintenance work that could impact divers (e.g., electrical supply, impact/sound/underwater noise, intake/outflow pipes/pumps).

All divers will, at a minimum, wear a wet suit with gloves and boots to improve insulation to/from electrical currents.

Appendix 5. Dive Safety Plan

Introduction

A Dive Safety Plan (DSP) documents the planning and hazard analysis for a specific type of diving operation (i.e., suction dredging, transect survey, rebreathers, etc.). Prior to engaging in each new diving procedure or when using a new type of equipment for which a DSP does not currently exist, the dive team conducting the dive operation must complete a DSP and the Regional Diving Officer must approve the plan. Once approved, future dives of a similar nature may reference the existing DSP. The DSP is not intended to supplant the Field Crew Emergency Plan and Pre-Dive Briefing. At a minimum, include the following information in the DSP:

Objective - Describe objective(s) of using the particular equipment or procedure.

Description of Equipment and Techniques

- 1) Provide references for equipment and techniques if available.
- 2) Describe the equipment to be used.
- 3) Describe the proposed sequence of operations, including required tasks and communications in detail.
- 4) Describe the support vessel, if applicable.

Diving Plan Hazard Analysis

- 1) Describe hazards associated with the proposed operation and equipment that the diver may experience and what preventative actions will be employed to alleviate the hazard. The following table format is suggested:

Hazard	Preventative Action
1.	
2.	

Appendix 6. Letter of Reciprocity (LOR) –Template

U.S. FISH AND WILDLIFE SERVICE LETTER OF RECIPROCITY REQUEST/REVIEW

Request: A Service diver that is currently authorized under the auspices of the U.S. Fish and Wildlife Service (Service) will use this form to request approval to dive with the Agency or Institution, as a visiting diver. The visiting Service diver will comply with the diving regulations of the Service *Dive Operations Handbook* or host Agency/Institution's Diving Safety Manual, whichever is greater based on reviews of the National Diving Control Boards of both agencies. The host Agency or Institution has the right to approve or deny this request and may require a checkout dive with the Diving Safety Officer (DSO) or designee of the host Agency or Institution. If this request is denied, the host Agency or Institution should notify the RDO of the visiting Service diver the reason for the denial. The Service RDO for the visiting Service diver will confirm the following information.

Review: A Service RDO will use this form to review a visiting diver's qualifications and verify the diver's experience. The visiting diver's DSO or equivalent will confirm the following information:

Agency: _____ Region: _____ Diver requesting Reciprocity: _____

Active Status Requirements: (RDO initial)

_____ Medical Exam	Date: _____	Expires: _____	Dive Log Total: _____	Last 12 Months	Last 6 Months
_____ Emergency O2	Date: _____	Expires: _____	Depth Authorization: _____		
_____ First Aid/CPR/AED	Date: _____	Expires: _____	Diving Restrictions: Yes or No		
_____ Dive Skills (Checkout)	Date: _____		IF "YES," explain: _____		
_____ SCUBA Regulator Service	Date: _____				
_____ Swim Tests	Date: _____				

Diver Authorizations and Experience: (RDO initial)

_____ Open Water (basic)	Drysuit _____	Altitude _____
_____ Open Water (advanced)	Full Face Mask _____	Cold/Ice _____
_____ Rescue Diver	Hookah _____	Overhead _____
_____ Master Diver (five certifications)	Nitrox _____	River Diving _____
_____ Dive Master	Mixed Gas _____	Line Tending _____
_____ Assistant Instructor	Rebreather _____	Other _____
_____ Instructor	Decompression _____	Other _____

Emergency Contact Information

Name: _____ Relationship: _____

Phone Number: _____ Cell: _____ Work: _____

This is to verify that the above individual is currently an authorized diver with the (Agency): _____

Regional Dive Officer: _____
(Signature) (Phone Number) (Date)

Appendix 7. Go/No Go Risk Assessment Worksheet

SCUBA DIVING CREW: Risk Calculation Worksheet - To compute the total level of risk, assign a risk of 0 (No Risk) through 10 (Maximum Risk) to each element. This is your personal estimate of the risk. Add the risk scores to come up with a total risk score. A maximum risk (10) in any single category results in an automatic “No-Go” decision. It is possible that a high risk “No-Go” score can be mitigated to a “Go” (e.g., by retrieving safety equipment, or by waiting for a storm to pass); most “No-Go” dive decisions (current/depth unsafe, diver too cold) cannot be mitigated on the same day.

TEAM DISCUSSION TO UNDERSTAND AND MANAGE THE RISKS IS MOST IMPORTANT - NOT THE ABILITY TO ASSIGN NUMERICAL VALUES TO RISK ELEMENTS!

Supervision	Even if a team is qualified to perform a dive, supervision acts as a control to further minimize risk. Some shallow shore dives may be conducted without a surface tender, but all diving from a boat will be conducted with a surface tender. The higher the risk, the more the supervisor needs to be focused on diver observation. A supervisor should be solely focused on supporting the dive mission, without distraction.
Crew Selection and Fitness	Crew selection and fitness should consider how qualified the divers are to complete the mission. SCUBA diving is a strenuous activity, particularly in extreme conditions. The dive experience and fitness level of the dive team for a specific mission needs to be considered. If the mission will require extended time under water, or be conducted in strenuous conditions, providing a spare diver for relief may decrease overall stress and fatigue and improve the safety of the dive mission.
Safety Equipment	SCUBA diving requires specialized equipment for safe dive operations. This includes, but is not limited to: properly functioning BCD, air supply, mask, thermal protection, emergency oxygen kit and tether lines. Lack of ANY piece of essential safety gear constitutes an immediate ‘NO-GO’ decision.
Environment Conditions	On a dive, water depth, current, and temperature all play a role in the risk and planning required. The risk involved in a dive increases with depth. Current increases buoyancy and thus swifter water requires more weight to achieve negative buoyancy. Adding weight also increases the risk involved in a dive. Even with thorough insulation, water will bring down the body temperature of a diver over time. Surface support personnel should be diligent in watching for signs of hypothermia during cold water dives.
Site-Specific Considerations	Consider factors affecting performance execution of the dive. This includes considerations for aspects of the site that may impact the dive such as: current, local weather, water clarity, substrate type, boat traffic, in-stream obstructions, and diver ingress and egress points. All site-specific considerations should be discussed during the pre-dive safety briefing. If in-stream hazards are discovered during the dive, the dive team should reassess the risk before proceeding with the mission.
Dive Complexity	This element encompasses the dive mission and environment together, along with how they can change. As hazard exposure increases so do the risks. The complexity of work under water will impact how each dive is planned. The dive mission and how it may change if the environment changes should be part of the pre-dive safety briefing. Divers or surface tenders may need to be replaced during the course of a complex, or higher risk, dive operation to reduce risk

Date:	Dive 1	Dive 2	Dive 3	Dive 4	
Time:					60
Supervision					
Crew Selection and Fitness					44
Safety Equipment					
Environment Conditions					23
Site-Specific Considerations					
Dive Complexity					0
Total					

RED
(High Risk)
50

AMBER
(Caution)
40
30

Green
(Low Risk)
20
10

GAR EVALUATION SCALE

Appendix 8. Approved Dive Variances

8.1 - Finless Diving Operations

Request for Variance – Panama City Field Office River Diving without Fins

Action: River Diving without Fins

Purpose: Collection of freshwater mussels while SCUBA diving on the river bottom with potential for navigation through obstacles.

The Service's *Dive Operations Handbook*, section 3.4.5, lists fins as required equipment for a SCUBA diver. The collection and monitoring of freshwater mussels requires divers to crawl along the river bottom, constantly retaining contact with the stream bed with their feet in the substrate while probing into the substrate with both hands to physically encounter mussels. Crawling in fins would require flexure of the knees and ankles and a loss of leverage from the whole leg muscular/skeletal system, thus increasing lower back stress, the risk of cramping, and significantly reducing mobility and comfort. Also, the conditions on small vessels are not conducive for divers that may be encumbered by fins, which can reduce maneuverability in and out of the water, and as the divers traverse across muddy stream banks, shallow water, and obstacles such as "downed" trees. Wearing rock boots or neoprene boots allows divers to enter and exit the river facing forward and standing, increasing comfort and awareness of the surroundings. This request for variance is seeking this procedure for Service divers that participate in river dives.

Procedure:

Service divers that elect to not wear fins must adhere to all other diving requirements, per 241 FW 10 and the *Dive Operations Handbook*. Service divers should not dive in currents greater than or equal to 3 knots. Divers may wear hard-soled dive booties or wading boots. To minimize the risk of diving without fins, Service divers will use a tether line (with a Dive Safety Plan approved by an RDO), to provide both a physical guide to the entrance/exit point, and to assist with traveling underwater. When surfacing, the tether line also assists divers in maintaining a safe ascent rate as the line is climbed hand over hand. The diver tether line must also be anchored to an attachment point (e.g., shoreline, dock, or vessel). The only situations where Service divers would not employ the diver-attached tether line are 'stand up' dive conditions with sufficient visibility to retain contact with the dive buddy or with the use of a weighted block ascent/descent line that can be used from a vessel to assist divers ascending and descending with the block weight heavy enough to support divers in a current < 3 knots. Stand-up dive conditions are when water is shallow enough and the current is slow enough for all divers to have the ability to stand up in the channel and stay in place.

Currently, the Panama City Field Office divers are using the non-tethered, weighted block ascent/descent method. This method employs a 50-pound concrete block that has an attached line and a floating buoy. The buoy line is attached to the boat on a line cleat, however, if the line becomes detached from the boat, the buoy will remain at the diver's location and provide a stand-alone ascent line. Attached to the 50# block is a swivel for the buoy line and two stainless steel cables approximately 6' in length. The cables swivel around the block attachment point and provide a measurable search arc for freshwater mussel searches for each diver. Two divers descend the weighted tether line to the block.

The divers proceed to lay out the cables at the 6 o'clock position against the river current. Each diver moves to the 12 o'clock position against the river current within the allotted search arc provided by the cables, as one diver moves clockwise and the other diver moves counterclockwise, until the entire radial plot has been searched. Each diver knows the approximate location of the other diver and can easily reach the other diver by following their cable to the block and locating the other diver's guide cable. Upon completion of the dive search, both divers meet at the block and ascend the line together to the vessel. Divers do not use the anchor line as the ascent/descent line, as the anchor can become dislodged and cause the boat to drift.

As a safety precaution for non-tethered divers, a 100-foot floating current/tag line and buoy is deployed downstream of dive locations to assist divers that may become detached from the ascent/descent line. In case a diver loses direction and is unable to ascend on a line, divers should utilize their BCD to inflate just enough air to compensate for the additional weight used in river diving. As the diver begins to become neutrally buoyant, the diver should swim to the surface at a rate of less than or equal to 1 foot/second. At the surface, the diver will fully inflate their BCD and swim to the vessel or floating current line. It may be advisable to swim to the shoreline or riverbank. Typically, while conducting mussel searches in water that is too deep to stand, the vessel should be anchored so that the divers are positioned in between the vessel and shoreline, providing a minimal distance to swim. All dives will have surface support personnel and will employ a diver recall method in case of emergencies.

8.2 - Hawaii Rebreather Diving Operations

Request for Variance - Region 1 Pacific Islands Fish and Wildlife Office and the Pacific Islands Refuge and Monuments Office

Action: Mixed Gas Rebreather Diving

Purpose: Inventory of mesophotic species – American Samoa.

This request defines specific considerations regarding the use of rebreathers on coral reefs at shallow and mesophotic depths. This document and appendices include the need for the use of rebreathers on this project as well as training, proficiency, and/or experience verification requirements for authorization, equipment requirements, operational requirements, and additional safety protocols to be used.

Rebreathers are defined as any device that recycles some or all of the exhaled gas in the breathing loop and returns it to the diver. Rebreathers maintain levels of oxygen and carbon dioxide that support life by metered injection of oxygen and chemical removal of carbon dioxide. These characteristics fundamentally distinguish rebreathers from open circuit life support systems, in that the breathing gas composition is dynamic rather than fixed. This variance will focus on closed-circuit rebreathers.

Closed-circuit mixed gas rebreathers (CCR) recycle all of the exhaled gas and replace metabolized oxygen via an electronically controlled valve, governed by electronic oxygen sensors. Manual oxygen addition is available as a diver override, in case of electronic system failure. A separate inert gas source (diluent), usually containing primarily air, heliox, or trimix, is used to maintain oxygen levels at safe levels when diving below 20 feet salt water (fsw). CCR systems operate to maintain a constant oxygen partial pressure (PPO₂) during the dive, regardless of depth. Advantages of rebreathers include increased gas

utilization efficiencies that are often independent of depth, extended no-decompression bottom times, greater decompression efficiency, and reduction or elimination of exhaust bubbles that may disturb aquatic life or sensitive environments.

The mesophotic reefs exist beyond 130 fsw and are not accessible by conventional open-circuit SCUBA. Closed-circuit mixed gas rebreathers (CCR) are required for diving the deep Mesophotic Coral Ecosystems (MCE) of American Samoa that lay between 100-300 fsw, in order to develop a better ecological understanding of these systems across this region. The data and knowledge gained from these deep dives will help FWS staff to understand the relationships between natural environmental factors and the distribution and community assemblages of MCEs.

Application of this variance is in addition to pertinent requirements of all other sections of the *FWS Dive Operations Handbook*. For rebreather dives that also involve staged decompression and/or mixed gas diving, all requirements for each of the relevant diving modes shall be met. The NDCB reserves the authority to review each application of all specialized diving modes, and include any further requirements deemed necessary beyond those listed here on a case-by-case basis.

No diver shall conduct planned operations using rebreathers without prior review and approval of the NDCB. In all cases, trainers shall be qualified for the type of instruction to be provided. Training shall be conducted by agencies or instructors approved by the RDO and NDCB.

An increased level of discipline and attention to rebreather system status by the diver is required for safe operation, with a greater need for self-reliance. Different rebreather systems have the same basic components with variations in design and operation. When evaluating any dive plan incorporating rebreathers, risk-management emphasis should be placed on the individual qualifications of the diver on the specific rebreather make and model to be used, in addition to specific equipment requirements and associated operational protocols. Familiarization of the rebreather being used, pre-dive checklists, and familiarization of dive buddy's units is incorporated into the pre-dive preparation.

The models of rebreathers used for this project will be AP Inspirations, used by the FWS and NPS, and the Poseidon Sevens, or Megalodon units used by approved partners. Certification is model-specific, but crossover by an experienced rebreather diver from one model of rebreather to another is easier than becoming a rebreather diver for the first time.

Standardization of rebreather units across a dive team with different models is not practical, however, being versed in your buddy's unit and its operation is standard practice. The team that will be diving on this project has either been trained on both the Poseidon and Inspiration or are very familiar with the units. Unit-specific components include the alarm indicators, the manual injectors, and open circuit bailout. Proficiency dives and warmup dives with team members are required prior to the project start date. This ensures that team members are familiar with the operation, the gear being used, each rebreather unit, and can assist in an emergency.

During proficiency and warmup dives, rebreather team members need to be familiar with manual injection buttons, open circuit bailout valve, the BCD inflator, quick releases, the alarm indicators, and other harness clips for the stage bottles on themselves and their buddies. These can be standardized to a large extent. Each team member would be using the same gas mixes, and stage bottles are carried in one of two different ways.

Procedure:

This field research will be conducted via surveys by a well-qualified team of technical mixed gas divers from multiple agencies (U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration (NOAA) Papahānaumokuākea Marine National Monument, Bishop Museum, University of Hawai'i, and Old Dominion University). Surveys will include two survey design approaches utilizing the same methods. One approach will use a modified type of rapid ecological assessment (REA) in three discrete locations at 40, 60, 80, and 100 meters over three time intervals. This approach creates monitoring sites to characterize change of MCE communities across depth and time. Another approach will use the same REA method at other locations and similar depths around Tutuila (20–30 sites), and if possible, the Manu'a Islands (6–10 sites around Ofu, Olosega, and Ta'u) to characterize change of MCE communities across locations. Additional surveys may be conducted around Rose Atoll and Swains Island if ship time becomes available.

This modified REA method will consist of six divers collecting data on fish, coral, invertebrates, algae, and habitat characteristics. The team will include two fish divers: one counting and sizing fishes on a 25-m belt transect and the other using a stereo video camera collecting data on the sizes of all fishes. The team will also include: a coral expert that photo documents coral species and collects samples to document the coral species, a diver focusing on photo documenting algal species and the collection of samples to document the diversity of algae, a diver focusing on counting mobile invertebrates along the 25-m belt transect and sampling plots for cryptic invertebrates, and a diver taking habitat photos to be used in a three-dimensional habitat reconstruction model. Additional dives will be conducted to deploy and retrieve sensors and settlement plates, and collect fish specimens, water samples, and specimens for thermal stress experiments.

These surveys will be multi-institutional and each program will follow their respective diving rules and procedures. *When diving as a multi-agency team, the team will follow the most conservative diving rules and procedures for that dive.* In general, divers descend at identified drop points for various defined activities while towing a PAM float that marks the location of divers at the surface. The team arrives on the bottom and the fish biologists lay out a 25 m transect. The benthic team begins to collect their respective data and follows the fish team. The team will ascend together. Dives will range in depth from 20 m (60') to 100 m (330') with maximum bottom times between 40-60 min. Upon ascent, a signal buoy is released to notify the surface vessel. A support diver will meet the dive team at 70 fsw with additional safety gas, and shadow team for the duration of the decompression. All divers will follow the most conservative real-time decompression schedule dictated by either the onboard CCR computer, their back-up off-board CCR computer, or those of their buddy. Only one dive will be completed in a day and no more than 7 consecutive days of diving will occur. Dives will be conducted from a small vessel operated by Pago Pago Marine Charters, various vessels from the National Park of American Samoa, or NOAA vessels.

8.3 - Ash Meadows Refugia Diving Operations

Request for Variance - Region 8/10 Ash Meadows Fish Conservation Facility, Ash Meadows NWR, Amargosa Valley Nevada

Action: Site-specific training to dive in overhead environment

Purpose: Monitoring of captive population of Devils Hole pupfish and ecosystem assessment.

Introduction

The Devils Hole pupfish, *Cyprinodon diabolis*, is a critically endangered aquatic species found only in a single geothermal pool and cave system in Amargosa Valley, Nevada. In recent years, the wild population of this high-profile species has declined to as few as 35 individuals. In response to declining numbers, captive breeding became a priority for the U.S. Fish and Wildlife Service (FWS) and culminated in the establishment of the Ash Meadows Fish Conservation Facility (AMFCF) where the only captive population of Devils Hole pupfish now resides.

Numerous attempts have been made to keep Devils Hole pupfish in captivity over the past five decades, but all have ultimately failed. Key to the current successes was utilization of a large ecosystem recreation referred to as the refuge tank (RT), designed to simulate the challenging biotic and abiotic features of the wild habitat. This is a concrete-walled pool of approximately 100,000 gallons system volume. The tank itself measures approximately 30 feet wide x 30 feet long x 22 feet deep. Roughly 80 percent of the tank volume is contained below a flat concrete ceiling, designed to mimic the cavern environment of the upper regions of Devils Hole. There are two access points to the surface, both along the northern wall of the tank. The primary access point is referred to as the deep pool. This is an opening in the northeast corner of the tank, measuring approximately 10 x 12 feet. This access point is equipped with a permanently affixed ladder extending to the base of the tank and a second entrance and exit point along a permanently affixed fiberglass shelf. Independent of the primary access point, there is also a diver port in the northeast corner of the tank measuring approximately 4.5 x 4.5 feet and featuring a second permanently affixed ladder. This diver port is used as a backup exit and also provides illumination to the recessed portions of the tank.

Because of the unique configuration of the refuge tank, more traditional methods of surveying fish such as visual observation or camera arrays are impractical. The sensitive nature of the fish and their protection status makes more intrusive monitoring such as mark-recapture unwise. Since 1972, the National Park Service (NPS) and other partners have utilized traditional SCUBA survey dives to monitor the wild population. These dives necessitate divers be certified as cave divers, as they enter true cave conditions and dives generally exceed 100 feet in depth.

Since 2014, NPS and AMFCF have monitored the RT population utilizing SCUBA. Because of the ceiling on the tank, divers entering the overhead environment have been required to be trained as either cavern or cave divers. While this requirement was enacted out of an abundance of caution, experience has shown that this requirement is excessive to safely work in the refuge tank, and the training requirement itself may cause undue stress and risk to the trainees, and unnecessary cost and logistical difficulty to the program.

The refuge tank itself is discussed more thoroughly in the dive site and hazard sections below, but in short, the dives more closely resemble a dive in a swimming pool than in a true cavern or cave environment. The water is clear, warm, and there is no noticeable flow or current. The tank is comprised of flat concrete panels on each side and there are no significant obstructions or entanglement hazards. Divers can easily see from one end of the tank to the other and throughout the dive they can see both exit points. Though the ceiling prevents a direct vertical ascent to the surface, at any point during the dive divers may still make a direct linear swim to the surface, free of obstructions.

Cave and cavern training is designed to allow divers to operate in environments far more challenging and dangerous than those experienced in the refuge tank, and as such, the training itself is inherently stressful and dangerous, and many of the skills taught are not appropriate to the dive techniques necessary to survey fish in the refuge tank. Additionally, the training is time-consuming and costly. There are relatively few instructors certified to teach these courses, and most training requires at least a week of travel and purchase of extensive additional gear for each diver, resulting in thousands of dollars of expense to qualify a single diver.

Because of the comparative ease of diving in the refuge tank, and the added risk, stress, and cost of traditional cavern/cave training, this variance is intended to allow implementation of a site-specific training program that will enable divers to work safely in the refuge tank environment. The training detailed in this variance utilizes gear redundancy and skill mastery to address the specific hazards encountered in the AMFCF refuge tank. This training applies solely to diving in the AMFCF refuge tank and is not intended to address training requirements in any other environment. All dives will be for research and monitoring purposes only. No construction, maintenance, or repair tasks will be performed under this variance.

Description of Dive Site

The primary access point to the AMFCF refuge tank is located inside a building outside of the primary facility (Image 1; not attached here, but would be attached if submitting variance for approval). Divers enter the water using a seated entry from the walkway placed at the end of the fiberglass shallow shelf. Water depth at point of entry is 22 feet and is constant throughout the deep pool. Images 2 and 3 (not attached) show the deep pool where divers enter and exit. There are several sensor cables mounted along the wall. Entanglement hazards such as these are all mounted directly adjacent to walls and as such, present little risk to divers. No entanglement hazards exist in the open area of the deep pool where divers work. The only structures present in the deep pool are a set of pipes, approximately 24" in diameter, mounted approximately 12" above the bottom. These pipes run parallel to the bottom, extending in a "U" pattern. Divers swim above or between the structures and use the pipes as transect guides. Divers do not swim below the pipes or in any area where free movement might be impeded. Within the overhead environment there is always at least 16 feet of vertical space between the bottom and ceiling, allowing the divers abundant room to maneuver and to avoid disturbing bottom sediment. There is little sediment to disturb; the bottom is largely bare and is constantly cleaned by snails. The sediment that has accumulated clings to itself and drops rapidly out of the water column. Even with aggressive finning, divers have been unable to suspend sediment sufficiently to obscure visibility across the pool. While the ceiling shadows much of the tank, the deep pool is illuminated sufficiently from the deep pool opening and the diver port that divers can see without artificial lights, although divers always carry at least two lights to aid in observing fish. Divers are always in close proximity to exit points, and in the event of an emergency, can easily reach an exit point and swim to the surface in less than a minute without exceeding a 60 foot-per-minute ascent rate.

Description of Dive Modes and Personnel

Dives will be conducted as either buddy-dive operations or as tethered dives. All divers must meet training requirements described below, and a lead-qualified diver must be present for all dives (see lead

diver requirements below), although the lead diver does not necessarily have to be on the dive if they determine that the dive team is capable of safely conducting the dive.

Buddy dives will be conducted with a minimum of four personnel. At least two divers will be in the water to provide redundancy and safety during the dive operation. Additionally, a safety diver will be topside to provide rapid diver assistance. The safety diver will be either positioned on the deck with gear assembled, ready to rapidly enter the water, or floating at the surface of the deep pool, ready to descend. An additional surface support person, who may or may not be a diver, will be tasked with checking divers in and out, assisting with gear handling, monitoring the underwater video feed, and operating diver recall and external emergency communications such as calling 911, etc., per established safety protocols. In typical dive operations, multiple surface support personnel will be available and these tasks will be distributed between several individuals.

Tethered dives will be conducted similarly with regard to personnel. Minimum staffing will include a diver, a trained line tender, a safety diver, and a surface support person. The line tender may or may not be a diver, but will be trained in line-pull communication, line management, and diver emergency procedures.

If electronic communication equipment is used for dives, an additional surface support individual is required to operate the surface communication equipment.

Site-Specific Hazard identification and Mitigation

Typical hazards for diving are to be addressed in the dive plan. Only those hazards unique to the overhead environment are addressed in this variance.

Hazard 1: *Overhead environment prevents direct vertical ascent to surface*

Mitigation:

- Divers will always maintain a clear visual path to the exit points. If divers at any point in the dive are not able to see both exit points, the dive will be aborted.
- Divers will be equipped with a fully redundant air supply to facilitate sharing of air between divers in emergencies; or, in the event of an equipment failure resulting in catastrophic air loss, divers will still have sufficient air to make a safe ascent without assistance.
- A safety diver will always be on site, ready to provide assistance and air to divers in distress.
- Diver status can be monitored throughout the dive via a live video feed.

Hazard 2: *Diver activity may cause sediment suspension, reducing visibility or obscuring exits (experience has shown that this is extremely unlikely)*

Mitigation:

- Divers will receive prior training in buoyancy techniques, gear configuration, and fin strokes designed to minimize disturbance.
- Dives will be aborted if visibility is insufficient to see from one side of the tank to the other (~30

feet).

- Divers will be trained to use compasses for navigation in limited visibility. If visibility obscures exit points, divers will immediately follow a compass heading north to find the north wall and proceed to either of the two exit points along that wall.
- Divers will be monitored by live video feed. If visibility inhibits monitoring, surface support staff will recall divers.

Equipment Requirements

Besides the standard dive equipment required by FWS standards (per 241 FW 10 and the *Dive Operations Handbook*), the following is also required to dive in the AMFCF refuge tank:

- Redundant air supply, comprised of a cylinder holding ≥ 13 cubic feet of air, regulator, and submersible pressure gauge.
- Two light sources.
- Audible underwater signaling device.
- Head protection, either a hood or helmet to prevent injury from impacting the ceiling.
- Extraneous items which may impede diver safety in overhead environments, such as surface markers and snorkels, may be removed at the discretion of the lead diver.

Training Requirements

Divers must have either cave or cavern certification, OR meet the following training requirements:

- Certified to the equivalent of PADI Advanced Open Water, including night/limited visibility and navigation training.
- At least 20 logged Service dives.
- Site-specific training in confined water (pool), to be provided by a lead diver or RDO in advance of AMFCF dives. Divers must demonstrate mastery of:
 - Switching to redundant air supply.
 - Air sharing using redundant air supply.
 - Switching to redundant air supply with obscured visibility (blacked-out mask).
 - Compass navigation without external visual reference (diver wearing blinders to obscure surroundings).
 - Two checkout dives accompanied by a lead diver following confined water training to check proficiency in AMFCF refuge tank.

Lead Diver Requirements

Assignment of a diver to “Lead Diver” status is determined by the RDO. To be considered a lead diver, a diver must meet the above requirements PLUS:

- Be certified to PADI rescue-diver equivalent; divemaster or instructor certification is preferred.
- Qualified as a Service diver for at least one year.
- Minimum 20 logged dives in the AMFCF refuge tank.
- Minimum 50 logged Service dives.
- Demonstrate to the RDO their ability to effectively lead divers.
- Demonstrate to the RDO their ability to effectively teach and assess student performance for all site-specific training skills. To accomplish this, a lead diver candidate will teach and assess all skills in confined water under the supervision of the RDO. The RDO will provide necessary guidance and preparation for the candidate prior to assessment.

Situation-Dependent Training

Additional training may be required as dictated by dive mode. Examples of such training includes but is not limited to:

1. Full-face/communications mask: If use of communication devices is desired, full-face mask training and certification will be performed by a nationally accredited training agency. Following certification, divers must demonstrate mastery of the above site-specific training skills in confined water, both with full-face and half masks.
2. Tethered diving: If tethered diving is being utilized, divers unfamiliar with tethered diving procedures will receive confined-water training for safe tethered diving skills prior to tethered dives at AMFCF.

8.4 – Variance (Reserved)

8.5 – Variance (Reserved)