marine technology
SOCIETY

Opportunity runs deep™

A Code of Practice for Diving Program Management: Select Guidelines for Applying Technology in Occupational Diving Projects

MTS Technical Diving Committee
Michael Lombardi, CMarTech, Michael Max, PhD.,
& CAPT Rusty Mirick (USN ret.)

marine technology
SOCIETY

Opportunity runs deep™

A Code of Practice for Diving Program Management:

Select Guidelines for Applying Technology in Occupational Diving Projects

MTS Technical Committee, Diving

Michael Lombardi, CMarTech, Michael Max, PhD., & CAPT Rusty Mirick (USN ret.)

*****NOTICE*****

The Marine Technology Society asserts that in no way is the enclosed Code of Practice is binding or compulsory, and it does not supersede any laws or statutory standards of practice or regulations. Further, MTS emphasizes that as with all business and occupational matters, the individual company, institution, or other organizing entity holds the ultimate responsibility for compliance with local, state, and federal regulations and international agreements as well as interpreting community best practices to mitigate questions of liability and risk management in their diving operations.

ISBN: 978-0-578-29086-7

Preface

The MTS Diving Committee published this position paper to guide occupational diving practitioners through developing and/or adopting technology and techniques into their underwater work operations by providing a logical framework to navigate potentially complex and sometimes conflicting regulatory, compliance, health & safety, training, and proficiency concerns commonly present in diving program management. This framework is intended to align with broadly accepted regulations and practices throughout all diving community sectors in both academia and industry.

This work was substantially influenced by the Diving Committee Co-Chairs' experiences in restructuring occupational diving programs and related consultation on diving program management including several academic and institutional projects for the National Park Service (USS Arizona Memorial), University of Rhode Island, NOAA's Caribbean Marine Research Center, Monterey Bay Aquarium, Scripps Institution of Oceanography, the Bahamas Marine EcoCentre, the Federated States of Micronesia Emergency Management Office, the American Museum of Natural History, Pearl Harbor Naval Shipyard, and Boston University, as well as within industry and the defense sector.

Acknowledgements

The Marine Technology Society (MTS) Technical Committee for Diving (Diving Committee) extends thanks to the MTS Executive Board and MTS Headquarters administration for supporting the development of this Diving Committee document.

Further, the Committee Co-Chairs extend appreciation to the committee membership at-large who have reviewed and contributed to this document. Finally, this document only exists because of the vision and foresight of Michael Max, who initially organized this paper and was a contributing author until his untimely passing in 2020. Mike is missed by the entire diving community, and we owe him a great debt of gratitude for his professional service.

Contributing Reviewers

As part of the peer-review process, the authors reached out to the MTS Diving Committee membership, as well as key opinion leaders representing diving community stakeholders for both review and comment. The authors extend thanks to the following (listed alphabetically by surname) for their expressed views which have greatly shaped this document.

Mr. Phil Beierl
Sr. VP – Aerospace and Defense Technologies
Oceaneering International Inc.

Mr. Neil Brock
Member, Diving and Manned Submersible Committee
Society for Underwater Technology

Mr. Paulstephen Chierico, P.E.
LDCR, CEC, Joint Diving Officer
Naval Aviation Training Systems and Ranges Program Office (PMA-205)

Mr. Jeff Godfrey
Diving Safety Officer
University of Connecticut at Avery Point

Mr. Peter LeHardy
Business Development Manager
Phoenix International Holdings, Inc.

CAPT Karin Lynn (USN ret.)
Civil Engineer Corps Officer, Ocean Engineer
United States Navy

Dr. Phil McGillivary
Pacific Area & Icebreaker Science Liaison
United States Coast Guard

Mr. Bill Messner
Founder, CEO, Designer
PonyPak Systems Inc.

Ms. Rhonda Moniz
New England Section Chair
Marine Technology Society

CAPT Bobbie Scholley (USN ret.)
Diving and Salvage Officer
Unites States Navy

Revision History

March 1, 2020	Initial Draft complete.
May 18, 2021	Co-authors Draft review complete.
May 26, 2021	Editorial pass by ML.
Oct 26, 2021	Edits of graphics and formatting pass by ML.
Dec 1, 2021	Edits to reflect contributions from MTS Diving Committee reviewers.
Dec 27, 2021	Edits to reflect contributions from external peer reviewers.
Jan 20, 2022	Second round edits to reflect contributions from external peer reviewers.

Contents

The MTS Diving Committee

The MTS Diving Committee's purpose is to take an active leadership role in steering fundamental issues [and opportunities] surrounding the development and application of new diving technology and techniques among and between occupational diving communities.

This purpose can be achieved through several activities, including:

1. Develop a Code of Practice to serve as a framework to guide dive project management decision making as it applies to cross-community cooperation to facilitate shared expertise related to technology resources and associated techniques that will advance diving science.

2. Establish a mechanism within the diving community as a whole that provides a means of 'verification' of qualifications related to the training and use of diving technology and techniques among and between communities.

3. Improve communication and interactions among and between diving professional organizations which all have vested interests in diving technology, and; in time, establish reciprocity agreements with the professional organizations such that a verification process is more universally acknowledged.

Objectives 1 is established through the enclosed Code of Practice, and when broadly implemented, provides a framework towards objectives 2 and 3.

Context & Significance

Diving, operations involving an individual submerged underwater in greater than one atmosphere ambient pressure, is inherently a technology dependent activity. Beyond breath-hold durations, humans cannot function underwater without technology.

Arguably then, diving technology enables underwater human endeavors in circumstances that necessitate intimate first-hand experience/judgment and other direct interactions through personal observation, dexterous manipulation, and spatial awareness. For the foreseeable future, this interaction will be required to guide forward progress of humankind's evolving relationship with the Blue Planet we all share, as well as to inspire the human element within, and guide the growth of, the Blue Economy.

This technology is the fundamental commonality within all diving pursuits and between all diving communities. Historically, diving has been broadly classified as 'occupational' (for work) or 'recreational' (for sport). In more recent years however, several communities of practice have emerged within each classification, largely defined by the scope of work or given tasks commonly associated with each community (Figure 1). Specialization within each community has resulted in distinct regulatory requirements, formal consensus standards of practice, as well as regionally accepted though informal best practices. These policies are generally directly keyed to the type of technology [and techniques] most routinely employed to conduct the specific tasks that define the respective community. Additionally, the distinction between occupational and recreational diving has become blurred in some instances, particularly with the emergence of organized citizen science programs, as well as public safety programs. Exploration in all diving sectors also contributes to blurring the binary notion of either occupational or recreational distinction, since both exploration and citizen science programs may be 'voluntary' to the extent diving performed is not compensated, i.e., work is performed pro bono by individuals and not by commercial divers for hire. Even so, all mission driven diving practices have tangential associations with - and offer potential benefits to - academia and industry, particularly in the development of new technology and/or advancement of associated techniques.

It is important to recognize that the value of technology and techniques commonly employed within a community sector is not necessarily exclusive to that user community, nor is their utility limited to just one user community. *The technology does not define the community, rather it is the task or scope of work; to be clear, the technology of choice has been selected because of its value to the work as well as its appropriate mitigation of risks associated with the given scope.* Additionally, the argument that a 'commercial diver' is someone hired to dive and perform the required task whereas all others are in other professions and dive as an ancillary duty to the profession is fundamentally flawed. Within each user community, there are individuals

specifically engaged to perform underwater work – in some cases this is in exchange for financial remuneration, in others it may be for some other bartered benefit, and still in others it may be completely voluntary. In all cases, compensated or not, the final decision to make the dive is made by the diver, though of course the repercussions of not making the dive may vary depending on the nature of the engagement.

Given the current trends in more diversified use-cases for diving, the MTS Diving Committee believes that international and national regulations and standards of practice would benefit from renewed scrutiny that better reflects contemporary diving community activities.

The distinct user communities are largely decentralized in their routine practice, and infrequently cross-communicate. As such, when a unique circumstance or issue outside of the routine operating regimen surfaces within a given community, technology/techniques and expertise are not always shared, and therefore efficient problem solving and community progress overall - stagnates. This is evident, for example, in how slow diving technology has evolved – very, very little has changed in fundamental life support technology for more than 100 years. The two seminal life support modes of surface supplied (air or mixed gas), and SCUBA (open or closed circuit), are still the mainstay of the diving equipment manufacturer industry. Tangentially, the progress of manned submersible technology, when considering [one] atmospheric diving, is outpaced by development of technologies dedicated to unmanned undersea systems.

Purpose & Intent

As specialized underwater problems present themselves that require human intervention, it is critically important for diving communities to recognize where expertise (technology and techniques) common in one user community may be the solution to a problem needing to be addressed within another user community. Why reinvent the wheel? While communities are decentralized, a reasonable diving program manager or diving contractor should recognize that each user community has established precedent and safe operating practices for the nature of their work including operational procedures, training, and vetting the dive team. It is therefore important to avoid stigmatizing any given community, and instead, consider a tailored approach to problem solving for potential application of new technology or of new techniques elsewhere within the diving community writ large.

A tremendous opportunity exists now to bridge the gap between these diverse and diverging communities (depicted in Figure 1). Consider instances where the successful development and application of proven technologies and techniques can be shared, risk managers can be better educated on safe practices, techniques emerge that improve productivity, training is enhanced for improved retention by personnel, significant time is saved for vetting work projects, and lowered costs drive more commerce at scale to create a substantially more viable diving industrial base.

Therefore, the MTS Diving Committee's purpose and intent is to catalyze crucial cross-community cooperation and communication through its Code of Practice and related outreach activities which together will provide a framework to better align disparate diving community activities.

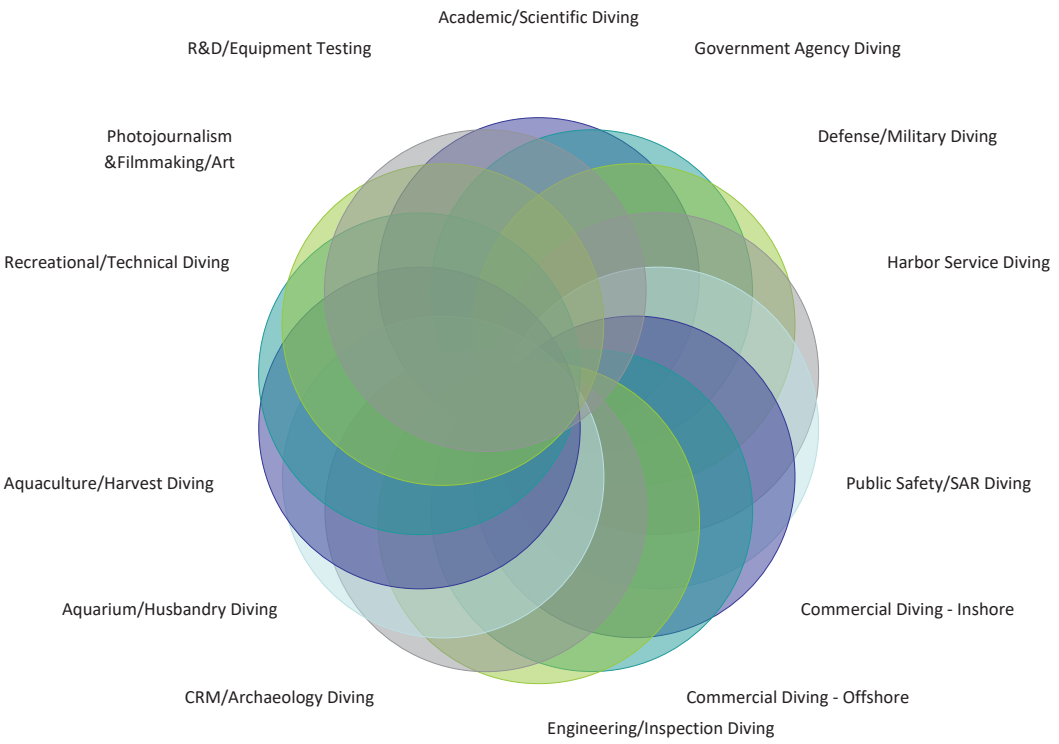

Figure 1: Diving technology is the fundamental shared commonality between communities, resulting in considerable overlap of operational practices. Navigating regulatory matters at this interplay is a significant program development opportunity to solve unique underwater problems.

Diving Community Challenges

When occupational diving communities do engage cooperatively either directly or through the sharing of technology and techniques, numerous examples of complex issues become raised which often relate to regulatory challenges and the practical management of associated risk. Up until now, these issues tend to present themselves on a per-project basis and in specific circumstances.

In many instances, memoranda of understanding executed at administrative, or management levels can help delineate the burden of risk management and associated liability within a diving operation. However, a challenge often remains at the deck plates, where diving program managers or safety officers lack a universally recognized baseline or framework to align standards, practices, and diver qualification vetting between two or more diving communities. Such a framework would present a logical tool to guide and assist administrative and management's navigation of risk mitigating decision making.

For illustration purposes, consider ten exemplar hypothetical examples of challenges faced within occupational diving:

1. A scientific organization requires deep technical diving to collect samples, in 200 fsw. The lead investigator, a scientist, has not maintained proficiency in deep technical diving. Deep [sport] technical divers who are proficient in the techniques can conduct the work cost-effectively, however, may likely not meet the requisite standards of the scientific organization that are imposed on its employed scientists or technical staff. The diving program manager has brokered an agreement in principle to use sport divers to complete the scientific diving tasks, however a gap is that a framework is missing to vet the divers to a recognized reference baseline needed to delineate issues of liability and risk management in terms both partner groups understand. Consequently, the scientific organization may not benefit from acquiring data from this environment.

2. A commercial diving company requires employment of a specific scientific instrument to gather data at a work site. The commercial diving company does not have the know-how for instrument use, end of dive day preventative maintenance, and troubleshooting. The operator/technician for the instrument may be a perfectly competent sport diver with on-the-job experience in proficiently operating the instrument underwater, however is not trained as a commercial diver. The diving program manager has brokered an agreement in principle to allow the technician to operate the instrument during routine diving tasks, however a gap is that a framework is missing to vet the diver to a written recognized reference baseline needed to delineate issues of liability and risk management in terms both partner groups understand.

3. A group of local citizen scientists is gathering data of significant scientific merit, on a volunteer basis, without pay. The lead scientist's sponsoring consortium may not permit volunteer divers to work within their program. The scientist lacks the funding necessary to employ large groups of personnel dedicated to gathering field data, long term. The diving program manager has brokered an agreement in principle to use an academic institution as a non-traditional partner to fold-in the local diving cooperative as students in a sanctioned educational program to complete the diving tasking, as long as all parties register, and a nominal tuition is paid up front. However, a gap is that a framework is

missing to vet the divers to a written recognized reference baseline needed to delineate issues of liability and risk management in terms both partner groups understand.

4. A team of archaeologists from multiple organizations need to assemble a dive and science team to explore a shipwreck site. None of their home organizations have a formal diving safety program. Members of the cooperative team do have the expertise to manage diving safety though the host organization needs to be educated on how to effectively manage this project. It is understood that to be qualified for field work, divers must minimally provide documentation of dives logged/past experience, successfully complete a check-out dive, and maintain an updated fitness to dive clearance. Also, a written release from liability for the organization and proof of diver certification copy is kept on file. As volunteer divers, there are strict rules about not removing anything from the site and not sharing information about the sites outside the organization which may be viewed as *proprietary data* to the project, despite the effort being clearly scientific in nature and not commercial diving per se. However, a gap is that a framework is missing to establish a dive program management structure for the Host Entity of the project to a written recognized reference baseline which is needed to delineate issues of liability and risk management in terms all participants understand.

5. A team of natural history filmmakers requires scientists to participate in manned underwater vehicle operations for a documentary. The scientists' home organization is not inclusive of manned underwater vehicle training or proficiency. The filmmakers do not have a formal diving safety program and the in-water safety dive team as well as a topside emergency vehicle recovery team adds complexity to this operation. The manned underwater vehicle operators do not offer training for vehicle-diver interaction. The film crew producer has brokered an agreement in principle to allow the vehicle technicians to operate in the vicinity of the safety divers and the team of underwater camera-divers. However, a gap is that a framework for diving project management of divers from multiple parties is missing, causing confusion about delineating issues of liability and risk management.

6. A military exercise reveals an abandoned minefield exists in an underwater park. Scientists and technologists are required to deploy instrumentation for mapping and detection experimentation. Due to the presence of unexploded ordinances (UXO), the On Scene Commander of the project to document the site is assigned to the military, by law. The military does not have a mechanism for civilian scientific diving within this program scope. The appropriate scientific organization for the diving involved does not have a provision for conducting operations in the vicinity of UXO. The U.S. Coast Guard Officer serving as the diving program manager has brokered an agreement in principle to use the technical support of the civilian scientists and their specialized equipment to

complete the diving tasking, as long as all parties sign a Memorandum of Agreement that limits the liability and indemnifies the non-government participants. However, a gap is that a framework is missing for the diving program manager to verify qualifications of the civilian divers to understand how their participation may safely align with the military divers.

7. The recreational boating industry requires divers to conduct routine hull maintenance tasks. This is a fast paced business, often requiring operations with a small, low-impact footprint. Techniques from the recreational SCUBA community are embraced as the best mode of intervention, though this commercial work is often carried out alone. Despite an impeccable safety record for decades, regulatory agencies have cited companies within this space for non-compliance with established commercial diving regulations during rare incident occurrences. Other diving communities may benefit from the technology and techniques within this community, however a gap exists where there is no framework for dive program management within this diving community that would present an opportunity to gather data on safe practices; thereby defining the community sector, and further educating other sectors on its unwritten but inherently safe and versatile techniques.

8. An engineering firm employs PE personnel that dive within the scope of their employment. The divers engage in underwater surveys within an industrial waterfront to gather structural inspection data for a future municipal development of public interest. The divers have not attended a commercial diving school but do have recreational dive training and considerable experience. A gap exists where on the job training should be defined for the diving personnel who must be trained and maintain proficiency on the specific techniques required for safely diving in industrial waterfronts. The company would benefit from a framework to implement an on-the-job training regimen in concert with industrial diving experts to ensure diving personnel are trained in the most appropriate modes to mitigate hazards within this environment.

9. A university loses a lightweight seabottom instrument more than 100 fsw that can be readily recovered by hand. The instrument's deployment and recovery support a non-proprietary data collection of public benefit. The university's divers are capable of diving in excess of 100fsw for scientific purposes within existing programmatic frameworks and with a minimal footprint, however, are not expert in search and recovery methods. A local commercial diving contractor, expert in search and recovery, is retained, though due to the depth is required to have a hyperbaric chamber on location during the dive which drives recovery costs up exponentially - it is decided to abandon the instrument. Publicly funded data is lost, as are university assets. A gap exists where the university diving safety program has not proactively educated the scientific officer on regulatory

requirements faced if certain project risks present themselves, resulting in shorting the budget. The University would benefit from a framework enabling industry-academia consultation between diving sectors, and consequently advancing cooperative interests in adopting advanced techniques.

10. New technologies are developed by the private sector that are marketed as useful scientific or industrial tools. The inventors are qualified divers who have completed some initial pool-testing of their technology that shows promise, but they lack formal dive program affiliations typically required for access to a larger population trial via reciprocal diving privileges to achieve more rigorous beta-testing and operational evaluation. As depicted in Figure 2, the challenges impeding an injection of new technology or techniques from one user community to another's diving operational concept are many. To get a technology that works in one user-community (left mesa) to transition over to the other user-community that might benefit too (the right mesa), the gap must be "bridged." To bridge the gap; a written recognized reference dive program framework is needed to align partner groups and thereby leverage the team's expertise for cooperative benefit.

Diving Science Defined

With the development and application of diving technology [and/or techniques] central to the cross-community cooperation required to address some of the aforementioned challenges – navigating these complexities is a scientific field unto itself ("diving science"). The MTS Diving Committee's Code of Practice, ("Code" herein), is then a framework for program and project structure that supports diving for this purpose – to bridge the gap that often impedes transition of technology (and techniques) from one user-community to another; and ultimately, to improve data-gathering and the transfer of knowledge in the field of diving science for its advancement.

Since MTS is an international organization with headquarters in the United States, the enclosed Code is modeled to meet the Scientific Exemption to OSHA 29CFPR1910 Subpart T (Commercial Diving Operations). It should be noted that Health & Human Services (HHS) 45CFR46 related to Human Subject Protections may at times be cited as cause for exemption to the commercial diving regulations for purposes of equipment testing or gathering health related data (such as decompression sickness (DCS) incidents), however, the 4HHS 45CFR46 does not provide any guideline for safe diving practices nor diving program management. As such, this Code leverages the well-practiced scientific exemption, affording an individual, company, institution, or other project Host Entity following this Code to be generally compliant with this scientific exemption.

Projects undertaken for commercial or exploitative purposes where the technology and techniques are not being introduced for data acquisition in furtherance of a scientific or experimental body of knowledge would not meet this scientific exemption, though would still benefit from leveraging this Code for project organization and establishing a baseline framework for diving program management and diving safety risk mitigation. Similarly, the Code provides a framework which may be embraced internationally by non-domestic entities that are not bound by U.S. laws and U.S. regulatory requirements.

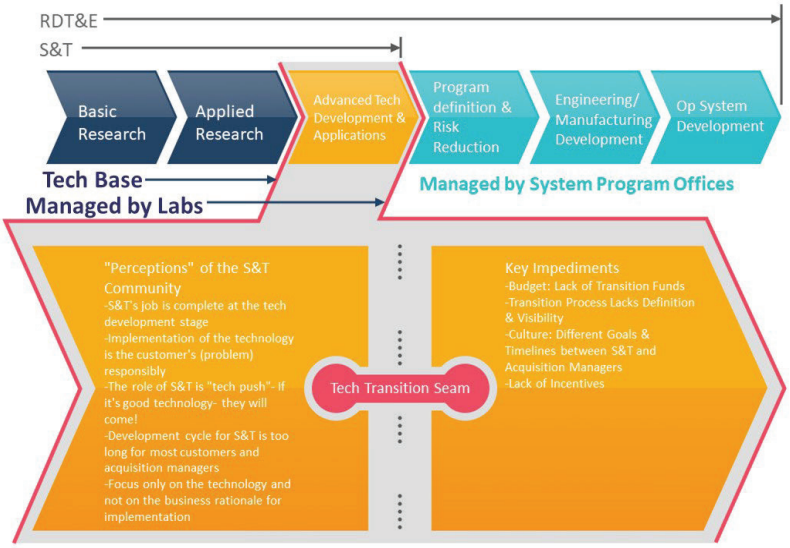

Figure 2: The transition of diving technology and techniques cross-community must overcome a technology transfer seam common in research to industry tech transfer. The challenges impeding an injection of new technology or techniques from one user community to another's diving operational concept are many. To get a technology that works in one User-community (left mesa) to bridge over to the other User-community that might benefit too (the right mesa) requires a recognized vehicle to make the transition 'seamless' and encourages value recognition among and between communities.

MTS Diving Science Code of Practice

Section 1.00 GENERAL INTENT

1.10 Purpose

The MTS Diving Committee recognizes that *the development and application of diving technology or related techniques is a scientific field unto itself* ("diving science"), and as such the purpose of this MTS Diving Science Code of Practice is to reinforce the notion that all diving activities associated with the development and application of diving technology and techniques are effectively self-regulated when conforming to scientific exemptions recognized within the occupational settings. Of paramount importance and focus is that diving activities be conducted in a manner that maximize safety for the divers, mitigate risks for the host organization, and allow a working reciprocity between diving communities engaged in diving science activities.

This general Code of Practice then serves as a framework for diving program managers and diving contractors to address concerns of diving project management, risk mitigation, liability, regulatory issues, training, and proficiency when technology and techniques are central to a given diving project.

As diving science progresses, so shall a development effort to maintain this Code. The MTS Diving Committee assumes a responsibility to update this Code and its practices to meet or exceed state of the art, safe practices of the diving community.

Scientific Diving Exemption

In 1982, OSHA exempted scientific diving from commercial diving regulations (29CFR1910, Subpart T) under certain conditions that are outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol. 50, No.6, p.1046).

Scientific Diving is defined as:

> *Scientific diving is defined (29CFR1910.402) as diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks.*

Exemption Requirements

OSHA has granted this exemption for scientific diving from commercial diving regulations under Appendix B to 29CFR1910 Subpart T, which reads as follows:

This appendix contains guidelines that will be used in conjunction with 1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

- *The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operations.*
- *The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.*
- *The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.*
- *Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and, therefore, are scientists or scientists in training.*

Further, diving programs meeting the exemption shall be defined as, and include the following elements:

1910.401(a)(2)(iv)
Defined as scientific diving and which is under the direction and control of a diving program containing at least the following elements:

1910.401(a)(2)(iv)(A)
Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.

1910.401(a)(2)(iv)(B)
Diving control (safety) board, with the majority of its members being active divers, which shall at a minimum have the authority to: Approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify the depths to which a diver has been trained; take disciplinary action for unsafe practices; and, assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for SCUBA diving.

Utility & Applicability

This code of practice is applicable to organizations engaged in the development and application of diving technology or techniques for the purpose of contributing to diving science. Examples would be as follows:

1. A company, institution, organization, or project with an established diving program that requires the use of a new diving technology or associated techniques to acquire technology product data or data resulting from its use for subsequent validation of the technology's utility.

2. A company, institution, organization, or project seeking to collaborate with another for the use of a new diving technology (or technique) from a community outside which regulatory reciprocity would typically be recognized.

3. An individual, company, organization, institution, or project engaged in developing and applying diving technology that lacks a formal diving safety program in place for the purpose of gathering technology product data or data resulting from its use for subsequent validation of the technology's utility such that it may then be formally adopted by another entity hosting occupational diving activities.

Review of Guidelines

As part of the MTS Diving Committee Co-Chair's annual report, any recommendations for modifications to this Code by the Committee Membership will be entertained for future edits according to procedures determined by the Committee Co-Chairs.

Safe Practices Manual

To leverage the framework provided within this Code, the entity organizing diving activities (Host Entity) shall develop and maintain a Safe Practices Manual consistent with this Code of Practice. This manual will then provide for the implementation of policies and procedures that will enable projects and programs to meet requirements of local environments and conditions as well as their furtherance as required.

Procedures specific to the local operations shall be written or adopted for each diving mode utilized, unique environment encountered, or specific technology or technique employed and referenced within the Host Entity's safety manual. Such best practices shall be well researched and reflect a referenceable community consensus.

1.20 Operational Control

Host Entity

The Host Entity is defined as the individual, company, institution, or other organizer of the diving science project or program which is connected to the work because of ownership of any equipment used, locations selected, or relationship with the individual(s) concerned.

For the purposes of this Code of Practice, a Host Entity of any diving science project or program shall be designated as having operational control over the diving operation. The Host Entity is ultimately responsible for the lawful conduct of the project or program and meeting any regulatory standards required for its operation that may exceed the scope of this Code of Practice.

This includes all actions and cases involving the operations of employees, volunteers, affiliates, or subsidiary programs where such persons are acting within the scope of their employment or other-directed assignments; as well as the operations of other persons who are engaged collaboratively, cooperatively, or contractually in a diving science project with or for the Host Entity. This broadly encompassing operational control ensures regulatory compliance by employees and ensures that those working with employees have been reasonably vetted to the extent that they may impact the assigned activity of an employee.

It is the responsibility of the Host Entity to adhere to this minimum Code of Practice guideline and any specific amendments made pertinent to the host's local program activities.

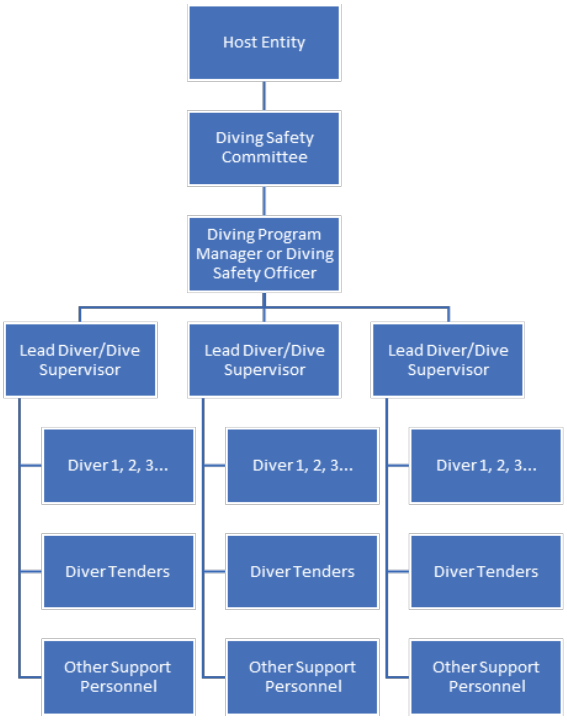

Figure 1: Dive program governance and organization. The most critical element for a diving science program is recognizing that the Diving Safety Committee has absolute and autonomous authority over the diving program, placing operational safety over any financial constraints or other pressures felt by the Host.

Diving Control Board, or Committee

The Host Entity will establish a Diving Control Board/Committee (Committee throughout) which shall consist of a majority of active divers familiar with the routine diving projects and programs of the Host Entity, and should be selected for their experience with the routine dive activity and therefore are not required to be employees of the Host Entity should that expertise not be held internally. *The Committee has absolute and autonomous authority over the diving program.* When a diving project or program requires expertise outside of the Committee's expertise, subject matter expert consultation will be procured with recommendations considered in so far as such recommendations apply to upholding this Code of Practice for the Host Entity. The Host Entity may establish procedures for determining committee appointments, however, may not circumvent the duties nor undermine the responsibilities of the Committee.

Diving Program Manager (DPM)

The DPM serves as a member of the Committee and is responsible for the safe conduct and implementation of the diving safety program. The DPM may also be referred to as the Diving Safety Officer (DSO), Diving Superintendent, or similar as determined by community best practice. The DPM shall possess formal leadership training, diving credentials, or demonstrable experience in leading, organizing, and managing diving operations within their community. The DPM must *also* have broad knowledge and experience that encompasses the nature of the diving science taking place under his/her purview. When projects require practical expertise beyond the DPM's knowledge, subject matter consultation will be procured to provide recommendations on how to move the project forward. The DPM may permit portions of this program, such as supervision of field teams, over a specified finite duration, to be carried out by a qualified delegate. However, the DPM may not delegate full accountability for the overall safe conduct and operations of the local diving program. The DPM shall be directed in the performance of the required duties by the Committee, but day to day operational responsibility for the conduct of the local diving program will be retained by the DPM.

Instructional Personnel

All personnel involved in delivering diving instruction under the direction of the Host Entity shall be qualified for the type of instruction being given. Instructional personnel will be selected by the DPM, or designee, who will solicit the advice of the Committee in conducting preliminary screening of applicants for instructional positions.

Lead Diver

For each dive, one individual shall be designated as the Lead Diver who shall be present at the dive location during the entire diving operation. This individual may also be referred to as the Diving Supervisor depending on community convention. This Lead Diver is responsible for coordination with other known activities in the vicinity that are likely to impact the safety of diving operations, executing dives according to the pre-determined plan, briefing divers on the pre-determined plan prior to splashing divers, and managing the dive operation for maximum safety and efficiency including equipment operability, reporting incidents, and suspending operations if needed.

Visiting Divers

Two or more diving programs engaged jointly in diving activities, or engaged jointly in the use of diving resources, shall designate one of the participating Committees to govern the joint dive project on behalf of their Host Entity.

The Host Entity Committee shall set criteria to verify qualifications of the visiting/guest divers. A visiting diver may be asked to demonstrate their knowledge and skills for the planned dive. Host entities will consider the professional merit and competency of the individual and community from which they obtained their predominate experience.

If a Host Entity denies an individual authorization to dive, the Committee shall notify the visiting diver with an explanation of all reasons for the denial.

Visiting diver requests shall be made as part of the Health & Safety Plan submitted to the DPM for approval. In all cases, the Lead Diver is responsible for adhering to the plan on site, and has the authority to limit participation if the visiting diver cannot demonstrate required knowledge and skills for the planned dives.

1.30 Consequence of Violation of Regulations by Divers

Failure to comply with the Host Entity diving safety manual may be cause for the revocation or restriction of the individual diver's authorization to dive. This determination will be made by the Committee.

1.40 Consequences of Violation of Regulations by the Host Entity

The Host Entity recognizes that failure to comply with the general guidelines of this Code of Practice may be cause for the revocation or restriction of the Host Entity's recognition by other organizations, and possibly jeopardize recognition as meeting the OSHA Scientific Diving Exemption (applicable to Host entities in the United States). Failure to comply with this Code of Practice could have broader negative implications for the Host Entity, including suspension or loss of the Host Entity business charter; exposure to civil or criminal legal action; and unwanted press and unsolicited media interest.

1.50 Record Keeping Requirements

The Host Entity or designee (typically the DPM) should maintain records for all personnel engaged in each project or program. The file should include evidence of diver qualifications, dive record/log sheets, fitness to dive records, reports of disciplinary actions, and other pertinent information deemed necessary.

Health & Safety Plans (HASPs), Dive plans, Activity Hazard Analyses (AHAs), and any related documents supporting the work should additionally be maintained.

Diver File

Each diver is required to maintain a current administrative file with the DPM, and should maintain this record personally as part of their measure of responsibility and commitment to occupational diving. Each diver is encouraged to maintain training records, dive logs, medical or fitness to dive records, and other documents to support his/her experience and verify competency. This information will expedite dive authorizations and reciprocal privileges.

Personal Diving Log

Each diver should log every dive made under the control of the Host Entity, and is encouraged to log all other dives to be considered as a measure of proficiency. Log sheets shall be submitted to the DPM following each dive project to be placed in the diver's permanent file. Details of the submission procedures are left to the discretion of the DPM. The diving log shall be in a form specified by the Host Entity and shall include at least the following:

1. Name of diver, buddy, with Lead Diver indicated.
2. Date, time, and location.
3. Diving modes used.
4. General nature or purpose of diving activities.
5. Approximate surface and underwater conditions.

6. Maximum depths, bottom time, and surface interval time.
7. Diving tables or computers used.
8. Detailed report of any near-miss or actual mishaps, and incidents.

The DPM will collate all divers' logs annually to summarize in an annual report to the Dive Safety Committee and will form the basis of any statistics submissions to required regulatory agencies.

Equipment Service Records

Maintenance of all equipment operated by the Host Entity, and/or used by project divers should be recorded.

Required Incident Reporting

All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death should be reported to the Committee according to incident reporting procedures of the Host Entity. The report will specify the circumstances of the incident and the extent of any injuries or illnesses.

The Committee should investigate and document any incident of pressure-related injury and prepare a report that is to be forwarded to any appropriate regulatory body during the annual reporting cycle. All pressure-related injuries reports will be retained on file with the Host Entity, and in the individual diver's file.

Annual Report

The DPM should prepare an annual report to the Committee summarizing the Host Entity's activity for the year. This report should include but is not limited to diving statistics, training conducted, field programs administered, summaries of incidents, and programmatic recommendations to the Committee.

Section 2.00 GENERAL DIVING PROCEDURES

2.10 Introduction

No person shall engage in diving science operations under the control of the Host Entity unless they are operating to the provisions of this Code and the Host Entity's diving safety manual.

2.20 Dive Planning

The dive planning process should include an analysis of the required tasks and their associated hazards to determine the appropriate equipment (technology) required, and further determine the required personnel qualifications and manning to perform the tasks. This information should be collated in the form of a Health & Safety Plan (HASP). For routine and recurring activity over time, a master HASP may be established to form the basis of the routine activity.

Task Determination

The task to be conducted during the dive, and the nature of the work environment, must be clearly defined since the nature of the task within a given environment substantially influences the selection of the most appropriate mode of diving to be employed. Diving modes should be determined as considered best practice for the given task, and this determination shall be made while considering best practices across all diving communities that operate within the given environment or utilize the given diving mode. Diving mode selection must be delineated in the HASP as it impacts all aspects of the dive and project planning.

Equipment Selection

Equipment shall be selected to appropriately employ the defined mode of diving required for the task. Equipment selection should reflect consideration of best practices across communities that operate within the given environment or utilize the given diving mode. When the equipment required is not routinely employed by the Host Entity, this Code of Practice should serve as a guide for technology/technique acceptance.

Personnel Determination

When conventional open-circuit SCUBA is utilized, the 'buddy' system will be enforced as it is designed to provide mutual assistance, especially in the case of an emergency. A dive buddy refers to an individual within immediate proximity of rendering mutual assistance.

Under unique circumstances, diving with a buddy may present undue risk to the success of an operation; further many modes of diving by their very nature do not include in-water partners such as hookah or surface supplied diving.

Personnel levels will be determined as most appropriate for the mode employed, and as consistent with community best practices and/or regulations. Deviations from established best practices shall be supported with evidence or references and approved by the Committee prior to implementation. Specific procedural changes due to deviations from best practice are a necessary element of any project plan and pre-dive brief by the Lead Diver or Dive Supervisor to the diving team.

Activity Hazard Analyses (AHA)

When a given technology or technique, human interaction with a technology platform, or operation within a specific environment subjects the diver or dive team to risks outside of those conventionally recognized during routine operations, a risk assessment will be conducted in the form of an Activity Hazard Analysis (AHA). The AHA will present actions to be taken to lower the assessed risk, and these actions shall be incorporated into the HASP. A guide to developing AHA's is presented in Appendix A.

Emergency Procedures

The DPM in cooperation with the Lead Diver will develop emergency procedures which follow the standards of care of the community and must include best practices and procedures for emergency care, recompression, and evacuation for each dive location. This may require coordination with a local point of contact or local EMS service. Emergency procedures specific to the project or program should be addressed in the HASP.

Written Health & Safety Plans (HASPs)

All diving projects require preparation of a written Health & Safety Plan (HASP) before field activities start to ensure that the activity is consistent with this Code of Practice, other applicable regulations, and that associated risks of the required task has been well evaluated. This HASP is typically prepared by the Diving Program Manager or Diving Supervisor and serves as the master document for managing the diving operation.

The HASP typically includes, at a minimum:

1. Description of the proposed work.
2. Location(s) of proposed dives.
3. Qualifications for each diver including documentation of applicable training and proficiency for the given dive(s).
4. Approximate number of proposed dives with specified tasks.
5. Description of technology and/or techniques employed to perform specified tasks.
6. Specific hazardous conditions anticipated, including unique hazards associated with the adoption of a specific technology, related technique, or within a unique operating environment.
7. Any post-dive immediate equipment maintenance, or securing of material, and/or record keeping requirements.
8. Emergency plan with the following information:
    a. Method of diver recall.
    b. Nearest operational recompression chamber.
    c. Nearest accessible hospital.
    d. Available means of transport.
    e. Name, telephone number, and relationship of person to be contacted for each diver in the event of an emergency.

Field Dive Plans

Before conducting any diving operations, the Lead Diver or Dive Supervisor will prepare and brief the dive team on the daily dive plan. This plan will review the HASP, though then focus on the immediate activity, as follows:

1. Transit to any locations (by small vessel for example)
2. Estimated depth(s) and bottom time(s) anticipated.
3. Specific tasks to be completed.
4. Decompression status and repetitive dive plans, if required.
5. Diver recall signal.

Field dive plans may be written, verbal, or come in the form of a sign in/out sheet or board depending on the nature of the dive activity. The specific format of the daily dive plan record will be determined by the DPM.

2.30 Diving Procedures

All diving shall take place in accordance with the approved HASP and consistent with the daily dive plans. Any decision to change the plan by way of scope of work, personnel, or modes is subject to Committee approval. Minor day to day procedural responses to condition changes are subject to DPM approval of the revised dive plan. All diving activities will commence keeping the priority on safety of the divers while efficiently completing the required tasks.

Pre-dive Checks

Pre-dive safety checks of the environment, operational footprint, and equipment are the primary responsibility of the diver and should be reviewed in concert with the Lead Diver or Dive Supervisor. These checks may be formal or informal depending on best practices of the community and as required by the given technology utilized or environment being intervened.

Refusal to Dive

It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unfavorable, or if he/she would be violating the precepts of his/her training, or the Code of Practice adopted by the Host Entity. No dive team member shall be required to dive against their will. No dive team member shall be required or 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.

Termination of the Dive

It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever they feel it is unsafe to continue the dive. The Lead Diver or Dive Supervisor may abort the dive and recall divers with or without cause and such decision shall not be disputed by the diver.

Emergencies and Deviations from Regulations and this Code of Practice

Any diver may deviate from these guidelines or dive plans to the extent necessary to prevent or minimize a situation that is likely to cause death, serious physical harm, or major environmental damage. A written report of such actions must be submitted to the Committee explaining the circumstances and justifications.

2.40 Post-Dive Procedures

After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions to the Lead Diver. The Lead Diver should report these issues or concerns to the DPM according to adopted procedure.

The Lead Diver should conduct a debrief of the dive for the divers.

Equipment shall be broken down and post-dive maintenance performed accordingly, and all required record-keeping and data transcription completed.

2.50 Flying After Diving or Ascending to Altitude (Over 1000 feet)

Changes in altitude 24 hours before or after diving should be addressed in the HASP.

Section 3.00 DIVING EQUIPMENT

3.10 General Policy

Equipment shall be selected according to most appropriate mode and configuration to accomplish the task at hand. This decision may be impacted by training, practical experience, and community best practices, however under no circumstance will an inappropriate mode of diving or equipment selection be accepted by the Committee.

Equipment to be employed will be referenced in the HASP and as such is subject to review and approval by the Committee. All equipment shall be regularly examined by the end user, dive team and Lead Diver / Dive Supervisor, and maintained according to manufacturers or Committee's recommendations and procedures. Equipment that is subjected to extreme usage under adverse conditions may require more frequent testing and maintenance.

When new technology or related techniques are employed, decisions to implement will be guided by both activity and equipment hazards analyses to navigate program implementation.

3.2Air & Breathing Gases Quality Standards

Breathing air shall meet the CGA Grade E specification (or equivalent) as set forth by the Compressed Gas Association (CGA Pamphlet G-7.1).

Other gasses used for diving shall be verified according to community best practice.

Section 4.00 PROGRAM ENTRY REQUIREMENTS

This section describes the process for a diver to engage in an occupational diving science activity organized by a Host Entity.

4.10 Administrative file

The applicant diver must establish an administrative file with the DPM which constitutes application to engage in the diving program. Many items are verification of qualifications that may lapse over time; as such this file must be maintained, with the onus for maintenance resting with the diver.

In addition to keeping up requisite forms, current copies of the following must be maintained as a portion of a record of training and proficiency:

- Appropriate dive certification(s), records of training, and experience verifications
- Diver Medical Examination or appropriate Fitness to Dive Record
- First aid & CPR certification
- O2 administration certification
- DAN insurance or equivalent dive accident medical coverage
- Proof of dive equipment servicing to appropriate manufacturer recommendation

4.20 Medical Examination or Fitness to Dive Record

All divers are required to have a current medical authorization for diving which declares the individual to be fit to engage in the proposed diving activities. Any medical restrictions or contraindications to diving should be indicated and reviewed by a Diving Medical Officer (DMO)/examining physician prior to authorization to dive by the Host Entity. The specific format of the required medical examination or fitness to dive record may be determined by the Host Entity and in accordance with any applicable community standards.

4.30 Classroom/Theory Evaluation

Before authorization to dive, the applicant must demonstrate to the DPM that he/she possesses sufficient knowledge of diving theory relevant to the project or operation. The format of this theory demonstration may be determined by the Host Entity.

4.40 Practical Evaluation

Before final authorization to dive, the applicant must demonstrate to the DPM that he/she possesses sufficient skill and proficiency in the field to participate in the project or program. The nature of the practical evaluations should be guided by community best practices, and while considering the nature of the local diving operation. The format of this practical evaluation may be determined by the Host Entity.

4.50 Waiver of Requirements

The DPM may grant a waiver for specific requirements of training, examinations, and minimum activity to maintain an authorization to dive after careful review of these requirements and a consensus agreement by the Committee while considering the occupational diving history of the applicant. Such waivers will be considered on a case-by-case basis.

Section 5.00 DESIGNATED DIVER AUTHORIZATIONS

No person shall engage in the organized diving project unless that person is authorized by the Host Entity. Only a person diving under the control of the Host Entity is eligible for a diving authorization for the Host Entity. Authorization to dive may be granted with several distinctions and restrictions.

5.10 Authorization Types

Authorization types do not necessarily represent a pathway of inexperience towards experience, rather they signify the relative designation to which the diver has been vetted for participation in a dive project for the given scope. For example, a novice diver may be considered a Diver in Training for relatively routine shallow water tasks and then progress through towards proficiency allowing them to serve as a Lead Diver for similar work. In the event this Lead Diver seeks to participate in a highly technical project, outside of their current training or proficiency, they may be designated as a Diver in Training for the new technical program. These designations are therefore specific to the project or program tasking and considered on a per project basis within the occupational setting.

Diver in Training

This designation signifies that a diver applicant is in the process of completing program entry requirements defined in Section 4.0 and authorizes the diver to participate in a project under the direction of a Lead Diver/Dive Supervisor, and within practical limitations defined by the DPM. A diver-in-training is effectively undergoing on the job training through mentorship with senior personnel.

Active Diver

This designation represents authorization to engage in diving according to an approved dive plan while working in concert with another active diver(s) or Lead Diver/Dive Supervisor. This qualification requires meeting all program entry requirements, and demonstration of any additional training and proficiency required to meet mission objectives.

Lead Diver or Dive Supervisor

This designation authorizes the individual to lead and/or supervise dive events and operations on behalf of the DPM. Documented leadership experience in the given environment, or while

conducting the designated task is required; and formal dive leadership training is recommended. The Lead Diver must demonstrate sound judgment and the ability to responsibly manage a dive operation to the DPM.

Temporary Diver Permit

This permit constitutes a waiver of the partial requirements and is issued by the DPM after his/her being convinced that the person in question has demonstrated proficiency in diving and can contribute measurably to a planned dive. It is valid only for a limited time. This permit is not to be construed as a mechanism to circumvent any requirements for dive authorization. Temporary permits shall be restricted to the planned diving operation and shall comply with all other policies, regulations, and standards of this standard, including medical requirements.

5.20 Continuation of Diving Authorization

During any 12-month period, each authorized diver must maintain their administrative file, including keeping up to date all qualifications that may expire. A minimum level of activity to maintain diving proficiency of 12 dives per year is highly recommended, however in no way guarantees authorization to dive on a given project. Requests for depth, special environment operations, or use of specialized equipment can be met with reasonable proficiency planning coordinated in advance of the dive operation. Failure to meet these requirements may be cause for revocation or restriction of authorization.

5.30 Revocation of Authorization

A diving authorization may be revoked or restricted for cause by the DPM or the Committee. Violations of regulations set forth in the applicable standards or adopted guidelines, or other governmental subdivisions not in conflict with this standard, may be considered cause. The DPM shall inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present their case in writing for reconsideration and/or re-certification to the DPM and the Committee. All such written statements and requests, as identified in this section, are formal documents, which will become part of the diver's file.

5.40 Re-authorization

If a diver's authorization expires or is revoked, they may be reauthorized after complying with such conditions as the DPM or the Committee may impose. The diver shall be given an opportunity to present their case to the Committee before conditions for re-certification are stipulated.

Section 6.00 TRAINING AND PROFICIENCY

A Host Entity must have a mechanism in place to verify training and proficiency of divers for occupational projects. They may or may not offer formal training internally. When reviewing diver qualifications and requests to dive, past training and ongoing proficiency from the diver's current community should be considered and given merit towards the diver's credentials.

Dive training in all communities and at all skill levels benefits immeasurably through mentorship; as such, upon program entry divers who are novice or new at any given skill level or for a given mode can participate in projects for educational purposes under supervision to the extent they will measurably contribute to the project objectives without placing undue risk on the project's divers. This on-the-job training is critical to promote ongoing training and proficiency within an occupational diving regimen.

6.10 Initial Active Diver Verification

One-hundred hours is widely recognized as a minimum experience benchmark for scientific diving qualification, aligns well with introductions to other occupational diving training regimens, and as such is presented in this Code as an example trajectory towards becoming authorized as an 'active diver'. These 100 hours include the effort to meet program entry requirements – administrative, theoretical aspects, and practical dive training, as well as on the job training. A minimum of 40 hours of on the job training under the mentorship of a Lead Diver/Dive Supervisor affords the opportunity for an entry level diver to demonstrate competency with the given diving mode towards being authorized as an active diver for comparable projects in the future.

Thereafter, an active diver assisting entry level divers through a 100-hour cycle and demonstrating leadership capabilities may then be designated as a Lead Diver for comparable dive tasks.

This progressive and recurring verification of training and experience can initially be undertaken as a dedicated course of study (such as at a commercial diving school, or semester academic course program), or may be verified through the culmination of multiple independent training programs or experience at the discretion of the Committee.

Note however that this 100-hour regimen does not only apply to novice divers seeking to enter an occupational diving program. This structure also serves as a model pathway for formal training and mentorship through advanced skill sets and for specific technology and techniques.

Sample Training Regimen to meet 100 hours of training		
Requirements	**Time Allocation**	**Opportunities**
administrative compliance		
work with DSO/DPM to satisfy all admin requirements	3-4 hours	
diver interview/orientation with DSO/DPM & written exam	2 hours	
practical requirements		
entry-level diver training (typically Basic Scuba)	30 hours	basic scuba most agencies
swim/watermanship test	2 hours	administered by DSO/DPM or delegate
1st aid, CPR, O2 administration for diving	6 hours	DAN, CPROx1stAED, Red Cross, similar
dive accident management/rescue diving techniques	15 hours	standard Rescue Diving course, with practical reflecting work environment
occupational diving techniques (this includes minimum 12 dives for 6 hours)	40 hours	On the Job Training conducted through mentorship in the field, with support from DSO/DPM or other qualified teaching assistants
		may include pertinent Advanced or Specialized Diver Training (Nitrox, Deep Diving, Drysuit Diving, Underwater Photography, Advanced Navigation, etc)
final evaluation	2-3 hours	DSO/DPM, one on one as needed
TOTAL	**100 hours**	**results in authorization as an active diver**

Figure 2: Sample 100-hour training regimen for initial verification of training.

6.20 Training for Specific Environments

A diver may work under the auspices of the Host Entity within the depths and environments for which training, and proficiency can be reasonably accounted for. Authorization for a given depth or environment should be granted only upon approval of a dive plan that accounts for management of recognized risks. Formal training for specific environments will be carried out by DPM approved Instructional Personnel and to recognized community best practices or standards that best meet the requirements of the diving operation. After completion of training, the diver must demonstrate to the Committee a degree of proficiency and sound judgment to perform work within the scope of the newly acquired skills and capabilities.

The following specific environments are broadly considered and warrant distinct considerations for authorizations to dive. A dive environment may fit one or more of these descriptions.

6.21 Confined water diving

Confined water diving is considered any dive within a pool, test tank, or similar controlled environment in which multiple modes of diving are relevant depending on the nature of the task. Confined water diving is commonly considered as a starting point for all diver training, often preceding Openwater diving, though occupational tasks and task rehearsals/mock-ups are also conducted in confined water.

6.22 Openwater diving

Openwater diving is considered any dive within the ocean or various freshwater bodies in which multiple modes of diving are relevant depending on the depth and nature of the task. Openwater diving is commonly considered as a starting point for all diver training, when following confined water training.

6.23 Deep Diving

Deep diving is considered any dive depth from which the diver cannot perform an emergency swimming ascent comfortably and with confidence which indicates redundant life support measures must be in place.

6.24 Cave and Cavern Diving

Cave and cavern diving is considered any dive where a diver enters a natural underground formation that is submerged or partially submerged and which prohibits a direct and immediate ascent to the point of entry. Caverns differ from caves in that sunlight is readily visible which help direct divers to the point of entry/exit.

6.25 Blue or Black Water Diving

Blue water diving is defined as diving in mid-water where the bottom is not within sight. Similarly, black water is this same environment, though at night.

6.26 Ice and Polar Diving

Ice diving is defined as diving through or beneath ice which may prohibit a direct and immediate ascent to the point of entry, and where special consideration must be given to diver thermal management.

6.27 Aquarium Diving

Aquarium or exhibit diving presents unique circumstances including but not limited to close quarters, very shallow water, close proximity to aquatic life, structural entanglements, intakes and other flow conditions which require specialized training and procedures.

6.28 Offshore Industrial Diving

Offshore Industrial diving is defined as diving in, around, or near offshore infrastructure such as but not limited to pipelines, cable installations, oil or gas infrastructure, or other industrial structures.

6.29 Inshore Industrial Diving

Inshore Industrial diving is defined as diving in, around, or near inshore infrastructure such as but not limited to ports, harbors, marinas, or other industrial facilities with submerged infrastructure such as hydro facilities, aqueducts, wastewater facilities, or similar.

6.291 Overhead Environments & Confined Spaces

Overhead and confined space environments present unique operational hazards that may vary considerably from cave and cavern diving however often require similar redundancies for controlled intervention.

6.292 Contaminated Water Diving

Contaminated water presents unique operational hazards that occur from the exposure to bacteria, viruses, nuclear or radioactive waste, construction slurries, sewerage, fuel, oil, or other fluid mediums that require significant efforts to shield the diver from the hazardous environmental exposure.

6.293 Potable Water Diving

Potable water presents unique operational circumstances that require mitigating contamination of the environment and as such the diver and all equipment must undergo a cleaning or decontamination procedure prior to entry. The diving at times requires entry into a confined space such as tunnel, shaft, pipe, or storage tank.

6.30 Training for Specific Dive Modes

A diver may work under the auspices of the Host Entity using specific dive modes for which training and proficiency can be reasonably accounted for. Authorization for a given diving mode will be granted upon approval of a dive plan that accounts for management of recognized risks. Formal training for specific diving modes use will be carried out by a DPM approved instructor and to recognized community best practices or standards that best meet the requirements of the diving operation. After completion of training, the diver must demonstrate to the Committee a degree of proficiency and sound judgment to perform work within the scope of the newly acquired skills and capabilities.

The following specific dive modes warrant individual consideration.

6.31 Open Circuit SCUBA

Open Circuit Self-Contained Breathing Apparatus (SCUBA) is widely accepted as the most common mode of diving and is often the point of entry for occupational diving training in both commercial and science sectors. It is commonly used throughout many diving communities.

6.32 Rebreather Diving

Rebreather diving involves specialized equipment that recycles the diver's breathing media to provide a variety of physical and physiological benefits. Rebreather diving includes oxygen only rebreather systems, semi-closed-circuit rebreathers, and fully closed-circuit rebreathers. Rebreathers may be self-contained or included as a component of a tethered system.

6.33 Surface Supplied Diving

Surface Supplied diving involves where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver is typically dependent on a surface-based dive team, i.e., topside, which varies in size and composition based on community best practices.

6.34 Hookah Diving

While similar to Surface Supplied diving in that the breathing gas is supplied from the surface by means of a pressurized hose, the supply hose often does not require a strength member, pneumofathometer hose, or communication line. Hookah equipment may be as simple as a long

hose attached to a standard SCUBA cylinder supplying a standard SCUBA second stage. The diver is responsible for the monitoring his/her own depth, time, diving profile, and assumes responsibility for tether management.

6.35 Staged Decompression Diving

Decompression diving shall be defined as any diving during which the diver cannot perform a direct return to the surface without performing a mandatory decompression stop to allow the release of inert gas from the diver's body.

6.36 Saturation Diving

Saturation diving involves the diver saturating their tissues with inert gas at a given depth and thereafter often residing at that depth or pressure until the mission is carried out. Typically, lengthy decompression in a controlled environment follows.

6.37 Atmospheric Diving

Atmospheric Diving involves utilizing a personal submersible, hard suit, or other one-atmosphere enclosure to protect the human from the effects of ambient pressure greater than one atmosphere. The diver [pilot] is individually responsible for his/her well-being during the dive. By contrast, a passenger submarine would be considered a manned undersea vehicle (MUV), and as such not considered categorically to be atmospheric diving.

6.38 Diving with ROVs or other subsea robotics

Manned diving in concert with or augmented by ROVs, or other subsea robotics including autonomous vehicles, presents unique operating hazards, which may vary depending on the mode of diving utilized. This includes diving in proximity to a robotic system in place for observation only, and/or diving while interacting with the robotic system.

6.39 Other Diving Technology

Certain other types of diving technology that impact the safety or well-being of the diver may require training and/or specialized operational procedures. Broadly accepted community best practices will be reviewed and adopted for the given project.

6.40 Training for Specialized Breathing Media

A diver may work under the auspices of the Host Entity using breathing media for which training and proficiency can be reasonably accounted for. Authorization for a given breathing media will be granted upon approval of a dive plan that accounts for management of recognized risks. Formal training for specialized breathing media use will be carried out by a DPM approved instructor and to recognized community best practices or standards that best meet the requirements of the diving operation. After completion of training, the diver must demonstrate to the Committee a degree of proficiency and sound judgment to perform work within the scope of the newly acquired skills and capabilities.

The following breathing media are considered 'specialized' and warrant consideration beyond very routine air diving operations by way of their handling, dive operational considerations, and their physiological impacts on the diver.

6.41 Nitrox Diving

Nitrox is defined for these guidelines as breathing mixtures composed predominately of nitrogen and oxygen, where the oxygen fraction is elevated and is most commonly produced by the addition of oxygen or the removal of nitrogen from air.

6.42 Mixed Gas Diving

Mixed gas diving is defined as dives done while breathing gas mixes containing proportions greater than 1% by volume of an inert gas other than nitrogen. Heliox and trimix are two examples of those breathing media considered mixed-gasses.

6.43 Pure Oxygen

Pure oxygen, typically accepted as 98% or greater by volume which is used in multiple ways including but not limited to accelerating decompression, first aid administration, and within closed-circuit breathing devices.

6.50 Development of Training Programs

When a required course of training is needed to prepare divers for a novel environment, specialized breathing media, or new diving technology or diving mode and there are no such well- established courses of training within a respective expert community that can be readily adopted, or such an existing course requires adaptation to best fit the application, a training program may be developed by the Host Entity which may in part involve on the job training when appropriate. When the training involves the use of new diving technology, the inventor or manufacturer of the technology or product should be consulted to develop an appropriate training regimen. If the manufacturer does not or cannot provide direction on training practices, the Host Entity may develop a training regimen, should engage subject matter expert consultation, and should seek counsel on any associated liabilities. Developed courses should be backed up by technical reference to applicable existing standards or community best practices.

This Code proposes that developed courses are organized to the below well recognized outline (credit: adapted from International Training Inc.).

NAME of TRAINING PROGRAM

Introduction
Include an overview of the course and its purpose.

Who May Teach
Describe instructor qualifications required.

Student to Instructor Ratio

> **Academic**
> Unlimited, so long as adequate facility, supplies, and time are provided to ensure comprehensive and complete training of the subject matter
>
> **Confined Water (swimming pool-like conditions)**
> List maximum number of students per instructor and/or with assistants.
>
> **Open Water (ocean, lake, quarry, spring, river, or estuary)**
> List maximum number of students per instructor and/or with assistants; it is the instructor's discretion to reduce this number as conditions dictate.

Student Prerequisites
Detail the minimum qualifications required to enroll.
Detail the minimum age required to enroll (including age with parental consent if applicable).
Detail the minimum verifiable experience required to enroll.

Course Structure and Duration
Details of confined or open water execution of dives are required, all with brief/debrief by Instructional Personnel.
Detail the minimum number of classroom hours if applicable.
Detail any restrictions on the dives, i.e., max depth, time, etc., if applicable.

Administrative Requirements

Administrative Tasks
Collect the course fees from all the students as applicable.
Ensure that the students have the required equipment.
Communicate the schedule to the students.
Have the students complete the applicable Liability Releases and Waivers.
Verify any required medical requirements.

Upon successful completion of the course, the instructor must
Issue the appropriate verification of training to the student, employer, and/or certifying body.

Required Equipment and Materials
Detail the minimum equipment requirements and materials for the course.

Approved Outline
Instructors may use any additional text or materials that they feel help present these topics.

Academic - The following topics must be covered
Detail all main subject areas to be covered, including sub-topics as applicable. Detail any academic requirements.

Practical - Required Skill Performance
Detail each required dive, by Number – i.e., Dive 1, Dive 2, etc., and list all required skills.

6.60 Proficiency

All occupational divers must attain and maintain proficiency in the environments, with the breathing media, and for the modes of diving they will employ during their work. At a minimum, 12 dives per year are highly advised to maintain an active file. This number of dives is adopted from the current scientific community consensus and represents the effort to go through the process of a dive once per month to maintain a very minimal level of activity. It is recognized that specialized diving circumstances cannot always be foreseen and therefore work-up proficiency regimens may be employed to reconstitute proficiency according to a HASP to minimize operational risks to the divers and diving project.

Appendix A: Guidelines for Assessing Risk with the Adoption of Diving Technology and/or Techniques

All diving carries inherent risks. These are mitigated through technology, its techniques for use, training and proficiency in these techniques, and further understanding when it is most appropriate to apply one technology mode versus another for the given diving task and/or within the specialized environment.

Over time, many risks become considered routine and are mitigated through standard conventions within given diving communities. When risks are identified for a given task that are not well understood by the Host Entity, or are cause for acute attention (differential pressure (delta P) for example), they must be analyzed. An Activity Hazard Analysis (AHA) is an appropriate mechanism to make safety decisions and further guide actionable directions.

MTS Diving Committee members are strongly encouraged to share AHA's for their diving technologies, modes, or specialized environments for community review and inclusion as a future supplement to this Code to guide continued development of safe practices among and between community sectors. A sample AHA format is provided.

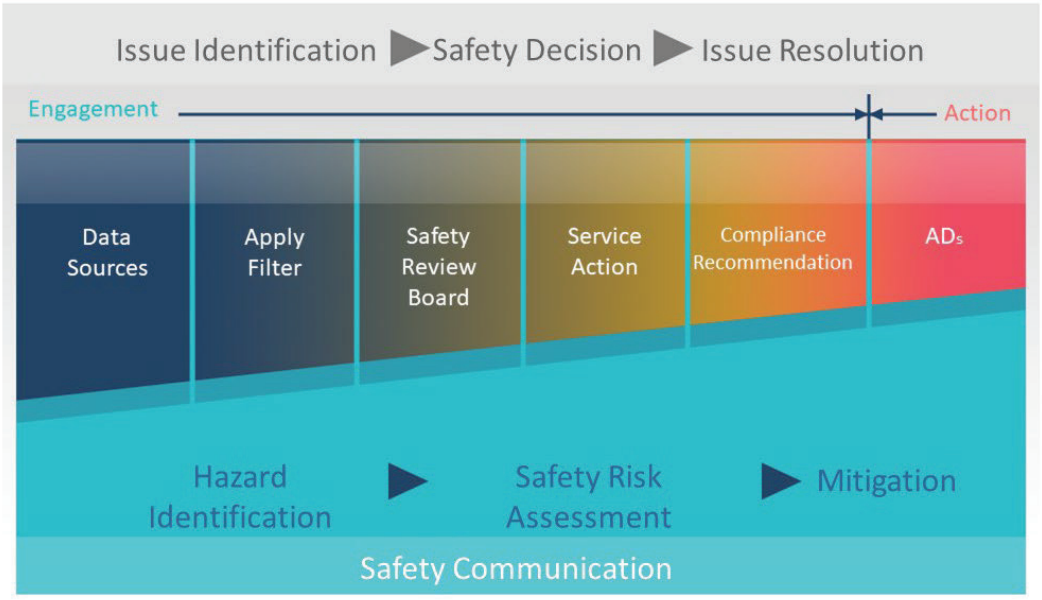

Figure 3: Safety communication workflow.

Activity	Hazards Identified	Actionable Decision to Mitigate Hazards
diving in XYZ environment		
diving with XYZ equipment/technology		
diving to performing XYZ operation		

Appendix B: Program Management Checklists

In publishing the enclosed Code of Practice as a guideline for developing and applying occupational diving programs, the MTS Diving Committee has prepared the below checklists for both Host Entities and project divers. The checklists may be used to guide program development and subsequent compliance with applicable regulatory bodies.

Checklist for Host Entity Self-Evaluation

The Host Entity is the organization taking the lead for project management and generally executing the project. The organization may or may not have a formal diving safety program, however, at a minimum the following organizational elements should be in place:

- ❑ Establish the diving objective for the advancement of diving science and/or related data gathering.
- ❑ Develop and put in place a Diving Safety Manual consistent with this guideline and meeting applicable regulatory requirements.
- ❑ Assemble a Diving Control/Safety Board comprised of experts in the technologies and techniques to be utilized.
- ❑ Appoint a Diving Program Manager, Diving Safety Officer, or similar responsible for overall risk management and site safety.
- ❑ Designate Lead Divers or Diving Supervisors to oversee the field operations.
- ❑ Establish a mechanism for vetting divers' qualifications for projects consistent with these guidelines.
- ❑ Prepare a HASP for each project and conduct diving activity according to plan.
- ❑ Establish administrative, record-keeping, and general operating practices consistent with these guidelines.
- ❑ Recognize that all dives are conducted at will; convey to each individual diver the authority to determine when to abort the dive.

Checklist for Project Divers

Divers applying for approvals to dive on a project should maintain a diving portfolio to support their application. At a minimum, this should include the following:

Entry-level divers / all divers

- ❑ Applicant/diver CV/summary
- ❑ Current medical clearance for diving
- ❑ Demonstration or verification of watermanship safety
- ❑ Verification of training in an appropriate diving mode
- ❑ Copies of dive logs to demonstrate proficiency
- ❑ Maintenance records for any personal equipment to be used on the project

Active Divers (in addition to above)

- ❑ Verification of training in basic emergency response – first aid, CPR, O2 administration
- ❑ Verification of training in dive accident management/dive rescue
- ❑ Documentation of at least 40 hours of on the job training or related experience
- ❑ Verification of additional training and proficiency applicable to the project or program

Lead Divers / Dive Supervisors (in addition to above)

- ❑ Verification of appropriate leadership training or comparable experience
- ❑ Verification of at least 100 hours of occupational diving project experience applicable to the project or program (ex. assistance to or mentorship through a complete 100-hour regimen)

Appendix C: Verification of Qualifications

While certifications to perform various diving skills or activities from agencies or schools may constitute a portion of the requirements to participate in an occupational diving activity, it is critical to recognize and communicate to project divers that there is no occupational diving certification per se, nor a license to dive under all conditions and circumstances – authorizations to dive for a Host Entity are restricted to their verification of training and proficiency sufficient to carry out the stated dive task.

However, throughout a diving career, the culmination of ongoing training and proficiency results in a portfolio of qualifications which afford Host Entities the ability to vet divers for projects. This portfolio, coupled with maintenance of certifications which may lapse (first aid, CPR, similar) and maintaining current fitness to dive, aligns with this Code's framework to engage the individual as an Active Diver for tasks which they can demonstrate proficiency and will contribute measurably to the success of the project.

A Host Entity may provide a letter or form to verify training and proficiency of its employees or those with a recurring professional affiliation with the Host Entity to another Host Entity to facilitate reciprocal diving privileges. This verification is in no way a waiver of requirements for the receiving organization who may conduct their own vetting process.

In the future, a more universal 'verification of qualifications' service program administered by the MTS Diving Committee is a logical fit within the MTS organization given the recent roll-out of the CMarTech credentialing program. A diving-specific professional credentialing program currently does not exist though if developed in the future, could allow an occupational diver to apply for a Verification of Training/Qualifications credential. This is not a certification process because no testing or training would accompany the verification except to point out where past training is community specific and therefore may pose restrictions when applying for dive authorization between community sectors.

Questions of liability that arise from certification rest with sanctioning authorities, those instructing on behalf of the manufacturers of a given technology or product, and/or designated Instructional Personnel when providing on the job training. It is the collation of training, proficiency, and practical work experience that are intended to be verified to facilitate cross-sector cooperation.

The endorsement by MTS of such a verification process is an open question. Assignment of a MTS Verification credential to an individual would have international implications though would not supersede national, international, or local standards or regulatory requirements. The MTS Verification alone would not be sufficient for approval to dive on any given project – the Host Entity establishes these approvals and retains responsibility for the occupational diving

program.

Professional verification of advanced technology or techniques training or past experience could well help individuals, institutions, and private companies bridge technology interests across these communities, and validate new technology use. This standardization of experience verification is a current diving community challenge that, if overcome, could reduce cost and risk to diving programs.

Similarly, a Host Entity might apply for recognition of self-compliance with this Code of Practice guideline, and as verification of making a commitment to diving science safety and advancement. Such recognition does not currently exist - if developed, could be established as a MTS Diving Organization Verification, for example. If such a recognition program were established, the MTS Diving Committee would assume the role of keeping the MTS Diving Organization Verification list up to date.

References

Benjamin, J., & MacKintosh, R. (2016). Regulating Scientific Diving and Underwater Archaeology: legal and historical considerations. *International Journal of Nautical Archaeology*, *45*(1), 153-169.

Butler, S. S. (1996). EXCLUSIONS AND EXEMPTIONS FROM OSHA'S COMMERCIAL DIVING STANDARD. In: MA Lang, CC Baldwin (Eds.) The Diving for Science…1996, "Methods and Techniques of Underwater Research", Proceedings of the American Academy of Underwater Sciences Sixteenth Annual Scientific Diving Symposium, Smithsonian Institution, Washington, DC.

Dunbar, J. S. (1987). AAUS and sport divers interaction?. In: Mitchell, CT (eds.) Diving for Science 86. Proceedings of the American Academy of Underwater Sciences Sixth Annual Scientific Diving Symposium. Held October 31 - November 3, 1986 in Tallahassee, Florida, USA. American Academy of Underwater Sciences.

Flemming, N.C. & Max, M.D. (eds). 1996. Scientific Diving. A general Code of Practice. Second Edition. On behalf of the Confederation Mondiale des Activities Subaquatiqes (World Underwater Federation), Scientific Committee. ISBN 0-941332-51-9. Best Books, Box 30100, Flagstaff, Arizona, U.S.A. & UNESCO Publishing , UNESCO, Paris, France. 278pp

Hicks, R. E. (1997). The Legal Scope of" Scientific Diving": An Analysis of the OSHA Exemption. In Maney and Ellis 1997 Diving for Science Symposium Proceedings.

Maney, E. T. J., & Genovese, S. J. (2000). Scientific diver training at Northeastern University. *Marine Technology Society Journal*, *34*(4), 38-46.

Nixon, DW (2009) Scientific Diving and the Law. In: Pollock NW, ed. Diving for Science 2009. Proceedings of the American Academy of Underwater Sciences 28th Symposium. Dauphin Island, AL: AAUS; 2009

OSHA CFR: Commercial Diving - Overview | Occupational Safety and Health Administration (osha.gov)

Technical Diving International Inc. General Course Standards. www.tdisdi.com. Accessed 03/2020.

UK STATUTORY INSTRUMENTS, 1997 No. 2776. HEALTH AND SAFETY: The Diving at Work Regulations 1997.

Sayer, M. D. J. (2007). Scientific diving: a bibliographic analysis of underwater research supported by SCUBA diving, 1995-2006. *Underwater Technology*, *27*(3), 75-94.