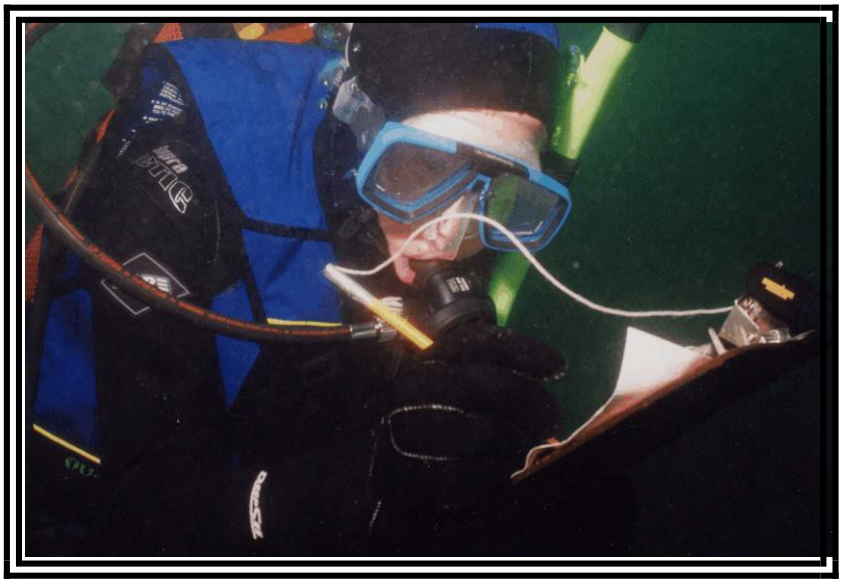
2024

SCIENTIFIC DIVING SAFETY MANUAL FOR OPEN WATER DIVING



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1. Introduction

The purpose of this manual is to set forth the standards for the organization and conduct of Memorial University's Scientific Diving Safety Program and to establish health and safety procedures for the university's scientific diving operations. The manual meets the requirements of the Canadian Association for Underwater Science Standard of Practice for Scientific Diving (revised ed. 2015). The CAUS is a self-regulating body dedicated to safety in underwater research through the establishment and continual peer review of standards of practice for scientific diving.

All scientific diving under Memorial auspices must be conducted in a manner that will minimize risk of and provide adequate protection for scientific divers from accidental injury or illness. This manual sets forth requirements and procedures which allow a working reciprocity with other CAUS institutions and related organizations in other countries.

The objectives of Memorial University's Scientific Diving Safety Program are:

- To enhance health and safety in university scientific diving operations by ensuring that all divers comply with all applicable regulations, standards and procedures;
- To facilitate use of diving in scientific study and research; and
- To encourage and promote reciprocity nationally and internationally in scientific diving programs.

2. Scope

The policies and procedures described in this manual apply to Memorial University's scientific diving* operations that include scientific diving and related training by university employees or its registered students as part of their research, occupation or instruction in connection with scientific research and teaching. This manual does not cover students or staff engaged in diving for non-university purposes.

The processes described in this manual do not apply to any diving performed as part of a commercial diving contract with Memorial University. Such contracts shall provide for the requirements of the Occupational Health and Safety branch of the Newfoundland and Labrador provincial government's Code of Practice for Diving Operations.

***Scientific diving is defined as diving performed to collect specimens or data for scientific use under the auspices of an educational or research institute operating in accordance with the Canadian Association for Underwater Science (CAUS) Standard of Practice for Scientific Diving. This includes diving and diving related training by University employees or its registered students as part of their research, occupation or instruction in connection with scientific research and teaching. This does not include any diving performed as part of a commercial diving contract with Memorial University.**

3. Definitions

Approved - acceptable to the DSO (DSO) or to the regulatory authority having jurisdiction.

Bailout system – an independent breathing gas supply carried by the diver, of sufficient quantity to return the diver to the surface, another source of breathing gas or to be reached by another diver in the event of a malfunction of the primary gas supply.

Bottom time - the total elapsed time, measured in minutes, from the time a descending diver leaves the surface to the time the diver begins final ascent.

Breathing gas/ Breathing mixture - air or other gas mixture whose use has been approved for human respiration; includes pure oxygen and therapeutic mixture.

Buddy system - the system of assigning diving partners, buddy pairs, in which divers stay in close proximity to one another (within sight of each other) and are capable of rendering assistance when necessary.

Contaminated environment – a workplace that contains a chemical, biological or radioactive material in sufficient concentration that should any quantity of it be ingested, absorbed or inhaled, it will likely endanger the health and safety of a worker.

Competent - qualified because of knowledge, training and experience to carry out required duties in accordance with this manual.

Decompression sickness - a disease caused by the formation of gas bubbles in the blood or body tissues because of pressure reduction.

Dive table - the profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures (air, mixed gas or oxygen as appropriate) to be followed after a specific depth-time exposure or set of exposures.

Dive team - divers and immediate support personnel who are approved for a diving operation.

Dive tender - a competent person at the dive site who tends the diver(s) and monitors the progress of the dive (see Section 12.6.2).

Diving mode - the specific equipment, procedures and techniques chosen.

Hyperbaric chamber - a pressure vessel and associated equipment designed for the purpose of subjecting humans to greater than atmospheric pressure.

Manual - Memorial University's Scientific Diving Safety manual.

Memorial or **Memorial University** or **university** - Memorial University of Newfoundland established pursuant to the Memorial University Act.

No decompression limit - in accordance with the dive table in use for the depth and duration of the dive, no decompression stop is required during the ascent.

Reciprocity - the process under which divers from another agency are granted equivalent diving privileges by another, under equally acceptable training and certification standards.

Scientific Diver - a person who has been approved to be involved in a diving operation under the auspices of Memorial University.

Scientific Diver in charge - a diver who has been designated by the diving project director, and approved by the DSO to be in charge of the dive site, is responsible for all aspects of the diving operation and has experience and training in the conduct of the planned operation.

Scientific Diver in training - a person who has completed an approved initial training course and is continuing to train in an on the job capacity.

Scientific Diving operation - the carrying out of a dive through on-site actions and procedures pursuant to a diving project governed by this manual.

Scientific Diving program - the assemblage of operational and administrative measures taken by Memorial University in conjunction with the diving project accomplished under it's auspices and includes diver certification, diving project approval, and record keeping.

Scientific Diving project - any undertaking which utilizes or involves diving under the auspices of Memorial University in accordance with the scope of Memorial's scientific diving program.

Scientific Diving Project Director - the person who is in charge of the diving project.

Scientific Diving and Boating Safety Committee - a committee of competent persons appointed by Memorial University to recommend procedures, policy and standards for diving operations, and to act as a board of review and appeal.
SCUBA - self-contained underwater breathing apparatus.

Scientific DSO (DSO) - a competent person appointed by Memorial University to administer and supervise the scientific diving program and ensure operational compliance with the diving safety manual.

Standby diver - a diver who is trained and equipped to operate at the depths and in the circumstances in which the diving operation is operating, and able to enter the water within one minute.

4. Diving and Boating Safety Committee (DBSC)

a. Membership

The membership of the DBSC is comprised of members knowledgeable about scientific diving safety and boating safety and scientific research. The membership of the DBSC shall include a

reasonable number of representatives from applicable university departments. Refer to Appendix A for the DBSC terms of reference (TOR).

b. Responsibility

The DBSC shall act as an advisory committee to the DSO in matters pertaining to scientific diving and boating. The committee shall meet periodically as required.

5. Diving Safety Officer (DSO)

Memorial University shall appoint a DSO to administer its Scientific Diving Safety Program.

a. Responsibility

The DSO shall report to the Director, Environmental Health and Safety and have experience in, and be responsible for:

- the oversight, approval and compliance enforcement of all diving operations under the scientific diving safety program;
- the development and/or approval of diver training programs;
- the certification of all scientific divers at Memorial;
- providing advice on the suitability of new equipment to be used on university diving programs;
- the custody and audit of all diving program records;
- serving as a member of the DBSC;
- participation in Canadian Association for Underwater Science (CAUS);
- providing representation on diving to different government agencies and other institutions, as required.

b. Authority

The DSO shall have authority to restrict, prohibit or suspend any unsafe diving operations, programs, projects or practices as they see fit.

6. Organization and Responsibility of Personnel

Responsibility for health and safety on scientific diving projects shall be in accordance with the following organizational plan.

a. Project Level: Scientific Diving Project Directors

Directors of research or study projects or programs (which includes instructors of courses, field trips or like instructional components, department heads, and persons in charge of any other scientific, research or educational undertaking, any of which utilize or involve diving), shall be responsible for ensuring that all individuals engaging in a scientific diving project are aware of and comply with this requirements outlined in this manual.

Personnel in charge at this level shall be designated as scientific diving project directors and shall have the authority to restrict, prohibit or suspend diving operations under their charge. When such person does not have the required diving knowledge and experience to perform the duties as director, the diver-in-charge shall be designated the scientific diving project director.

b. Operations Level: Scientific Diver in Charge

Each scientific diving operation undertaken as part of a scientific diving project shall have a designated scientific diver in charge **at the dive site or location** with experience and training in the conduct of the planned operation. The scientific diver in charge shall have charge of all aspects of the operation and shall serve as its coordinator and supervisor.

The scientific diving project director or a person appointed shall be designated as the scientific diver in charge. The scientific diver in charge must ensure that a dive plan is constructed for each scientific dive and is responsible for briefing the crew with respect to the dive plan.

The scientific diver in charge must also ensure that all necessary equipment is available and in good operating condition, and must be familiar with the standards, procedures and regulations that pertain to the diving operation.

The scientific diver in charge shall have the authority to restrict, prohibit or suspend any unsafe diving operations, programs, projects or practices under his charge.

c. Operations Level: Scientific Dive Team Members

Scientific divers and immediate support personnel (e.g. surface safety attendants) selected or approved by the diving project director or designate to be involved in a scientific diving operation shall be considered members of the scientific dive team(s) for that operation.

It shall be the scientific dive team member's right, responsibility and duty to refuse to dive or engage in diving support activity if he/she:

- feels unfit or inadequately trained or unprepared for the activity;
- judges that the conditions are unsafe; and/or
- feels that engaging in the activity would violate the precepts of his/her training or the requirements set forth in this manual.

d. Emergency Deviation from the Standard

The scientific diver in charge may deviate from the requirements of this manual to the extent necessary to prevent or minimize a situation that is likely to cause death, injury or major environmental damage. In such cases the scientific diver in charge must:

- notify the scientific diving project director and DSO as soon as possible after the onset of the emergency situation indicating the nature of the emergency and extent of the deviation from the prescribe standards, and
- submit such information in writing as soon as possible thereafter.

7. Authorization for diving

No persons shall engage in a scientific diving at Memorial unless he/she is registered with the DSO pursuant to the provisions of this manual or is authorized to engage in training prescribed herein. Once registered, the DSO will issue a scientific diver registration certificate indicating the level of certification achieved (see Scientific Diving Certification Levels below) as well as expiry date.

a. Scientific Diving Program Registration

Prior to acceptance into the university's scientific diving safety program and participating in any diving operations, all divers and dive tenders must register with the DSO by submitting a scientific diving registration package, which must include the following:

1. Diver registration form* with proof of age (must be at least 18 years of age)
2. Medical statement from physician indicating fit to dive
3. Current CPR certificate (within 3 years)
4. Current emergency first aid certificate (within 3 years)
5. Current oxygen therapy certificate (within 2 years)
6. Open water diver certification card
7. Review of manual acknowledgement form*
8. Copy of personal dive log (with at least 5 dives)
9. Brightspace (D2L) scientific diving safety course award
10. Completed open water check out form* signed by diver in charge

*Forms available on the Environmental Health and Safety Scientific Diving website.

i. Medical Requirement

All divers must be:

(i) declared medically fit by a licensed physician approved by the DSO to be knowledgeable in diving medicine in accordance with the CSA Standard Z275.4-02 "Competency Standard for Diving Operations" (see item 3 above), and

(ii) found to be free of any defect that would prohibit the type of diving in which they engage.

The results of medical examinations are to be maintained on file with the examining physician in accordance with accepted medical practice. A statement of clearance must be provided to the DSO certifying medical fitness to dive and a copy of the approval must be kept on file by the DSO.

The medical examination and approval is required every **two years** up to age 39, and **annually** thereafter, or more frequently as determined by the examining physician, or:

(i) after any major illness or injury; or

(ii) at the request of the DSO or diver-in-charge.

ii. Discretion to Deny or Revoke Registration

Any applicant who does not appear to possess the judgment necessary under diving conditions to ensure the safety of the scientific diver and his/her team may be denied registration.

A scientific diver's registration may be revoked or restricted for cause. The diver shall be informed of the reasons for revocation, and will be given an opportunity to present a case for reinstatement to the DBSC.

Failure to comply with the standards procedures and regulations set out in this manual shall be cause for the University DSO to revoke a diver's authorization.

iii. Maintenance of Registration

Term of Registration

- All University scientific diver registration certificates shall expire **one year** from the date of last diving medical examination.
- All University scientific diver registration certificates shall expire **six months** after last dive. (If due to illness or absence from the University and no diving has been done, this period may be extended by one month by the DSOr.)
- All University scientific diver registration certificates shall expire when the holder fails to meet the requirements of the Scientific Diving Program as set forth in this Manual.

If a diver allows his/her registration to expire by failing to meet the requirements of 7a of this manual, he/she may apply in writing to the university DSO stating reasons why the certificate was allowed to lapse and stating reasons for requesting it's renewal.

b. Scientific Diver Certification Levels

iv. Scientific Diver in Training

This certification authorizes scientific diving in a training capacity only. A scientific diver in training must:

- have fulfilled all basic requirements for registration as outlined in 7a. prior to conducting research activities,
- be familiar with the diving techniques and diving problems associated with their proposed underwater activities [i.e. participate in the task-based risk assessment associated with the approved dive(s)].

A certified scientific diver in training may engage in scientific dives with the following restrictions:

- maximum diving depth of **20 m**;
- must dive with DSO or certified Scientific Diver I or II.

v. Scientific Diver I

To achieve a scientific diver I certification the diver must:

- Be registered as a scientific diver in training
- have a minimum of 25 logged dives with 15 hrs of bottom time (at least 15 of these dives must be completed while registered as a scientific diver in training).
    - plan and execute a minimum of 4 working dives to the anticipated depth under the direct supervision of the DSO or designate.

A scientific diver I is restricted to a maximum depth of **20 m**.

vi. Scientific Diver II

To achieve a scientific diver II certification the diver must:

- be a certified scientific diver I;
- complete an exam in the physics and physiology of deeper diving (with a minimum grade of 75%);
- plan and execute a minimum of 4 working dives to the anticipated depth under the direct supervision of the DSO or designate or have equivalent knowledge or experience acceptable to the DSO.
- demonstrate proficiency in areas including but not limited to:

    - deep diving pre-dive planning including breathing gas consumption calculations;
    - selection and use of redundant air systems;
    - briefing procedures including narcosis awareness, gas and time monitoring dive termination criteria;
    - appropriate dressing in and equipment assembly procedures for deep extended dives;
    - pre-dive and in-water safety checks;
    - maintenance of the buddy system;
    - ascent rates, safety stops, post dive activities.

A scientific diver II must observe the following restrictions:

- maximum diving depth of **40 m**;
- must dive with the DSO or another scientific diver II when deeper than 20 m.

vii. Diver in Charge

To achieve a diver in charge rating a diver must:

- be a certified scientific diver I or II;
- have a minimum of 1-year experience and 50 logged dives;
- have experience in the field of scientific diving, specific to the depth, task and

environment.

viii. Surface Safety Attendant

A surface safety attendant or diver's tender shall:

- be trained in CPR and First Aid and Oxygen Provider;
- have knowledge of diving equipment, systems and procedures and accident management.

ix. Maximum Depth

Scientific divers using SCUBA can conduct only one dive in a 12-hour period between the depths of 30 m and 40 m.

* Dives over 30 m requires special permission from the DSO.

c. Competency Requirements for Registration

Memorial University divers and diving courses shall meet the Competency Standards of the CAUS Standard of Practice for Scientific Diving. The basic SCUBA certification shall meet ACUC, PADI Open Water, or equivalent requirements.

i. Diver Communication Systems

The diver must have the knowledge and skill to safely and effectively use hand and line signals as well as any wired or wireless modes of underwater communication used during the dive.

ii. Underwater Hazards

The diver must have a working knowledge of the potential hazards involved and appropriate safety actions required, associated with diving from vessels, environmental hazards (including adverse weather conditions), underwater entrapment, contaminated environments, hazardous water flows, differentiated water pressures, underwater mechanisms, hazardous sea life, fish nets and the limitations and operational restrictions of scuba.

iii. Compressors and Associated Equipment

If using high-pressure compressors, the diver must understand and demonstrate knowledge in the principles and operation of such apparatus, associated equipment and applicable safety requirements.
The diver must understand and demonstrate knowledge in:

- compressor safety, maintenance and operation,
- charging and decanting air cylinders,
- the applicable regulations and relevant guidelines on compressed air standards,
- use and maintenance of air filtration equipment,

- air purity and air analysis,
- basic requirements of CSA Standard Z 180.1 - Compressed Breathing Air

iv. Legislation and Standards

The diver must have an understanding of the relevant diving regulations and knowledge in the following areas is required:

- The Canadian Association for Underwater Science Standard
- Memorial University Guide to Diving Safety
- Any other relevant regulations, standards or guidelines that may apply.

v. Environment and Diving Mode

Attention shall be given to the development of proficiency under the specific environmental conditions under which the diver is expected to work effectively. Diving under hazardous conditions or using any mode other than SCUBA requires special training and specific approval by the DBSC (see Appendix C Special Modes and Environmental Conditions).

vi. Swimming and Watermanship

Prior to taking part in scientific diving activities the candidate will perform a rescue tow of 100 m with both participants fully geared with the appropriate thermal protection.

The participant will also complete one of the following tasks:

- demonstrate a survival swim/ float without any aids for not less than 20 minutes;
- swim 200 m without swim aids;
- snorkel 400 m using mask, fins and snorkel;
- conduct a head first surface dive to retrieve an object in 3 m of water.

vii. General Diving Skills (Checkout Dive Skills Evaluation)

Prior to participating in scientific diving, a documented evaluation of a diver's competency is required. A performance evaluation must include but not limited to:

- pre-dive planning including emergency contingencies and evaluation procedures;
- local environment orientation and hazard assessment;
- dive planning procedures to be implemented to counter any known hazards;
- briefing procedures;
- appropriate dressing in and equipment assembly procedures;
- pre-dive safety check;
- appropriate entry techniques;
- maintenance of the buddy system;
- underwater navigation skills;
- diving skills circuit - may be conducted in a confined or open water setting and must

include:
    - proper weighting;
    - proper decent/ascent techniques;
    - proper buoyancy techniques;
    - mask removal and replacement;
    - scuba unit removal and replacement;
    - regulator recovery and clearing;
    - weight belt removal and replacement;
    - options for out of air emergencies;
    - free flowing regulator;
    - dry suit over-inflation procedures;
- appropriate exit techniques;
- appropriate dressing down and equipment disassembly procedures;
- post dive debriefing;
- dive log requirements.

A checkout dive skills evaluation form must be completed by the diver in charge and submitted to the DSO for approval. Once approved, a dive certificate will be issued indicating the level of certification and expiry date.

8. Diving Projects

All diving projects shall be approved by the DSO prior to the commencement of the diving activities.

a. Application for Approval

A scientific diving permit application form shall be completed and submitted to the DSO for approval prior to the start of any diving operations. A comprehensive dive plan for each diving operation must be included with the application, and include the following details:

- Lead Diver in Charge or Supervisor
- Date
- Location
- Description of diving operation
- Diving procedure(s) used
- Type(s) of diving equipment used
- Dive crew and their assignments
- Air purity analysis onsite
- Diver logs and dive tables onsite
- Emergency services and contact information available
- Diver rescue plan and emergency procedures available and understood

b. Planning of Diving Operations

The diver in charge shall ensure that the dive plan is completed and approved by the DSO. Prior to commencement of any dive, the following must be completed:

- Tool box meeting form completed
    - Hazard assessment review (Risk register)
    - Complete JSA form
    - Complete and review dive plan
- SCUBA Pre-dive checklist completed

The dive plan must be communicated to all members of the diving crew on a daily basis and documented in the daily tool box meeting form.

Each diver must satisfy the diver-in-charge that he/she completely understands the signals and procedures in use.

A list of locally operational recompression chambers, medical facilities and emergency evacuation agencies shall be available at the dive site.

For each dive location a procedure shall be established for transporting an injured diver to a medical facility/recompression chamber.

Except in the case of an emergency, a diver must not be permitted to remain at any depth longer than the maximum time planned for that depth during that dive.

c. Termination of Dive

A dive shall be terminated in accordance with the dive plan or when:

- the diver-in-charge directs the dive be terminated;
- a diver requests termination;
- a diver loses contact with or fails to respond correctly to communications from a buddy team member*;
- a diver's pressure gauge reads approximately 500 psi or 33 Bars;
- a diver is aware of any sign of malfunction of gear or sign or symptom of distress;
- a member is aware of any unusual or unplanned situation that threatens the health or safety of any dive team member; or
- there is indication of the recall signal.

* As appropriate to the conditions, diving activity may be resumed given restoration of proper communication between buddy team members.

d. Dive Site Requirements

i. First Aid Kit

A CSA-approved first aid kit, including an oxygen therapy unit of sufficient capacity to reach emergency medical services, must be located at the dive site. A listing of locally operational recompression chambers, medical facilities and emergency evacuation agencies (including addresses, telephone numbers and radio frequencies, as appropriate) shall be available in the first aid kit at the dive site.

ii. Emergency Communication System

A means of providing effective voice communication with emergency assistance personnel must be on site while diving operations are in progress.

iii. Dive Tables

Defense and Civil Institute of Environmental Medicine (DCIEM) shall be followed during all diving operations. A copy of the DCIEM tables must be at every dive site.

iv. Signed Medical Evaluation

A copy of the form "Medical Evaluation of Fitness for SCUBA Diving" signed by the examining physician must accompany each diver whenever diving operations are undertaken at a site other than a pre-approved or normal site.

v. Standards, Procedures and Regulations

A copy of this manual, the provincial Occupational Safety Code for Diving Operations, , and the Protocol for Diving Emergencies, all of which are attached to this Manual, must be present at the dive site.

vi. Identification of Dive Site

When open water diving operations are in progress, warning devices shall be displayed as follows:

- Buoys, flags, lights, lamps or flares to define the limits to be kept clear of any equipment other than that connected with the diving operation; or
- In navigable water, flags and lights in accordance with the requirements of the appropriate authority;

Unless otherwise indicated by the appropriate authority, when diving is conducted from a boat or pier or under any circumstances in which marine traffic is probable, the recognized diver's flag* shall be prominently displayed. If diving is conducted in international water, the International Code Alpha**flag shall be flown.

Flags and signals employed for dive site identification shall be displayed only while diving operations are in progress.

*Recognized diver's flag - a red square having a white diagonal stripe from the upper left to the lower right
**International Code Alpha - a white and blue pennant

e. Communications

Each diver shall:

- be in constant audio communications with the surface; or
- be tendered on a lifeline by a diver's tender; or
- employ the buddy system whereby the divers shall remain, at all times, in visual or physical contact with each other. In accidental or unavoidable circumstances, they shall both surface immediately.

Where the buddy system is employed, in open water or areas free of obstructions, one of the divers shall be attached to an identifiable float located on the surface and visually monitored from the location that allows for immediate assistance rendered to the submerged divers in the event of an emergency.

f. Minimum Crew

Subject to clauses in 8d the requirements for all dive sites are:

- a sufficient number of workers are present for each diving operations to ensure, so far as is reasonably practical, that the operation can be undertaken safely; and
- a minimum of three workers are present at each dive site, one of whom is a diver, one a standby and one a diver's tender; or
- two divers using the buddy system, with a dive tender.

i. Standby Divers

A standby diver shall be on hand, ready to go into the water, when:

- dives that require, or may require, decompression are being carried out;
- a person is doing his/her first open water dive;
- by the very nature of the dive, there is an added risk involved (identified on scientific diving permit);
- night diving is being carried out;
- diving in the vicinity of ice or under ice.

ii. Dive Tender

During scientific scuba diving operations only, the person-in-charge on the surface need not have the diving experience of a functional diver or a diving supervisor. He/she is required however, to be competent in all aspects of the diving operation, including emergency response as outlined in 8.1.

g. Crew Responsibility

i. Diver

Responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive if, in his/her judgement, conditions are unsafe or if he/she would be violating the precepts of his/her training or this manual.

ii. Diver in Charge

The diver in charge has complete and direct responsibility for the diving operation and is knowledgeable and competent with the diving equipment, diving operations in progress, emergency diving procedures, diving physics and physiology and medical aspects of diving.

The diver in charge is responsible for the safe diving operations of the project. This includes identification, evaluation and control of all hazards associated with the project. Responsible to communicate the hazards and mitigating factors to all crew members involved in the project.

The diver in charge must know the dive plan, brief the crew, ensure all equipment is in good operating condition, supervise the entire operation and ensure the standards, procedures and requirements of all applicable underwater diving regulations are met.

iii. Standby Diver

The primary responsibility of the standby diver is to provide assistance underwater in the event of a diving emergency, and must be readily available to render assistance in the event of an emergency. A standby diver on the surface may also perform other duties which do not compromise the safety of the diving operation.

iv. Dive Tender

The dive tender is responsible for the maintenance of visual, auditory or tactile contact with the diver(s) through appropriate means and must be able to report the diver's location to the diver-in-charge when required. The dive tender must ensure that divers using umbilical, hookah, tethers or other such equipment are in constant contact with the surface and remain free of entanglements and hazards.

9. Scuba Limitations for Scientific Diving

a. Prohibitions for Scuba diving.

Scuba will not be used in the following diving operations, which are also not part of scientific diving:

- Underwater burning and welding;
- Salvage operations;

- Demolition;
- Handling explosives; or
- Jetting and suction dredging.

In addition, scuba diving operations shall not take place in the vicinity of inlets, outlets, culverts, water control structures or any other area with the potential for pressure differential.

b. Special instances requiring DSO approval

Approval, in writing, from the university DSO shall be obtained prior to any of the following:

i. Night Diving

- All night dives shall be carried out in accordance with the procedures described in this manual.
- Approval from the university DSO shall be obtained prior to night diving (ie. An approved scientific diving permit).
- Each diver shall carry an underwater dive light and spare, as well as fluorescent sticks and a whistle.

ii. Decompression Dives

- All decompression dives have to be carried out in accordance with the DCIEM air tables and in accordance with the provisions of this manual, and the additional regulations.
    - Scuba is not to be used for diving operations which exceed the no decompression limits.
- Dives requiring decompression shall be carried out at a maximum distance of 20km from the Health Sciences Centre decompression chamber in St. John's.
    - Dives requiring decompression beyond the 20km limit shall have a portable decompression chamber approved by the DSO.
- Dives requiring decompression shall be carried out only under the supervision of a qualified individual designated by the DSO.
- All ascents from dives requiring decompression shall be carried out on a line appropriately marked in 10 foot Increments measured from the surface to two increments deeper than the first stop.

iii. Ice Diving

- Ice diving shall be carried out only under the supervision of a qualified individual designated by the university DSO and in accordance with the provisions of this manual.
- In addition to a standby diver, a topside attendant is required for each pair of divers that enter the water. If there is only one pair, he/she may be the diver in charge.

Special equipment required for ice diving:

- Ice saw, axe or auger;

- Environmentally-protected regulators (preferred);
- Buoyant tether lines for each diver (both the same length);
- Tether line for the standby diver shall be:
    - of high visible colour;
    - 5 meters longer than the tether used by other divers; and
    - made of a material that floats, and have a minimum breaking strength of 2000 lbs.

Procedures for Ice Diving:

- The minimum diver certification for ice diving is scientific diver level I.
- Before divers enter the water, a safety line shall be attached to each diver's harness.
- Only one pair of divers shall dive through the same hole at any one time.
- Ice diving should not be attempted in ice fields composed of separate pans of ice.
- The hole through which the divers enter and exit the water shall be at least four feet square and shall be well-marked around the perimeter.
- On completion of the dive, if possible, the ice which was removed from the hole should be replaced and the site visibly marked as a warning of dangerous ice to all persons.
- All scientific divers must have special training before ice diving is undertaken.

iv. Diving in the vicinity of Icebergs

Diving near icebergs shall be carried out only under the supervision of a qualified individual designated by the university DSO.

Special Equipment and Procedures

- Boat on site;
- Regulators with pressure gauges, depth gauge and compass;
- Only two divers shall be in the water at any one time; and
- Divers should not swim on the surface within 18.3 m of the iceberg.

10. Diving Equipment

All diving equipment must be of a standard acceptable to the DSO, and inspections and servicing must be done in accordance with manufacturers' recommendations.

a. Maintenance and Inspections

Scuba tanks must receive a visual inspection every year and hydrostatic testing every five years in accordance with Canadian Transport Commission regulations. Tank valves must be serviced every two years and regulators must be serviced every year. Gauges (depth and pressure) and buoyancy devices must have a functional check every six months.

b. Use of Diving Equipment

All diving equipment, regardless of ownership, shall conform to the standards of this manual if used on diving projects or operations. Diving equipment must also be used and maintained in accordance with the manufacturer's recommendations. At no time shall equipment be used in modified form unless modification has been specifically approved by the DSOr or by an agency acceptable to the DSOr.

Each scuba diver must use:

- Open-circuit scuba, complete with demand regulator and tank with quick release harness;
- Face mask;
- Swimming fins;
- Suitable knife;
- Depth gauge, compass, pressure gauge;
- Exposure suit;
- Inflatable buoyancy compensation device (BCD);
- Underwater watch with elapse time indicator, bottom timer or dive computer;
- Weight belt with quick release buckle ;
- Underwater light and back up light when night diving;
- When risk of entrapment is present, one complete spare set of underwater breathing apparatus with fully charged cylinder must be assembled at the dive site;
- When diving in open water, each free-swimming diver must carry an audible or visual locating devise such as a diver's flag, whistle, flare or strobe light;
- Alternate air source (such as, pony bottle, or ASpare Air@); and
- Any other equipment as may be required by the DSOr.

c. Digital Dive Computers

Divers may use digital dive computers during university diving operations provided:

- that the DCIEM dive tables are adhered to at all times;
- personnel using dive computers have thoroughly reviewed the manufacturer's manual and are familiar with the features and limitations of the computer.

d. Inspection of Equipment in Preparation for Diving

Before commencing a diving operation, the diver in charge shall ensure that all diving systems and equipment used in connection with the diving operation are of an approved type and design, are in operating condition, and free of defects (identified in the SCUBA pre-dive checklist).

Immediately before each dive, each diver shall check that he/she has all the required equipment, and such equipment is properly fastened in place and all apparatus functioning. Before descent, the same check shall be conducted in the water.

e. Compressors and System Requirements

All tanks, fixtures and fittings used in connection with compressors must meet the appropriate requirements of CSA Standard B51: boiler, pressure vessel, and pressure piping code.

Compressor systems required to supply air to a diver must meet the requirements of CSA Standard Z 180.1-M85, Compressed Breathing Air.

11. Records

a. Diver's Personal Log

The university shall supply the diver with a personal logbook, which must be kept by every diver. The diver shall maintain the logbook such that it:

- is permanently bound;
- has numbered pages;
- contains the diver's signature and photograph; and
- contains any factor relevant to the diver's safety and health.

Divers shall:

- retain their personal logbook for five (5) years after it's completion;
- have their personal logbook at the dive site and available for inspection;
- have entered in or attached to their personal logbook:
    - a record of any certificates or qualifications obtained that are currently valid;
    - a certificate confirming successful completion of any diving course; and
    - a record of the divers training experience.

The personal logbook shall show all entries in chronological order and shall include,

- an entry witnessed and signed by the diving supervisors for each dive; and
- for any entries for medical recompression or hyperbaric exposures, the entries shall be witnessed by the presiding physician or diving supervisor.

The personal logbook shall contain for each dive the following:

- the type of diving apparatus used;
- the gas medium breathed;
- the time the diver left the surface;
- the time the diver reached the bottom;
- the maximum depth attained;
- the time the diver left the bottom;
- the time of the surface interval;
- if a repetitive dive undertaken;
- the decompression table used;

- the date;
- the name of the diver;
- the name of the tender(s);
- the name of the standby diver;
- any unusual incidents;
- the dive location;
- the environmental condition; and
- the signature of the diving supervisor.

b. Daily Diving Log

A daily record of each dive (i.e. a copy of the diver's personal log) shall be kept by the diver in charge and filed with the DSO. Such record shall be separate from the log owned and maintained by the diver (e.g., Divers personal log). The diver in charge shall submit the daily record for inspection as required by the DSO. The DSO shall retain the daily record and any accident or incident reports for a period of five (5) years.

All divers are to submit every six (6) months a copy of their filled diving logs to the DSO.

An individual training record will be maintained in the DSO for each diver in the program. This record shall include all diving certifications; safety training certificates; signed waivers; medical certifications and depth certifications.

c. Equipment log

Tanks, valves, regulators, gauges and compressors must have adequate service logs or service records indicating the dates and results of servicing. In addition, a copy of the itemized records from an authorized repair agency must be submitted to the DSO when requested.

All maintenance records shall be kept for a period of five (5) years.

d. Incident Reporting

The diver in charge of a diving operation shall notify Memorial's DSO and the Diving Project Director as soon as possible after the occurrence of any accidents or incidents involving the health and safety of diving personnel or the integrity of the environment, and shall complete and submit to the DSO a report of such accident or incident within 48 hours of the occurrence.

For the purposes of this Memorial's scientific diving safety program, an incident shall include but not be limited to the following:

- death;
- injury, including squeezes, lacerations and fractures;
- convulsions, or serious impairment of consciousness during or after a dive;
- decompression sickness;
- dysbaric gas embolism, pneumothorax, subcutaneous emphysema or mediastinal emphysema;

- any serious illness which results from a diving operation;
- any serious mishap (entrapment, entanglement, etc.), even though the dive team member escapes actual injury (i.e. “near miss”), or any series of incidents prior to, during or after a diving operation that make approved procedures or equipment suspect; and
- any serious mishap or series of incidents that threaten the integrity of the environment or the general health and safety of personnel.

i. Content of Incident Report

The facts shall be established with care and recorded on an accident incident report form as soon after the accident or incident as possible. The report shall include the following information:

- the place, date and time of the accident or incident;
- the names and duties of persons involved, including any injured;
- the names of witnesses;
- a detailed description of the accident or incident including the dive profile (as appropriate) and all relevant details, however remote;
- a statement of the sequence of events which preceded the accident or incident;
- identification of any unsafe conditions, acts or procedures which contributed in any manner to the accident or incident; and
- any further comments including (if appropriate) any corrective actions which might prevent similar accidents or incidents.

ii. Disposition of Records

Copies of the report shall be kept on file by the DSO for a period of 5 years.

12. Boating

a. Vessel registration

All vessels utilized by Memorial personnel (whether owned by Memorial or an external entity) must be registered with Transport Canada if it:

- is a commercial vessel with a gross tonnage of 15 or more and powered by motors totaling 7.5 kW (10 horsepower) or more,
- will have a marine mortgage,
- needs a reserved name,
- will travel outside of Canada.

All Memorial personnel who will operate a vessel (whether owned by Memorial or an external entity) must have an up to date Pleasure Craft Operator Card issued by a Transport Canada accredited provider. Individual’s who operate vessels at Memorial shall submit a copy of their Pleasure Craft Operator Card to the DSO prior to any voyage.

Prior to use, the vessel captain must complete a pre-boating checklist, which must be maintained and

available for review by the DSO for five (5) years.

b. Use of boats during scientific diving projects

Boats shall be used as a diving platform:

- on all dives requiring decompression;
- on all dives where marine traffic is probable;
- on all dives where, in the opinion of the divers, the distance from shore is too great to swim.

Boat Tenders

When diving is conducted from a boat, a boat tender shall remain with the boat at all times. Boat tenders shall have sufficient training to operate the boat and tend the divers safely. The boat tender must be familiar with the emergency communication system present on the vessel and must be able to contact emergency assistance personnel if required. The boat tender may act as the dive tender.