

Simon Fraser University

**DIVING SAFETY MANUAL FOR OPEN WATER
DIVING**

March 2016

Simon Fraser University
Vice President, Research
Burnaby BC V5A 1S6

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2007, August 2011, December 2013, April 2015, March 2016

Regulations and safety procedures for on-campus chamber diving are
described in a separate manual - S. Ferguson (Environmental Medicine
and Physiology Unit)

**Simon Fraser University
Diving Safety Manual for Open Water Diving
March 2016**

SCOPE AND APPLICATION

The SFU Diving Manual has been written to meet 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.

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 CAUS Standard of Practice for Scientific Diving.

The SFU Diving Safety Manual for Open Water Diving provides the guidelines for all open water diving under Simon Fraser University auspices. University auspices include all open water diving by University employees or registered students as part of their research, occupation or education, and diving funded by the University or using University diving equipment or facilities. Commercial diving under contract with the University is not covered by this manual and must meet the requirements of the Workers Compensation Board of BC Occupational Health and Safety Regulations. University divers should contact the University Diving Safety Officer to see if they also fall under Part 24 of the WCB OH&S Regulations.

The SFU Diving Safety Manual for Open Water Diving covers requirements for snorkel diving and open-circuit air SCUBA diving. Other modes and forms of diving are not covered by this manual and are not permitted under University auspices without special authorization from the Diving Safety Officer, the SFU Diving & Environmental Medicine and Physiology Unit Safety Committee and endorsement by the CAUS Standards and Procedures Committee.

All diving under SFU 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.

Statement of Authorization

The Simon Fraser University Diving Safety Manual for Open Water Diving has been developed over several years, making use of field experience gained during that time. It meets the current requirements of the Canadian Association for Underwater Science Standard of Practice for Scientific Diving and has been officially endorsed by the CAUS Standards and Procedures Committee.

The procedures have been prepared by the SFU Diving & Environmental Medicine and Physiology Unit Safety Committee for the use of personnel diving under university auspices. University auspices include diving by university employees or registered students as part of their research, occupation or instruction.

The Diving Safety Manual is approved for use by university personnel. The responsibility for ensuring compliance with the Diving Safety Manual rests with the SFU Diving & Environmental Medicine and Physiology Unit Safety Committee and the Occupational Health and Safety Program.

Dr Andrew Petter
President

**Simon Fraser University
Diving Safety Program
March 2016**

**SFU Diving & Environmental Medicine and Physiology Unit
(EMPU) Safety Committee**

| | |
|----------------------------|--|
| Chair | Dr Joy Johnson, Vice President, Research |
| Secretary | Sherri Ferguson, EMPU |
| Members | Dr Elizabeth Elle, Chair, Biological Sciences Michael Neudorf, Director, EH&S Dr Isabelle Côté, Biological Sciences Dave Geddes, Seneca College Dr Neilson Maclean, Emergency physician Dr Peter Reuben, Chair, EMP Sonja Savic-Kallesoe, President, BaroMedical |
| Diving Safety Officer | Dr Isabelle Côté |
| Hyperbaric Safety Director | Sherri Ferguson |

**SIMON FRASER UNIVERSITY
DIVING SAFETY MANUAL FOR OPEN WATER DIVING
March 2016**

1. INTRODUCTION

This Diving Safety Manual sets forth the policy for the organization and conduct of the Simon Fraser University Diving Safety Program and the regulations and procedures for safety in off-campus diving operations. This manual covers snorkel diving and open-circuit air SCUBA diving. Other modes or forms of diving are not covered and require special authorization. This manual complies with the requirements for scientific diving of the Canadian Association for Underwater Science (CAUS Standard of Practice for Scientific Diving, Apr 2015 edition).

The purpose of the University Diving Safety Program is to ensure that all diving under the auspices of Simon Fraser University is conducted in a manner that will maximize protection of divers from accidental injury and occupational illness. University auspices include all open water diving by University employees or registered students as part of their research, occupation or education and diving funded by the University or using University diving equipment or facilities.

This document is designed to ensure safe diving and to provide a framework for reciprocity between organizations with similar standards.

2. UNIVERSITY DIVING SAFETY PROGRAM ORGANIZATION

A. Diving Safety Committee

Diving safety will be under the purview of the Diving & Environmental Medicine and Physiology Unit (EMPU) Safety Committee. The membership of the Diving & EMPU Safety Committee shall consist of the VP Research (or designate) who will act as Chief Executive Officer for the University, one member from each academic department or school that undertakes diving or use of the EMPU for research and/or teaching purposes, the Diving Safety Officer, the Hyperbaric Safety Director, and the Director of Environment Health and Safety (or designate). The VP Research may appoint a Chair and Secretary, as well as external experts, such as physicians trained in

hyperbaric/diving medicine, hyperbaric safety consultants, or hypobaric consultants, as resource members.

The Diving & EMPU Safety Committee shall:

- (1) Recommend the issue, reissue or revocation of diving authorization;
- (2) Recommend procedures and policy for safe diving under University auspices;
- (3) Review and approve diving projects and diving practices and restrict or prohibit diving operations it considers unsafe;
- (4) Act as a board of appeal.

B. Diving Safety Officer

The University shall appoint a Diving Safety Officer to supervise and administer the University Diving Safety Program.

The Diving Safety Officer shall be an experienced scientific diver and shall:

- (1) Serve as a member of the Diving & EMPU Safety Committee;
- (2) Act as operational authority and administration of the University Diving Safety Program;
- (3) Be responsible for all aspects of the program including but not limited to:
 - (a) Diver authorization, competency and training;
 - (b) Diving project review and field evaluation of projects and personnel;
 - (c) Maintenance of diving records;
 - (d) General conditions of operational health and safety in the diving program and compliance with this manual.

The Diving Safety Officer shall have authority to restrict, prohibit or suspend any diving operations, programs or practices which he/she considers unwise or unsafe.

The Diving Safety Officer shall report to the Chair of the Diving & EMPU Safety Committee.

3. ORGANIZATION AND RESPONSIBILITY OF PERSONNEL

Personnel involved with diving operations conducted under the auspices of Simon Fraser University shall be responsible and accountable for the health and safety of those operations in accordance with the following organizational plan.

A. Project level: Diving Project Directors

Directors of research or study projects or programs, instructors of courses, field trips or like instructional components and persons in charge of any other scientific, research or educational undertaking, any of which use or involve diving, shall be responsible for ensuring that all individuals engaging in diving in conjunction with their project are aware of and comply with this manual.

Personnel in charge at this level shall be designated as Diving Project Directors and shall have the authority to restrict, prohibit or suspend diving operations under their charge.

B. Operations level: On-site Diver-in-Charge

Each diving operation undertaken as part of a diving project shall have a designated person-in-charge, the Diver-in-Charge, who will remain at the dive site at all times during diving operations and who is responsible for all aspects of the dive operations. The Diver-in-Charge shall have experience and training in the conduct of the planned operation.

The Diver-in-Charge will be appointed by the Diving Project Director. The Diver-in-Charge shall ensure that all diving and related activity under his/her charge is conducted in a safe and healthy manner and in compliance with the procedures and requirements set forth in this manual.

The Diver-in-Charge shall have the authority to restrict, prohibit or suspend diving and related activities under their charge. When appropriate, the Diving Project Director can be the Diver-in-Charge.

C. Operations level: Dive Team Members

Divers and immediate support personnel who are involved in a diving operation shall be considered members of the dive team(s) of that operation.

Final authority and responsibility at the dive site shall rest with the dive team members. It shall be each dive team member's right, responsibility, and duty to refuse to dive or engage in dive support activities if he/she:

- (a) Feels unfit or in any other way unprepared for the activity;
- (b) Judges that the conditions are unsafe or unfavorable;
- (c) Feels that engaging in the activity would violate the precepts of his/her training or the requirements set forth in this manual.

It is the dive team member's responsibility to report to the Diving Safety Officer any significant change in health or medication.

D. Operations level: Surface Safety Attendants

The Surface Safety Attendant is part of the Dive Team and provides surface support for the diving operation. The Surface Safety Attendant is a person who remains on the surface during a scientific diving operation and who monitors top-side hazards and who has the authority to abort the dive if there is any risk to the health and safety of the divers.

4. GENERAL REQUIREMENTS

A. Minimum Entry Requirements

All personnel or students involved in diving under University auspices must register with the University Diving Safety Officer (see Appendix 1) and meet all criteria herein described.

Prior to commencing scientific diving activities or scientific diver training, the candidate must be 18 years of age or older, or must be of legal age in the province or have signed authorization form from a parent or legal guardian. In addition, the following documents must be submitted to the Diving Safety Officer prior to or during a training program for scientific diving, as appropriate, and must be submitted by those divers who have demonstrated competency prior to scientific diving activities.

- SCUBA diving certification (with at least 5 logged open water dives and 2.5 hours underwater time)
- Medical evaluation declaring medical fitness to dive
- Dive registration form (Appendix 1)
- Current CPR and emergency first aid certification
- Current open water diving evaluation
- Personal diving log
- Signed waiver and release forms
- Current project description and approval, if applicable [Appendix 2; see Section 4D]
- Equipment list and service record

Medical evaluation must be carried out by a licensed physician trained in diving medicine. The certificate of medical fitness to dive must be renewed every two years up to age 39, annually from age 40 onward, and more frequently if clinically indicated.

B. Scientific Diver Competency

Prior to commencing operations as a scientific diver, the candidate must demonstrate competency in diving as outlined below (Points 1-6). Competency evaluation will be conducted initially and annually by the Diving Safety Officer or a designate (preferably at Instructor level). The scope of re-evaluation on an annual basis will be the responsibility of the Diving Safety Officer.

1. *Diving Theory*

Prior to taking part in scientific diving activities the candidate must demonstrate knowledge in, and understanding of, diving theory by completing a written exam with a mark of 75% or higher. Topics must include but not limited to:

- (a) diving physics;

- (b) diving physiology and medical considerations;
- (c) diver communication;
- (d) underwater hazards;
- (e) problems with contaminated air;
- (f) DCIEM Diving Tables;
- (g) the diving environment;
- (h) diving equipment;
- (i) problem management;
- (j) legislation and standards;
- (k) scientific diving techniques.

2. 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 four tasks:

- (a) Demonstrate a survival swim/float without any aids for not less than 20 minutes;
- (b) Swim 200 m without swim aids;
- (c) Snorkel 400 m using mask, fins and snorkel;
- (d) Conduct a head-first surface dive to retrieve an object in 3 m of water.

3. General Diving Skills

Prior to participating in scientific diving activities the diver must demonstrate the ability to perform basic diving skills in an open water

environment. A performance evaluation must include but is not limited to:

- (a) Pre-dive planning including emergency contingencies and evaluation procedures;
- (b) Local environment orientation and hazard assessment;
- (c) Dive planning procedures to be implemented to counter any known hazards;
- (d) Briefing procedures;
- (e) Appropriate dressing in and equipment assembly procedures;
- (f) Pre-dive safety check;
- (g) Appropriate entry techniques;
- (h) Maintenance of the buddy system;
- (i) Underwater navigation skills;
- (j) Diving skills circuit - may be conducted in a confined or open water setting and must include:
 - 1. Proper weighting;
 - 2. Proper descent/ascent techniques;
 - 3. Proper buoyancy techniques;
 - 4. Mask removal and replacement;
 - 5. Regulator recovery and clearing;
 - 6. Weight belt removal and replacement;
 - 7. SCUBA unit removal and replacement;
 - 8. Options for out-of-air emergencies;
 - 9. Dealing with and breathing from a free-flowing regulator;
 - 10. Dry suit/BCD over-inflation procedures.
- (k) Appropriate exit techniques;
- (l) Appropriate dressing down and equipment disassembly procedures;
- (m) Post-dive debriefing;
- (n) Dive log requirements.

4. Diver Rescue and Accident Management Techniques

The candidate must demonstrate proficiency in diver rescue and accident management procedures specific to location, mode, and condition of diving to be undertaken. A performance evaluation must include but is not limited to:

- (a) Site management and accident prevention;
- (b) Self-rescue skills;
- (c) Diver rescue skills at surface;
- (d) Diver rescue skills underwater;
- (e) Missing diver procedures;
- (f) Recognition and treatment of diving-related injuries;
- (g) Accident management and evacuation procedures;
- (h) Accident and incident reporting.

5. Oxygen Provider Proficiency

The candidate must possess current certification in the provision of therapeutic oxygen to an injured diver.

6. Scientific Diving Techniques

Scientific divers performing specialized tasks underwater must be properly instructed, trained and equipped to conduct these tasks in a safe manner. Training may include, but not be limited to, techniques such as:

- (a) Transects and quadrats ; other census or assessment techniques with a variety of organisms and habitats, underwater sampling design;
- (b) Photography/video;
- (c) Specimen collecting; handling and transport of equipment underwater;
- (d) Small object search and recovery (using lift bags);

(e) Surveying and mapping, use of lines.

C. Types of Diver Certification

1. *Diver-in-training*

This certification is a limited permit authorizing diving in a training or on-the-job training capacity only and requires that a diver must fulfill all minimum entry requirements. A diver-in-training must dive under authorized supervision and under the following restrictions:

- (a) Maximum diving depth of 20 m;
- (b) Must dive with the Diving Officer or an authorized Scientific Diver I or II;
- (c) Diving only during daylight hours;
- (d) Diving must not include use of special modes or be performed under special conditions (see Tables 1 and 2).

2. *Scientific Diver I*

To achieve the Scientific Diver I rating, the diver must pass the CAUS Exam with at least 75% and

- (a) Fulfill all minimum entry requirements;
- (b) Demonstrate competency as outlined, and plan and execute a minimum of 4 working dives to the anticipated depth under the direct supervision of the Diving Officer or a designate.
- (c) Accumulate a minimum of 25 logged dives and 15 hours bottom time as a Diver-In-Training or demonstrate to the Diving Safety Officer's satisfaction equivalent knowledge, training and experience as a scientific diver.

A Scientific Diver I is limited to a maximum diving depth of 20 m and may act as a Surface Safety Attendant for dives shallower than 20 m.

3. Scientific Diver II

To achieve a Scientific Diver II rating, the diver must:

- (a) Be a certified Scientific Diver I;
- (b) Complete an exam with a minimum grade of 75% on the physics and physiology of deeper diving;
- (c) Plan and execute a minimum of 4 dives to the anticipated depth under the direct supervision of the Diving Officer;
- (d) Demonstrate proficiency in areas including but not limited to:
 - 1. Deep diving pre-dive planning including breathing gas consumption calculations;
 - 2. Selection and use of redundant air systems;
 - 3. Briefing procedures including narcosis awareness, gas and time monitoring, dive termination criteria;
 - 4. Appropriate dressing in and equipment assembly procedures for deep extended dives;
 - 5. Pre-dive and in-water safety checks;
 - 6. Maintenance of the buddy system;
 - 7. Ascent rates, safety stops, post-dive activities.

A Scientific Diver II must observe the following restrictions:

- (a) Maximum diving depth of 40 m;
- (b) Must dive with Diving Officer or another Scientific Diver II when deeper than 20 m.

A Scientific Diver II may act as a Surface Safety Attendant for dives deeper than 20 m.

4. Surface Safety Attendant

A surface safety attendant shall attend the dive team at the dive site and must:

- (a) Possess a current, nationally recognized first aid and CPR certification;

(b) Possess current certification in the provision of therapeutic oxygen to an injured diver;

(c) Have knowledge of the diving equipment, systems and procedures in the conduct of the planned operation;

(d) Have knowledge of emergency accident management protocols and procedures.

5. *Visiting Diver*

This certification is a limited permit to dive to be used only on a temporary basis for personnel who do not normally and would not otherwise dive under the auspices of the University. Before being authorized to dive, visiting divers must provide evidence of certification, medical clearance, and experience. Visitor authorization shall be valid under the restrictions stipulated by the Diving Officer, and based on diver competency as outlined in this manual.

6. *SCUBA Certification Deeper than 40 m*

Certification for SCUBA diving shall not normally be given for depth greater than 40 m.

7. *Snorkel Diver*

Snorkel Divers shall have completed an approved course with at least 3 open water dives and 1.5 hours in water, unless otherwise specified by the Diving Officer. An open water evaluation of skills may be required under the supervision of the Diving Officer or designate.

Snorkel depth certification shall be limited to a maximum depth of 10 m.

8. *Special Circumstances and Equipment*

Attention shall be given to the development of proficiency under the specific environmental conditions relevant to the research project or in using any mode other than SCUBA or snorkel. Special environments and equipment may require special training and specific approval of the Diving Officer or Diving & EMPU Safety Committee. Special environments and equipment may include but not be limited to:

(a) Overhead environments or diving in the vicinity of ice or under ice;

- (b) Current/surge diving;
- (c) Kelp bed diving;
- (d) Boat diving;
- (e) Low visibility diving;
- (f) Night diving;
- (g) Full-face masks and helmets;
- (h) Voice-transmitting communication devices;
- (i) Extreme water or surface temperatures;
- (j) Diving in the vicinity of nets or cages.

Special equipment may include but not limited to:

- (a) Surface supply;
- (b) Hookah;
- (c) Nitrox or other mixed gases;
- (d) Rebreathers.

D. Project Description and Approval

All diving projects shall be approved by the Diving & EMPU Safety Committee prior to starting of diving activities. Applications must be submitted in writing to the Diving Safety Officer and include details of the project, proposed locations, and emergency plans (see Appendix 2). Educational dives on course field trips which may not be part of a research project shall nevertheless require approval. Course instructors or divers anticipating such dives must indicate their plans to the Diving Officer.

Approved project descriptions are valid for one year.

E. Waiver of Specific Requirements

If an applicant for certification can show evidence of previous qualifying experience or training, he/she may be granted a waiver for specific requirements of training and experience. The requirements for a medical evaluation shall not in any case be waived. Under normal circumstances experienced divers will be required to be checked out by the Diving Officer.

F. Maintenance of Authorization

1. *Term of Authorization*

All diving certificates shall expire one year from the date of the last annual (for divers more than 40 years old) or biannual medical examination, or six months from the date of the last logged dive, or one year from the date of the last evaluation with the Diving Officer, whichever comes first.

2. *Diving Activity*

During any 12 month period, each certified diver shall log a minimum of 12 dives. At least one dive to the depth of certification shall be made during each six month period.

Failure to log dives to the depth of certification as above may be cause for revocation or restriction of a certificate.

3. *Monthly Logs*

All certified divers must normally submit monthly diving logs to the Diving Officer summarizing their diving activity. Failure to do so shall be a positive indication that the diver has not been diving for that month. All dives must be recorded in a diver's daily log and should be summarized in a monthly log and the record for all months submitted on an annual basis.

4. *CPR Certification & Diver Rescue Training*

All certified scientific divers are responsible for maintaining current (every two years) CPR certification and diver rescue training. Proof of CPR certification and diver rescue training must be filed with the Diving

Officer. Divers must also have training in emergency first aid and oxygen therapy.

5. *Recertification*

If a diver's certificate expires or is revoked, he/she may be recertified after complying with such conditions as the Diving & EMPU Safety Committee may impose.

G. *Revocation of Authorization*

Failure to comply with the standards set out in this manual will result in revocation of certification. The diver shall be informed of the reasons for revocation, and will be given an opportunity to present a case to the Diving & EMPU Safety Committee.

H. *General Equipment Requirements*

1. *Diving Equipment*

All diving equipment including cylinders, regulators, buoyancy compensators, compressors, valves, pressure gauges, reserve gas-supply systems, umbilicals, helmets and all accessories necessary for the safe conduct of the diving operation must be:

- (a) Of approved design, sound construction, adequate strength, free from patent defect and maintained in a condition that will ensure its continuing operating integrity for the purpose and depths for which it was originally designed or subsequently used;
- (b) Of a standard acceptable to the Diving & EMPU Safety Committee;
- (c) Adequately protected against malfunction at low temperatures that may be caused by:
 - i) ambient air or water; or
 - ii) the expansion of gas;

- (d) Used in an unmodified form unless the modification is specifically approved by an agency acceptable to the Diving & EMPU Safety Committee;
- (e) Examined, tested, overhauled and repaired in accordance with the manufacturer's recommended procedures and as directed by the diving safety committee. Records of equipment maintenance and testing must be kept for a period of 5 years.

2. Checking of Gauges and Metering Equipment

Gauges and metering equipment must have a functional check every 12 months. When a discrepancy is indicated it shall be rectified without delay. If gauges and metering equipment are removed from service, such equipment shall be tagged as defective.

3. Cylinder and Compressor System Requirements

(a) Cylinders and compressor systems used to supply air to a diver must meet the requirements of CSA Standard Z275.2-04, Occupational Safety Code for Diving Operations; and

(b) All tanks, fixtures and fittings must meet the appropriate requirements of the CSA Standard B51-03 (R2007) Boiler, Pressure Vessel, and Pressure Piping Code.

4. Lifelines

Lifelines must:

- (a) Be secured at the surface to a safe point of anchorage;
- (b) Be tended at all times by a diver's tender;
- (c) Be secured in a manner that will prevent loss of contact with the diver;
- (d) Be affixed securely to a diver's safety harness;
- (e) Be of sufficient length and free of knots and splices; and
- (f) Have a breaking strength appropriate to the diving operation.

5. *Maintenance and Inspections*

Each SCUBA tank must receive a visual inspection including "Visual Plus" testing every year and hydrostatic testing every 5 years in accordance with Canadian Transport Commission Regulations. Tank valves must be serviced every two years and regulators must be serviced every year. Any malfunction shall be rectified without delay. The Diving Officer shall be informed of new equipment to be employed in diving.

6. *Communications*

An effective two-way means of communication must be provided between the underwater site of a diving operation and any person in control of equipment that supports or otherwise assists diving operations at the work site (surface supply, tethered SCUBA). Where voice communications are required, the standard of sound reproduction shall be adequate to enable the diver's breathing to be clearly heard.

In surface supply diving operations, in addition to the primary communication system, an emergency signal system must be employed.

7. *Surface Equipment*

When diving is in progress, the following equipment must be present at the dive location:

- (a) First-aid kit appropriate for the diving operation (Appendix 3) and for the work location; and
- (b) Such other equipment (e.g., oxygen) as may be required for the safe conduct of the diving operation.

8. *Digital Dive Computers*

Digital dive computers must not be used in place of DCIEM diving tables

9. *Use of Diving Equipment*

Diving equipment must be used and maintained in accordance with the manufacturer's recommendations. At no time shall equipment be used

in modified form unless the modification has been specifically approved by the Diving & EMPU Safety Committee or by an agency acceptable to the Diving & EMPU Safety Committee.

I. Diving Records

1. *Diving Logs*

Diver's Personal Logbook

Each diver shall maintain and retain in his possession for a five-year period a personal logbook that records the following information:

- (a) Diver's name;
- (b) Date;
- (c) Diving mode;
- (d) Gas media breathed (if other than air);
- (e) Bottom time;
- (f) Maximum depth attained;
- (g) Surface interval;
- (h) Pressure group if repetitive dive;
- (i) Dive team signature(s);
- (j) Dive table and schedule used; and
- (k) Any unusual incident or condition.

Daily Record

An additional daily record of each dive shall normally be kept by the Diver-in-Charge or the Surface Safety Attendant on site. Such records shall normally be separate from the log owned and maintained by the individual diver, e.g., Diver's Personal Log.

The daily record shall be available at any time for inspection, if required, by the Diving Officer.

The Diving Officer shall retain all diving records for a minimum period of 5 years.

Training Record

An individual training record must be maintained by the Diving Officer for each diver, including all diving certifications, depth and specialty endorsements. The training record must be retained as part of the organization's diving records for at least 5 years.

2. *Equipment Record*

A record of equipment maintenance and testing shall be kept by individual divers.

3. *Annual Project Description and Approval*

All diving projects must be outlined on the Annual Project Description and Approval Form (Appendix 2) and submitted to the Diving Officer for review by the Diving & EMPU Safety Committee before the beginning of any diving operations. All divers involved should have the appropriate depth and environmental certifications for the planned dives and should sign the submitted project approval form.

4. *Period of Records Maintenance*

All records shall be maintained for a period of at least 5 years.

5. OPERATING REGULATIONS

A. Authorization Required

No persons shall engage in diving under the auspices of Simon Fraser University unless he/she holds a valid certificate issued by the Diving Officer as approved by the Diving & EMPU Safety Committee pursuant to the provisions of this document, or is engaged in training as prescribed by the document.

SCUBA diving applies to diving operations in which divers use self-contained underwater breathing apparatus.

SCUBA diving may be performed in either a free-swimming or a tethered mode.

When SCUBA diving is accomplished in a free-swimming mode, the divers must employ the buddy system and have a surface safety attendant.

When SCUBA diving is accomplished in a tethered mode, the diver must be:

- (a) Secured by a lifeline; and
- (b) Tended by a diver's tender.

B. Maximum Depth

Divers breathing air on SCUBA must not exceed 40 m (130 ft) depth.

C. Maximum Depth – Emergencies

Divers breathing air on SCUBA may dive to depths greater than 40 m (130 ft) for the purpose of saving a life but must exercise extreme caution, have sufficient air and no decompression time and must, where conditions permit;

- (a) Be secured by a lifeline; and
- (b) Be tended by a diver's tender.

D. Communication

1. Buddy Divers

Free-swimming divers using SCUBA must maintain effective two-way communication with each other at all times while in the water and must be in a position to render assistance in case of need.

2. Tethered Divers

Tethered Divers employing SCUBA shall have effective two-way communication with the surface. Line signals are acceptable.

3. Surface Safety Attendants

One or more surface safety attendants shall be present at the dive site during all diving operations. *Minimum crew size* is three (3) for dives at depths of less than 20 m (i.e., two divers and a surface safety attendant).

E. Stand-By Diver

A stand-by diver must be present at the dive site during SCUBA diving operations as follows:

- (a) During operations involving decompression diving;
- (b) Where there is danger of diver entrapment;
- (c) Where there are special hazards (such as under ice);
- (d) When the depth of 40 m is exceeded; and
- (e) Where required by the Diving & EMPU Safety Committee, Diving Officer or Diver-in-Charge.

Stand-by divers must not dive or be required to dive except in the event of an emergency.

F. Snorkel Diving

Snorkel diving, as approved under this manual, includes diving operations in which divers utilize a snorkel for surface swimming or breath-hold diving. Snorkel diving shall be accomplished in a free-

swimming mode only. Snorkel diving shall not be permitted where there is danger of entrapment.

G. Special Modes and Conditions

Personnel who have an operational need to dive under the special conditions listed in Table 1 or to use the special diving modes and equipment listed in Table 2, excluding non-crew observers in one-atmosphere submersibles, are required to obtain written permission from the Diving & EMPU Safety Committee prior to undertaking such activity. In all cases, the special modes and conditions listed below require training, certification and operating expertise beyond the general requirements already stated in this manual. Application for permission must be made in writing to the Diving & EMPU Safety Committee and must describe the rationale and purpose of the proposed diving project. The Diving & EMPU Safety Committee may seek advice from other diving agencies in considering an application outside the specified regulations.

TABLE 1 - Special Environmental Conditions

Diving under ice
Altitude diving
Deep diving (deeper than 40 m/130 feet)
Decompression diving
Diving in zero visibility
Diving in contaminated water
Night diving
Diving in caves, shipwrecks, pipes, tunnels or other enclosed spaces
Blue-water diving (no bottom)
Diving in strong currents

TABLE 2 - Special Diving Modes and Equipment

Umbilical diving
Rebreathing apparatus (closed and semi-closed circuit)
Mixed gas diving (includes use of oxygen)
Bells (open and closed)
Saturation diving
Habitats
Chamber diving
Submersible vehicles (includes atmospheric diving systems)
Diver lock-out vehicles
Compressors
Power tools
Explosives
Electrical equipment

Underwater Power Tools

Where power tools are to be used underwater in diving operations, they shall be specifically approved for this purpose by the Diving & EMPU Safety Committee.

Hand-held electrical tools and equipment supplied with power from the surface shall be de-energized before being placed into or retrieved from the water.

Hand-held power tools shall not be supplied with power from the dive site until requested by the diver.

H. General Diving Procedures

1. Planning of Diving Operation

A general plan of the diving operation shall be discussed in detail and accepted by the Diver-In-Charge, divers and any non-diving support personnel.

The plan of the diving operation shall include safety and health aspects of the following as appropriate to the conditions:

- (a) Surface and underwater conditions and hazards;
- (b) Dive team assignments;
- (c) Diving equipment;
- (d) Breathing gas requirements and supply;
- (e) Thermal protection;
- (f) Residual inert gas status of dive team members;
- (g) Dive profiles and altitude corrections; and
- (h) Emergency procedures including procedures that are to be followed in the event of an equipment or system malfunction.

A listing (including addresses, telephone numbers and radio frequencies, as appropriate) 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 a diver to an operational recompression chamber or medical facility in the event of an accident.

2. *SCUBA Diving Equipment*

As appropriate for the dive operation, each SCUBA diver shall be equipped as follows:

- (a) Open-circuit SCUBA, complete with demand regulator, alternate air source (octopus) easily accessible and tank with quick-release harness;
- (b) Face mask;
- (c) Swimming fins;
- (d) Snorkel for surface swimming;
- (e) Suitable knife;

- (f) Weight belt with a quick-release closure;
- (g) Submersible pressure gauge;
- (h) Exposure suit or protective clothing appropriate for the condition of work and the temperature of the water;
- (i) Orally and manually inflatable buoyancy device;
- (j) Elapsed-time indicator and depth gauge (or the equivalent);
- (k) An auditory signaling device (e.g., whistle);
- (l) A surface marker buoy (i.e., safety sausage).

3. *Snorkel Diving Equipment*

Each snorkel diver shall use that portion of the following equipment appropriate to the conditions:

- (a) Face mask;
- (b) Snorkel or breathing tube;
- (c) Swimming fins for the feet;
- (d) Suitable knife;
- (e) Exposure suit or protective clothing appropriate for the condition of work and the temperature of the water;
- (f) Orally and manually inflatable buoyancy device;
- (g) Weight belt and a quick-release closure;
- (h) Auditory signaling device (e.g., whistle).

4. *Air requirements*

No SCUBA diving operation shall be permitted unless each diver carries a sufficient quantity of the appropriate breathing gas to complete the planned dive with an adequate reserve.

The Diver-In-Charge must ensure that all breathing gases used in conjunction with a diving operation meet the minimum purity requirements as outlined in the CSA Z275.2-04 Occupational Safety Code for Diving Operations.

5. *Dive Tables*

DCIEM (Defense and Civil Institute of Environmental Medicine) Air Diving Tables and procedures will be followed as a minimum requirement during all diving operations. Diving activity shall be restricted to no-decompression diving unless specifically approved by the Diving Officer or Diving & EMPU Safety Committee.

6. *First Aid Kit*

A first aid kit, approved by the Diving & EMPU Safety Committee and meeting IFA regulations and appropriate to the location and nature of the diving operation, shall be located at the dive site. The contents of the kit shall be as described in Appendix 3.

7. *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 and are in operating condition.

8. *Pre-Dive Check*

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

9. *Identification of Dive Site*

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

(a) Buoys, flags, lights, lamps or flares to define the limits to be kept clear of by any equipment other than that connected with the diving operation;

(b) In navigable water, flags and lights in accordance with the requirements of the appropriate regulatory authority.

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

10. Adherence to Planned Time/Depth Procedures

Except in the case of accident or unavoidable circumstances, a diver must not be permitted to remain at any depth longer than the maximum time planned for that depth during that dive nor shall the planned maximum depth be exceeded.

11. Termination of a Dive

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

- (a) The Diver-In-Charge requests termination;
- (b) A diver or Surface Safety Attendant requests termination;
- (c) A diver loses contact with or fails to respond correctly to communications from a buddy team member;
- (d) A diver fails to respond correctly to communications from the tender;
- (e) A diver goes on diver-carried reserve breathing gas supply;
- (f) A diver is aware of any sign of malfunction of gear or sign or symptom of distress; or
- (g) Any diver team member is aware of any unusual or unplanned situation which threatens the health or safety of any dive team member.

Note: As appropriate to the conditions, diving activity may be resumed in Item (c) given restoration of proper communication between buddy team members.

12. Diving Logs

Personal diving logs must be maintained for all dives.

13. Equipment Logs

Service logs must be maintained by individual divers or teams indicating the dates and results of servicing of tanks, valves, regulators, gauges, and buoyancy devices.

6. EMERGENCY AND DECOMPRESSION PROCEDURES AND REPORTING

A. Diver's Responsibility for Safety

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

B. Emergency Deviation from this manual

In emergencies when danger to life exists or is probable, divers may, at their own discretion, deviate from the requirements of this manual to the extent necessary to prevent or minimize the situation. The Diving Officer and Diving Project Director shall be notified as soon as possible after the onset of the incident and a written report of the incident shall be submitted to the Diving Officer, explaining the circumstances and justifications for actions taken.

C. Emergency Procedures

In the event of an accident which warrants it, the Diver-In-Charge shall identify the location of the nearest emergency medical facility and operational hyperbaric facility suitable for his/her diving operations and shall make arrangements for emergency notification of and transportation to the facilities. Should the Diver-in-Charge be incapacitated, another dive team member, including divers and/or surface safety attendants, shall contact rescue personnel and carry out appropriate first aid and emergency procedures in accordance with information contained in the diving first aid kit and the precepts of their training.

A list of emergency phone numbers for BC is contained in Appendix 4. The Diving Officer and Diving Project Director shall be notified as soon as possible after the onset of the emergency, and a written report of the emergency shall be submitted to the Diving Officer.

D. Decompression Procedures

1. General

Diving operations must be carried out in strict accordance with tables and procedures published or approved by the Defense and Civil Institute of Environmental Medicine (DCIEM) (now known as Defense Research and Development Canada (DRDC)).

2. Hyperbaric Chambers

A hyperbaric chamber, Class A (double-lock type), in operable condition, must be located within 4 hours of travel time by available means of transportation from the dive site when:

- (a) Planned dives exceed the no decompression limit; or
- (b) The depth of 40m (130 ft) is exceeded.

Hyperbaric chambers must conform to CSA Standard Z 275.1, Hyperbaric Facilities, and shall be operated in accordance with the requirements of CSA Standard Z275.1, Hyperbaric Facilities.

3. Stand-by Diver

A Stand-by Diver shall be present at the dive site when

- (a) Planned dives exceed the no decompression limit; or
- (b) Depth of 40 m (130 ft) is exceeded.

4. Pressure-Related Illness

When a diver shows any indication of pressure related illness or requires therapeutic recompression for any reason, treatment and transportation to a hyperbaric facility must be initiated immediately and medical personnel alerted.

5. Air Transportation of Distressed Diver

If transportation is required, the altitude and in-flight conditions must not exceed 300 m (960 ft) above dive site whenever possible.

6. *Diving After Treatment for a Pressure-Related Illness*

Any diver who has suffered pressure-related illnesses must not dive unless approval for further diving is given by a physician experienced in diving/hyperbaric medicine.

7. *Post-Dive Procedures*

On completion of decompression, a diver must remain awake for at least one hour in the company of a dive team member who is prepared to transport him/her to a hyperbaric chamber if necessary.

The diver(s) must not exceed an altitude or elevation 300 m (960 ft) above the dive site for 12 hours and preferably 24 hours after completion of any decompression.

E. Incident and Accident Reports

1. *Duties of Diver-In-Charge*

The Diver-In-Charge of a diving operation shall notify the Diving Project Director and the Diving Officer 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 Diving Officer a report of such accident or incident within 48 hours of the occurrence.

2. *Scope*

For the purposes of this manual, accidents and incidents warranting reporting shall include but not be limited to the following:

- (a) Death;
- (b) Injury, including squeezes, lacerations, and fractures;
- (c) Convulsions, or serious impairment of consciousness during or after a dive;
- (d) Decompression sickness;

(e) Dysbaric gas embolism, pneumothorax, subcutaneous emphysema or mediastinal emphysema;

(f) Any serious illness which results from a diving operation;

(g) Any serious mishap (entrapment, entanglement, etc.), even though the dive team member escapes actual injury, or any series of incidents prior to, during or after a diving operation which make approved procedures or equipment suspect; and

(h) Any serious mishap or series of incidents which threaten the integrity of the environment or the general health and safety of personnel.

3. Content of Report

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

(a) The place, date and time of the accident or incident;

(b) The names and duties of persons involved, including any injured;

(c) The names of witnesses;

(d) A detailed description of the accident or incident including the dive profile (as appropriate) and all relevant details, however remote;

(e) A statement of the sequence of events which preceded the accident or incident;

(f) Identification of any unsafe conditions, acts or procedures which contributed in any manner to the accident or incident; and

(g) Any further comments including (if appropriate) any corrective actions which might prevent similar accidents or incidents.

4. Disposition of Records

Copies of the report shall be kept on file in the University diving records for a period of 5 years.

A copy of the report shall be forwarded by the Diving Officer to the President of the Canadian Association for Underwater Science.

APPENDIX 1
Simon Fraser University
Diving Safety Program

DIVING REGISTRATION FORM

Name: _____ Date of birth: _____ Sex: _____

Address: _____

_____ e-mail: _____

Home tel.: _____ Office tel.: _____ Cell: _____

SFU Department: _____ Status: Staff/Faculty/Student/Other _____

Current SCUBA certification(s) *Give certifying organization(s), date(s) and level(s)*

Number of dives logged: _____ Total hours of diving logged: _____

Approximate number of dives in the past year at:

0-10 m _____

10-20 m _____

20-30 m _____

30-40 m _____

Geographical area(s) of most diving: _____

Date of last CPR/First Aid course *Give certifying organization* _____

Emergency contacts

Name: _____ Relationship: _____

Day tel.: _____ Night tel.: _____ Cell: _____

GP name: _____ Day tel.: _____ Night tel.: _____

Medical insurance number(s) (BC Care card/DAN insurance number)

Signature: _____ Date: _____

APPENDIX 2
**SIMON FRASER UNIVERSITY
DIVING SAFETY PROGRAM**

ANNUAL PROJECT DESCRIPTION AND APPROVAL FORM

Please fill out the information requested below as completely as possible. Circle relevant categories and add details where necessary. Questions concerning diving operations and project approval should be directed to the Diving Safety Officer, Dr Isabelle Côté (x23705; B8272).

1. Project director (= Principal investigator):

Campus address:

Telephone:

Email:

Project start date:

End date:

2. Project description

Please include a short introduction, hypotheses/questions addressed, and detailed methods to be used, particularly as they relate to diving. Use as much space as needed.

Discipline: Zoology • Botany • Chemistry • Geology • Oceanography • Other

Funding: Unfunded • University • Grant • Donation • Other

If funded, specify funding source :

3. General diving information

Circle all options that apply and provide requested information. Expand spaces as needed

Mission(s): Observation and Recording • Surveying • Coring • Photography • Collection and Sampling • Installation and Maintenance • Training • Other (specify):

Mode: SCUBA (air) • SCUBA (other) • Snorkel • Special modes & equipment (specify; see Appendix):

Dive sites:

Give country, site names and coordinates; indicate access (i.e. shore or boat) for each site

Anticipated total number of dives:

Maximum depth (m):

Anticipated number of dives at:

0-10 m:

10-20 m:

20-30 m:

30-40 m:

Dive team

Name each crew member, his/her home institution and role in the project; identify the diver-in-charge with an asterisk

Special environmental conditions (list all applicable)

4. Description of dive plan(s) (including dive profiles and residual nitrogen status across the period of study; please expand the space below as needed)

5. Risk assessment and safety protocols

A. Fill out risk assessment grid attached. *Take as much space as needed for full assessment.*

B. Emergency procedures. *Describe the communication equipment, oxygen and first aid resources, emergency health services availability, chamber and transport availability and activation time for your proposed dive site. Use additional page(s) as needed.*

6. I understand that all diving conducted under University auspices must comply with the University Diving Regulations. I understand further that all personnel involved in the diving operations described herein must be registered with SFU's Diving & EMPU Safety Committee.

PI Signature _____ Date _____

Risk assessment, mitigation and contingency grid

List hazards in the first column under the relevant category, tick the likely level of risk for each hazard, and explain how risk will be mitigated and contingency plans if needed. This risk assessment should cover all fieldwork risks, and thus include but not be limited to diving risks.

| Hazard | Risk | | | Mitigation and contingency |
|------------|------|--------|-----|----------------------------|
| | High | Medium | Low | |
| Physical | | | | |
| Biological | | | | |
| Chemical | | | | |
| Human-made | | | | |

Office use

Approved • Not approved

Comments:

Signed: _____ Date: _____
 (Diving Safety Officer; on behalf of Chair of Diving & EMPU Safety Committee)

**APPENDIX 3
SIMON FRASER UNIVERSITY
DIVING SAFETY PROGRAM**

DIVING OPERATIONS FIRST AID KIT CONTENTS

LEVEL 1 FIRST AID KIT

Except for blankets, these items must be kept in a container that can readily be taken to the scene of an injury. The container must be weatherproof if necessary to keep the items clean and dry. Blankets must be readily available to the first aid attendant.

- 3 blankets
- 24 14 cm x 19 cm antiseptic towelettes, individually packaged
- 60 hand cleansing towelettes, individually packaged
- 100 sterile adhesive dressings, assorted sizes, individually packaged
- 12 10 cm x 10 cm sterile gauze dressings, individually packaged
- 4 10 cm x 16.5 cm sterile pressure dressings with crepe ties
- 2 7.5 cm x 4.5 m crepe roller bandage
- 1 2.5 cm x 4.5 m adhesive tape
- 4 20 cm x 25 cm sterile abdominal dressings, individually packaged
- 6 cotton triangular bandages, minimum length of base 1.25 m
- 4 safety pins
- 1 14 cm stainless steel bandage scissors
- 1 11.5 cm stainless steel sliver forceps
- 12 cotton tip applicators
- 1 pocket mask with a one-way valve
- 6 pairs of latex gloves
- 1 first aid record book and pencil or pen

APPENDIX 4

Simon Fraser University Diving Safety Program Recompression Chambers/Emergency Services

Recompression chamber availability and emergency contact information are subject to change. Please confirm the active status and phone numbers for those facilities/services appropriate to your diving operations prior to each field season.

Emergency Services

British Columbia

- 911 on the telephone
- VHS radio channel 16 (PAN PAN, PAN PAN, PAN PAN, THIS IS A DIVING EMERGENCY)
- Vancouver General Hospital
855 West 12th Ave
Vancouver, B.C.
24 hour number (604) 875-4111
Direct Line to Hyperbaric Chamber (604) 875-4033
- D.A.N. Divers Alert Network (1-919-684-4DAN)