Department of Biological Sciences (National University of Singapore)

SCIENTIFIC DIVING OPERATIONS MANUAL

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Chapter 1: INTRODUCTION AND OBJECTIVES

1.1 Introduction

The National University of Singapore (NUS) is committed to continuously maintain and improve high standards of occupational health and safety. These consistent efforts extend to minimising the risks associated with SCUBA diving activities.

The Department of Biological Sciences (DBS) at NUS conducts scientific diving as a tool for teaching and scientific research.

The following regulations and codes, to which we made reference, apply within Singapore:

a. Singapore Workplace Safety and Health Act and its subsidiary regulations
b. Singapore Standard SS 623:2016 Code of Practice for Scientific Diving

1.2 Objective

The goal of this publication, the ***DBS (NUS) Scientific Diving Operations Manual*** **(henceforth the Manual)**, is to identify safety standards and practices for scientific divers at the Department of Biological Sciences (NUS). Activities carried out by scientific divers as part of the **DBS (NUS) Scientific Diving Programme** include, but are not limited to, scientific research, natural resources studies, environmental management, and academic or educational activities involving undergraduate and graduate students. The **Manual** is not intended to be a comprehensive diving manual that describes all dive procedures. Specific dive procedures for each scientific diving event should to be planned by relevant dive teams alongside the nominated Diving Officer; and documented as standard operating procedures (SOPs) to be made available to all Scientific Divers.

1.3 Compliance

This **Manual** applies to scientific diving activities for depths not exceeding 30 m, where breathing gas is supplied through self-contained underwater breathing apparatus (SCUBA). It does not apply to:

a. Diving to depths greater than 30 m;
b. Diving with pure oxygen;
c. Decompression diving;
d. Recreational diving;
e. Commercial diving;
f. Cave or wreck diving;
g. Diving covered by Singapore Standard SS 511:2010.

Compliance is required for personnel (staff, students and attached personnel, including external collaborators) should they undertake diving within the auspices of DBS (NUS) and within Singapore territorial waters. In the event that scientific diving is undertaken overseas,

then personnel should adhere to the diving safety standards of the overseas host institution. The DBS (NUS) standards will apply in the absence of safety standards or protocols governing scientific diving at the overseas host institution.

In preparing this Manual, references were made to the following publications:

a. Singapore Standard SS 623:2016 Code of Practice for Scientific Diving
b. Singapore Standard SS 511:2010 Code of Practice for Diving at Work

Acknowledgement is made for the use of information from the above publications.

The contents of this Manual shall be reviewed both periodically, and as required, so that the maximum period between reviews is two years. The Diving Officer, in consultation with the Office of Risk Management and Compliance (ORMC) and other employees, shall conduct the review. Any feedback should be provided in writing to the current DBS (NUS) Diving Officer (Danwei HUANG) or through the Principal Investigators (PIs).

CHAPTER 2: ORGANISATIONAL FRAMEWORK, ROLES AND RESPONSIBILITIES

2.1 Mission

The mission of the DBS (NUS) Scientific Diving Programme is to ensure the health and safety of Scientific Divers within the Department by providing a safe diving environment, establishing roles, responsibilities and procedures, as well as identifying diving and safety training needs.

2.2 Requirements

The basic requirements of the DBS (NUS) Scientific Diving Programme are as follows:

a. Institute appropriate dive standards and practices. DBS (NUS) shall follow the Singapore Standard SS 623:2016 Code of Practice for Scientific Diving to minimise risks associated with open water scientific diving. More conservative practices will be implemented according to the needs of DBS (NUS) Scientific Divers and detailed in the *DBS (NUS) Scientific Diving Operations Manual*. The Manual also specifies the documentation required, the types of diving allowed, risk assessment and management of diving activities, and emergency responses.
b. Ensure adequate dive competencies. It is important to ascertain the competencies of DBS (NUS) Scientific Divers before they embark on scientific diving projects. A range of competencies are to be expected, from relatively novice student divers to experienced research staff. Dive training requirements for both groups, as well as procedures to assess the competencies of divers, shall be established according to the Singapore Standard SS 623:2016.
c. Review of dive proposals. Proposed dive plan, risk assessment, or verification of Certification to the NUS Laboratory Occupational Safety and Health Management System that includes scientific diving, must be submitted for each research project, prior to diving phase of project.
d. Medical fitness to dive. All Scientific Divers are required to undergo an annual dive medical to ensure they are fit to participate in scientific diving.
e. Pre-dive planning. Before every dive, all members of the Dive Team shall be aware of the pre-dive plan and update the risk assessment as appropriate.
f. Emergency response planning. Emergency response plan for diving-related emergencies must be submitted for every project that involves scientific diving.
g. Manage diving incidents. Surveillance, reporting and investigations of diving accidents and incidents.

2.3 Organisational Framework

The organisational framework to execute the Scientific Diving Programme follows:

Entity	**Responsibilities**
DBS	The Department shall:

	a. Implement a diving operations management system to ensure that all SCUBA diving activities performed by staff, students and attached personnel under the auspices of DBS (NUS) comply with the Singapore Workplace Safety and Health Act and Singapore Standard SS 623:2016, and allocate resources where applicable. b. Appoint the Department Diving Officer in writing. c. Produce and review periodically the *DBS (NUS) Scientific Diving Operations Manual* with inputs from the Diving Officer and ORMC. d. Review periodically the diving activities, issues and incidents within the Department Safety Committee.
Diving Officer	The Diving Officer shall be an experienced Scientific Diver with at least a qualification equivalent to PADI Rescue Diver, a minimum of 100 hours of underwater diving experience, and satisfy any other reasonable requirements as specified by NUS. The Diving Officer: a. Has the authority to restrict or suspend any diving operations or practice which he/she considers unsafe. b. Has the authority to require additional safety practices, procedures or equipment. c. Shall assess and approve dive proposals, risk assessments and emergency plans for diving-related research projects. The dive proposal is to be submitted as the DBS (NUS) Dive Project Registration Form (**Annex A**) plus DBS (NUS) Dive Risk Assessment Form (**Annex B**); or verified lab certification including diving activities, as part of the Integrated Online Research Compliance system. d. Shall assess and record Scientific Divers' competencies, release and waiver (**Annex C**), dive medicals and dive logs. e. Should implement annual theory refresher training in the form of a written or online test of at least five questions on the management of diving situations and emergencies. f. Should implement annual practical refresher training in the form of underwater instruction and practice on the management of diving situations and emergencies. The actual conduct of the training can be carried out by the Dive Coordinator based on the curriculum set by the Diving Officer. g. Should monitor diving-related issues (e.g. diving activities, dive equipment and dive medical). h. Shall assist with the investigations of dive incidents with the Department Safety Committee. i. Should facilitate diving safety audits of laboratories in the Department with diving activities. When approving dive proposals, the Diving Officer shall ensure that the divers are trained and competent for the diving operation proposed. He/she may authorise a diver for certain operations only, depending on the qualifications and competency of the diver.

Principal Investigator	The PI of each diving-related research project shall ensure: a. Compliance with diving safety procedures and policies specified within the *DBS (NUS) Scientific Diving Operations Manual* and relevant legislations. j. Submission of dive proposals, risk assessments and emergency plans for diving-related research projects, or verification of lab certification, as part of the Integrated Online Research Compliance system. The dive proposal is to be submitted as the DBS (NUS) Dive Project Registration Form (**Annex A**) plus DBS (NUS) Dive Risk Assessment Form (**Annex B**). k. That diving-related equipment are appropriate and functioning. b. Clearance from the Diving Officer for the activities where risk is high or new activities not within the scope of the Manual. c. Divers are of appropriate competency level. d. All divers are medically fit to dive. e. Site-specific safety and familiarisation trainings are provided to project members. f. Adequate support for first aid, emergency oxygen and medical treatment of divers. g. Notification to the Diving Officer of diving-related incidents. h. Assistance to the Diving Officer during investigation of diving-related incidents.
ORMC	As the office in charge of safety and health matters, environmental compliance and emergency management in NUS, ORMC: a. Shall review dive standards periodically or when required in consultation with Diving Officer. b. Should facilitate consultation on diving-related matters that have implications for various Departments. c. Shall be the single point of contact for external notifications to regulatory bodies pertaining to occupational injuries or diseases. d. Should conduct diving safety audit of the Department on a periodic basis.

CHAPTER 3: DIVER COMPETENCIES, TRAINING AND CERTIFICATION

A nominal roll of Scientific Divers shall be maintained by the Department or the Diving Officer. This document shall include information on divers' training, experience, medical fitness to dive, next-of-kin information, scientific diving status and approval by the Diving Officer.

3.1 Requirements as a Scientific Diver

The following requirements shall be met before a student, staff or attached personnel can undertake scientific diving for a project:

a. Be at least 18 years of age;
b. Hold a minimum of PADI Rescue Diver certificate from a recognized SCUBA training and certifying organisation;
c. Have at least 15 h of underwater diving experience after certification;
d. Meet the minimum competencies set out for training in A.8 of the Singapore Standard SS 623:2016;
e. Be current in SCUBA diving, defined as having dived over the past 12 months;
f. Certified as medically fit to dive; a diving medical examination should be done on an annual basis, at the Occupational and Diving Medicine Centre, University Health Centre, NUS, or by a medical practitioner overseas who has attended a Basic Diving Medicine course and certified to conduct dive medicals;
g. Completed and signed the DBS (NUS) Diving Release and Waiver Form (**Annex C**);
h. Be familiar with first aid including cardiopulmonary resuscitation (CPR), administration of emergency oxygen and automated external defibrillator (AED).

3.2 Restricted Scientific Diver

In the case where the applicant to the DBS (NUS) Scientific Diving Programme does not hold a minimum of PADI Rescue Diver certification, but at least a PADI Open Water Diver certification; or not be current in SCUBA diving, defined as having dived over the past 12 months, restrictions apply. The Restricted Diver shall:

a. Not dive deeper than 18 m depth;
b. Not use powered tools or lift bags;
c. Be supervised by a Scientific Diver who will conduct a familiarisation briefing, evaluate the diver by means of at least one check-out dive in similar water conditions without task, and determine if the Restricted Diver can perform the dive activity independently;
d. Comply with all other requirements specified in section 3.1 above.

3.3 Dive Team Members

All dive teams shall comprise a Dive Coordinator, a Dive Leader who can be the Dive Coordinator, Scientific Divers which can include Restricted Scientific Divers, as well as a Diver's Assistant. Note the above limitations to be imposed on Restricted Scientific Divers.

- Dive Coordinator
  a. While a diver is in the water, there shall be a Dive Coordinator appointed by the Diving Officer present at all times. The Dive Coordinator shall be responsible for the safe conduct of the diving and shall coordinate and direct the activity of the diving teams at all times;
  b. The Dive Coordinator shall be appointed in writing (hard or soft copy) by the diving officer to supervise diving operations;
  c. The Dive Coordinator shall be a trained, experienced diver, qualified in accordance with A.5 of the Singapore Standard SS 623:2016, with experience in the diving techniques which may be required to be used and in the use of equipment and procedures used in the diving operation to be performed, and trained in the recognition and management of diving emergencies;
  d. The Dive Coordinator shall ensure that all diving operations under supervision are carried out in accordance with the Standard.

- Dive Leader
  a. A Dive Leader is a Scientific Diver in charge of a specific part of a diving operation;
  b. The Dive Leader shall be the Dive Coordinator or a person appointed by the Dive Coordinator;
  c. The Dive Leader shall take responsibility for any decisions required as the dive proceeds, in consultation with the Dive Coordinator, and ensure buddy diver(s) in the group are familiar with the pre-dive plan and conduct the dive in accordance with the Standard and, as far as possible, in accordance with the pre-dive plan and risk assessment.

- Scientific Diver
  a. A Scientific Diver shall be trained, experienced and certified in diving to competency levels appropriate for the diving operation as set out in Annex A of the Singapore Standard SS 623:2016;
  b. The Scientific Diver has been certified as medically fit to dive by a medical practitioner appropriately trained in underwater medicine in the 12 months prior to the dive;
  c. The level of training and experience required by a diver considered a competent person is largely dependent upon the type of equipment or diving apparatus being employed and an assessment of the risks likely to be met;
  d. The Scientific Diver shall ensure that he/she is familiar with the pre-dive plan before diving, dive in accordance with the pre-dive plan, act as a buddy diver during the dive to others in his or her designated buddy group;
  e. Buddy divers shall maintain effective two-way communication with each other at all times while in the water and be able to render assistance if necessary.

- Diver's Assistant
  a. Every time a diver goes underwater or is subjected to pressure, the diver shall be attended to by a Diver's Assistant;
  b. The Diver's Assistant shall be familiar with scientific diving and the requirements of underwater work, signals in use, in particular, the systems of surface hand

signals to be used in the diving operation, and first aid including CPR, administration of emergency oxygen and AED;

c. The Diver's Assistant shall record the time of descent and surfacing of each diver, maintain a constant vigil during a dive for divers surfacing at a distance from the vessel or other dive control position, assist in the recovery of divers and all equipment and samples from the water, have knowledge of the dive plan, and assist with the gearing up of divers and handling of field equipment;
d. The Diver's Assistant shall not be engaged in any other activity, other than those stated above while the diver is in water or under pressure.

CHAPTER 4: DIVING PROCEDURES

4.1 Planning Procedures

a. Ensure each diving student, staff or attached personnel has taken the necessary medical vaccinations, undergone a dive medical examination to ensure that he/she is physically fit, has certification equivalent to PADI Rescue Diver (for Scientific Diver) or PADI Open Water Diver (for Restricted Scientific Diver) with at least 15 logged dive hours, has completed CPR, AED and oxygen administration training (e.g. ORMC's CPR/AED Familiarisation Course and in-house oxygen administration training), and has carried out appropriate risk assessments.
b. Ensure all students, staff and attached personnel have completed the Safety and Health Induction Checklist. Staff and students should have completed the Science Safety Orientation Programme, with details of their next-of-kin, blood groups, allergies, dive certifications and experience duly noted.
c. Ensure each diver is current in SCUBA diving, defined as having dived over the past 12 months. If not, he/she shall be supervised by an unrestricted Scientific Diver (staff or student with at least Rescue Diver certification) who will conduct a familiarisation briefing and evaluate the diver by at least one check-out dive.
d. Each team shall comprise a minimum of three persons, including two divers and a Diver's Assistant who will not be participating in the actual dive.
e. Designate the Dive Coordinator for each dive trip. The Dive Coordinator may be the Diver's Assistant if he/she is not diving.
f. Dive Coordinator appoints a Dive Leader to be in charge of each specific part of a diving operation. The Dive Coordinator may be the Dive Leader if he/she is diving.
g. Dive Coordinator ensures that all members of the team have been certified and trained for activities to be performed during the dive trip.
h. Dive Coordinator ensures that all equipment to be used during the dive trip are well maintained. These include cameras, underwater housings, dive gear, dive tanks, wetsuits, booties, gloves, transect tapes and specimen collection tools (e.g. hammer, chisel, net, shovel, mesh bag, cooler box).
i. Dive Coordinator prepares a pre-dive plan to be approved by the Diving Officer and conveyed to every member of the Dive Team. The plan shall detail the following:
    i. Dive sites and order of dives
    ii. Methods of performing the tasks
    iii. Tasks of each diver and buddy pair
    iv. Diving equipment, breathing gases and procedures to be used
    v. Intended bottom times and dive profiles including maximum depth
    vi. Vessel used and other logistic details, e.g. thermal protection if necessary
    vii. Specific hazards and the methods used to address them
    viii. Emergency response plan
j. Dive Coordinator makes reservations for Department vehicle or other land transport for getting to dive vessel, and makes reservations for dive vessel (e.g. *Galaxea*; http://sjinml.nus.edu.sg/facilities-research-vessel/).

k. Dive Coordinator ensures that the required number of dive tanks are charged prior to dive trip, or ensures that the dive vessel supplies the required number of dive tanks. Prepares at least one additional tank.
l. Dive Coordinator packs at least one fully-stocked first aid kit (or ensure dive vessel has one), charged emergency oxygen tank and AED (or ensure dive vessel has them), emergency contact numbers and addresses, pre-dive plan and risk assessment, and the appropriate research permits.
m. Every team member should pack equipment, sufficient drinking water and food, dive gear, and a charged mobile phone.

4.2 Diving Procedures

a. All team members should be punctual for departure to dive site. For early morning trips, Dive Coordinator should ensure that all team members will arrive at meeting point on time.
b. Follow all traffic and boating regulations.
c. Upon arrival at dive site, Dive Coordinator conducts on-site risk assessment and briefing prior to each dive to emphasis safety and emergency procedures, assign buddy pairs (trios allowed with approval by Dive Coordinator), distribute tasks and equipment, as well as set specific bottom time and dive profile.
d. Diver's Assistant reviews on-site risk assessment, ensures all divers are physically fit to dive, deploys dive flag, monitors diving conditions, and implements headcount procedure.
e. Every diver performs pre-dive safety checks in presence of dive buddy prior to every dive.
f. Scientific diving work commences with all members of the Dive Team having an underwater timekeeping device, a depth indicator, and a submersible tank pressure gauge. A dive computer is recommended and shall be appropriate for the type of breathing mixture used.
g. After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions. He/she should also not undertake any activities that will increase the risk of decompression sickness, e.g. strenuous exercise or heavy alcoholic intake within 24 hours after a dive.
h. When diving close to no-decompression limits, the divers should remain awake for at least one hour after diving, accompanied by someone who is prepared to transport him/her to a hyperbaric chamber if necessary. Any omitted decompression shall be informed to the Dive Coordinator who will then initiate a consultation with a diving physician.
i. Upon completion of all dives, return to Department to wash dive gear and equipment thoroughly with freshwater.
j. No flying for 12 hours after a single no-decompression dive, and for 18 hours after multiple no-decompression dives.
k. Every diver to log all dives after every dive trip.
l. In case of an accident/incident, cease all dives and activate the lab's Emergency Response Plan.

4.3 General Safety Precautions

Exercise prudence during all diving activities to avoid unnecessary risk to oneself and others.

All diving shall be conducted in buddy pairs, unless the task being undertaken dictates the use of a third diver, whereupon specific approval should be obtained from the Dive Coordinator. Divers should maintain close contact and be in a position to render assistance in case of need. If buddy separation occurs, divers should search for the prescribed period (normally 1–3 min) as specified in the pre-dive plan and briefing, then surface and remain there until contact is re-established visually or until the bubble trail is sighted.

The diver's flag shall be prominently displayed whenever diving is conducted under circumstances in which boat traffic is a possibility or whenever required.

A set of appropriate dive tables should be available at the dive location as a backup when a dive computer is not available or has malfunctioned.

Plan and ensure adequate surface interval time to allow complete off-gassing.

Ensure that one is well hydrated for the duration of the dive trip.

Take extra precautions when venomous and/or dangerous animals have been sighted.

4.4 Dive Profiles

Some types of dive profiles are associated with higher risks of decompression sickness than others. A dive profile which attains maximum depth early in the dive and gradually ascends to shallower depths is recommended. Dives that incorporate “rectangular”, “reverse” or “saw tooth” profiles are known to expose divers to a higher risks of decompression sickness and should be avoided.

The maximum ascent rate should be no faster than 18 metres per minute (1 feet per sec) with an optimal rate of 15 metres per minute. Since the ascent is part of the decompression process, a faster-than normal ascent (or emergency ascent) shall be reported to the Dive Coordinator as soon as possible.

Multiple ascents can occur during a dive when a particular item is left onboard, during transfer of items to the vessel, or if an item drops into the water that requires retrieval. Multiple ascents during a dive increase the risk of decompression sickness by increasing the opportunity for bubble formation during the extra ascents. Once bubbles have formed, rates of gas up-take and elimination are altered for all subsequent dives until there has been a long enough surface interval to allow complete off-gassing. Dives should be planned carefully to ensure the number of ascents during a dive is kept to a minimum. For shallow dives, there should not be more than 2 ascents (excluding final ascent) per shallow dive. A shallow dive is defined as a maximum dive depth of 3–10 m.

Divers performing successive multi-day repetitive dives shall use the dive tables/dive computer for calculating their no decompression limits on each dive even if all dives are shallow.

Divers performing repetitive dives over multiple days shall have a 24 hour break from diving every third day, except where using repetitive dive profiles involving less than three dives per day, in which case a 24 hour break shall be taken on the fifth day.

Excessive dive duration is a potent predisposing factor to decompression illness, particularly when coupled with multiple ascents and multi-day diving operations. All dive plans should keep the amount of time divers spend in the water on any given day to a minimum. No diver is to spend more than 2 hours for any one dive; and not more than 6 hours total time in the water in any 24 hour period, regardless whether the dive tables/computers allow this or not.

4.5 Specialised Dive Techniques

All equipment used in connection with diving operations shall be operated, maintained and serviced in accordance with the manufacturer's instructions.

Nitrox diving, reduced visibility diving and other specialised dive techniques shall comply with the guidelines of the certification agency for which the diver has obtained his certification.

4.6 Refusal and Termination of Dive

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

It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever he/she feels it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water. The dive should be terminated while there is still sufficient air to permit the diver to safely reach the surface, including decompression time.

4.7 Accidents and Incidents

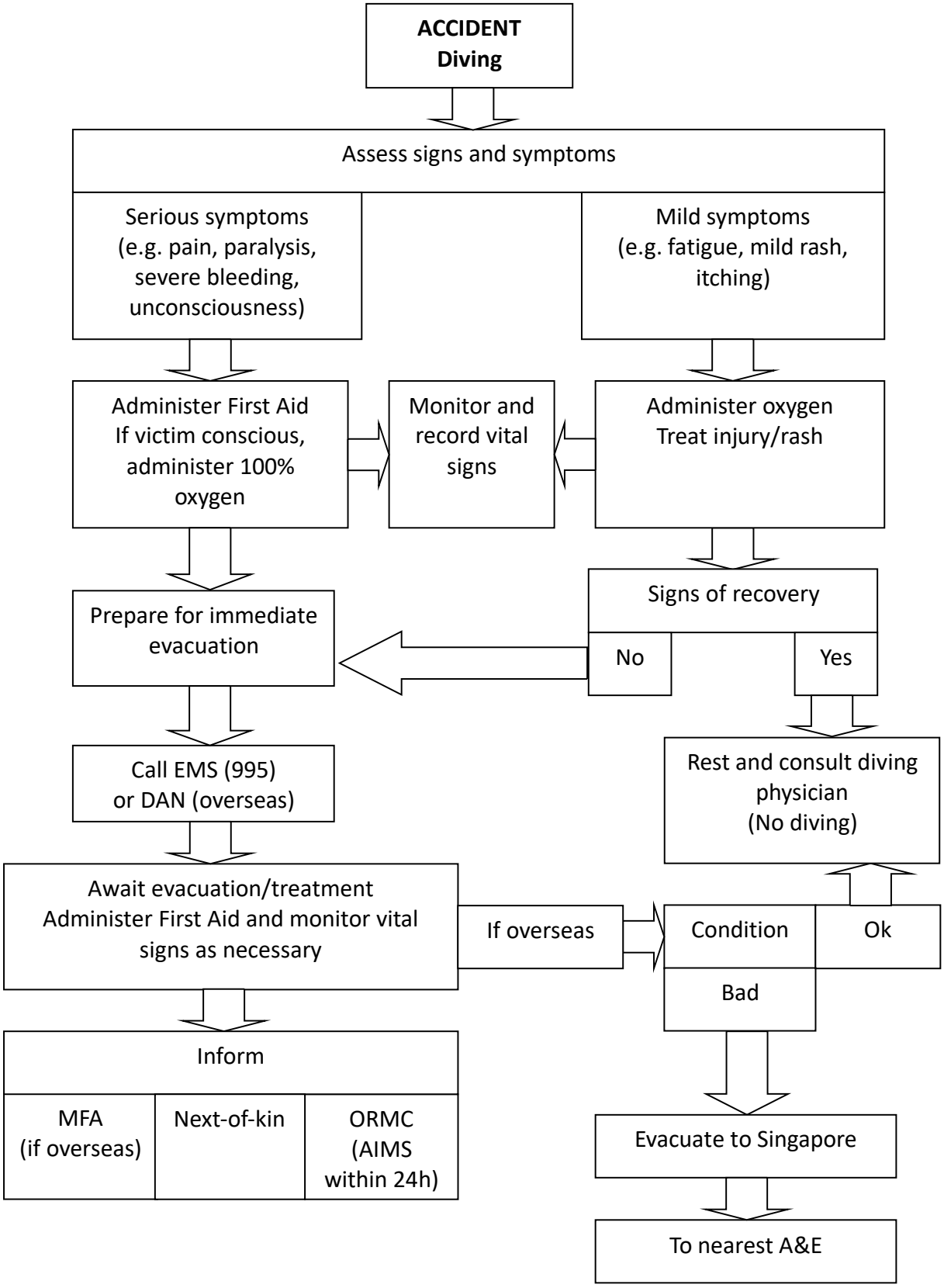
Accidents and incidents shall be reported using the ORMC Accident and Incident Management System within 24 hours for all accidents/incidents except for fatality (https://inetapps.nus.edu.sg/osh/portal/eServices/ehs360_aims.html).

For any cases involving fatality, call Campus Security at 6874 1616 immediately.

All diving equipment is to be quarantined, i.e. kept within DBS (NUS), and not be tampered with till after it has been inspected by the investigation team.

CHAPTER 5: FIRST AID AND EMERGENCY RESPONSE

5.1 Emergency Response Plan



5.2 Emergency Contacts

Emergencies
Police
999
Ambulance
995
NUS Campus Security
(+65) 6874-1616
NUS ORMC
(+65) 6516-1084
NUS University Health Centre
(+65) 6601-5035

Radio contacts
Singapore Coast Guard
VHF Channel 06
Distress Channel
VHF Channel 16

Hospitals
From Republic of Singapore Yacht Club
National University Hospital: (+65) 6779-5555
From Sentosa, East Coast Park
Singapore General Hospital: (+65) 6222-3322
From Tanah Merah, Changi Beach, Pasir Ris Park
Changi General Hospital: (+65) 6788-8833
From Punggol Beach, Sungei Buloh
Khoo Teck Puat Hospital: (+65) 6555-8000

Others
International SOS
(+65) 6338-7800
Republic of Singapore Yacht Club
(+65) 6768-9233
Tanah Merah Ferry Terminal
(+65) 6540-8037

Accident and Incident Management System (via EHS360)
https://inetapps.nus.edu.sg/osh/portal/eServices/ehs360.html

DAN 24h hotlines
DAN USA / Canada / Latin America / Caribbean
+1-919-684-9111
DAN Asia-Pacific
Within Australia: 1800-088-200 (within Australia)
International: +1-919-684-9111 (outside Australia)

DAN Europe
+39-06-4211 8685
DAN Japan
+81-3-3812-4999
DAN Southern Africa
0800 020 111 (within South Africa)
+27-828-10-60-10 (outside South Africa)

Recompression facilities

Hyperbaric & Diving Medicine Centre
Singapore General Hospital
Block 4 Level 1
Outram Road
Singapore 169608
Tel: (+65) 6222-3322
Operating hours: Mon–Fri: 0800–1700

Hyperbaric Medical Services Pte Ltd
Blk 1 #01-330 Thomson Road
Singapore 300001
Tel: (+65) 6355 9021
Mobile: (+65) 8040 6236
24h hotline: (+65) 6355 9021 / 6732 8552
Operating Hours:
Monday to Friday - 9.00am to 6.00pm
Saturday - 9.00am to 1.00pm

Naval Medicine & Hyperbaric Centre
Singapore Navy
36 Admiralty Road
West Sembawang Camp
Singapore 759960
Emergencies: (+65) 6758-1733
Appointments: (+65) 6750-5632

CHAPTER 6: DOCUMENTS AND RECORDS

6.1 Diver Recordkeeping

Every Scientific Diver shall keep and maintain a permanent record of all dives undertaken for the duration of the diver's research. These records shall be accessible and reviewed on an ongoing basis by the Diving Officer.

The **individual** permanent diving records are to include:

a. Highest SCUBA certificate;
b. Annual fitness to dive certificate;
c. Personal dive log of all training, personal and work dives, updated and accessible to the Diving Officer for review on an ongoing basis. Divers can also print the dive log after every dive trip for review by the Diving Officer.
d. Record of accidents and incidents including decompression treatment (if any).

6.2 Principal Investigator Recordkeeping

The PI shall keep **project** permanent diving records that include:

a. Certification to NUS Laboratory Occupational Safety and Health Management System that includes scientific diving; OR, approved DBS (NUS) Dive Project Registration Form (**Annex A**) plus DBS (NUS) Dive Risk Assessment Form (**Annex B**) for each project;
b. Pre-dive plans for all dive operations;
c. Diving-related risk assessments;
d. Personal particulars and next-of-kin contact information for each Scientific Diver;
e. Copy of highest SCUBA certificate of each Scientific Diver;
f. Copy of annual fitness to dive certificate of each Scientific Diver;
g. Record of accidents and incidents including decompression treatment (if any).

6.3 Diving Officer Recordkeeping

The Diving Officer shall keep **individual and project** permanent diving records that include:

a. DBS (NUS) Dive Project Registration Form (**Annex A**) plus DBS (NUS) Dive Risk Assessment Form (**Annex B**) for each project;
b. Appointments in writing for Diving Officer and Dive Coordinators;
c. Personal particulars and next-of-kin contact information for each Scientific Diver;
d. Copy of highest SCUBA certificate of each Scientific Diver;
e. Copy of annual fitness to dive certificate of each Scientific Diver;
f. Completed and signed DBS (NUS) Diving Release and Waiver Form (**Annex C**) for each Scientific Diver;
g. Personal dive log of all training, personal and work dives for each Scientific Diver, updated and accessible for review on an ongoing basis.
h. Record of accidents and incidents including decompression treatment (if any).

6.4 Diving Equipment Maintenance

All breathing apparatus shall comply with the requirements of 6.1.2.2 to 6.1.2.7 of the Singapore Standard SS 623:2016. The manufacturer of component parts of a diver's breathing apparatus shall specify proper storage and maintenance conditions.

Where tests are carried out (e.g. for breathing gas purity, records of test results, together with identification of the breathing gas supply or air compressor), they shall be maintained for a minimum period of seven years.

An **equipment log** is to be maintained by the PIs of laboratories in the Department with diving equipment which is in use. In particular, the log documents the last and next service dates of the dive regulator, which includes the open-circuit SCUBA with two demand regulators, submersible pressure gauge and associated hoses. It should also record the acquisition date and the Scientific Diver currently using the dive regulator and buoyancy control device.

All diving equipment are to be inspected and tested for serviceability prior to each diving operation. Equipment not in working condition is to be repaired or replaced prior to further use. Servicing and repair works shall be performed by a trained technician sourced by the Dive Coordinator. The equipment log and service reports (if any) shall be maintained for a minimum period of seven years.

6.5 Inspection and Audit System

Department should set up an internal audit system to ensure that PIs implement appropriate dive planning, procedures, documentation and reporting. The system is to be reviewed on an ongoing basis for enhancement and improvement.

ORMC should conduct a safety inspection and audit for the various PIs during the surveillance audit once every 3 years unless specified otherwise, following initial certification to the NUS Laboratory Occupational Safety and Health Management System.

The audit findings should be documented and submitted to the respective PIs and Diving Officer for corrective actions. The Diving Officer should ensure all corrective actions have been implemented within an acceptable timeframe. Inspection and audit records should also be filed centrally at the departmental level for easy retrieval. ORMC, Faculty SHOs or Department Safety Committee should access the records periodically to ensure compliance with legal regulations and the *DBS (NUS) Scientific Diving Operations Manual*.

Annex A

DBS (NUS) DIVE PROJECT REGISTRATION FORM

1. Project title: _____

2. Commencement date: _____ Intended duration: _____

3. Principal Investigator(s): _____ Tel: _____

Address: _____

Email: _____

4. Dive Coordinator(s): _____ Tel: _____

5. No. of students and staff involved: _____

Names of Divers: _____

_____

6. Description of project, and intended principal work methods: _____

_____

_____

7. Intended location(s) of field sites: _____

_____

_____

8. Will the fieldwork:
a. Involve the use of a: small boat/'bum' boat/dive tender/shore dive
b. Diving involving SCUBA open circuit/semi-closed/closed circuits
c. Type of breathing gas used: air / NITROX (specify type of NITROX: _____)

9. Please list dive training competency levels required: _____

_____

PI signature: _____ Date of submission: _____

Annex B

DBS (NUS) DIVE RISK ASSESSMENT FORM

Project Title: _____

Risk Assessor: _____ Assessment Date: _____

Environment or tasks with potential to cause harm	Type of injury that can occur	Risk control measures	Severity			Likelihood			Risk L/M/H
			L	M	H	L	M	H	
Environment									
Monsoon period									
Strong currents (>1 knots)									
Visibility (<0.5m)									
Hazards peculiar to dive location									
Tasks									
Night Dive									
Heavy work									
Individual									
Frequency of dives (>3 per day)									
Working depth (>10m)									
Duration of dive (>90 min)									
Decompression dive									
Exertion to reach dive site									
Excessive underwater acoustics/noise									
Boat									
Excessive storage of hazardous substances									
Other factors									

Any deviation from *DBS (NUS) Scientific Diving Operations Manual*?

Any additional control measures of note or comments?

Assessed level of RISK: LOW MODERATE HIGH (please circle)

Name and Signature of Risk Assessor: _____ **Date:** _____

Name and Signature of Dive Officer: _____ **Date:** _____

Annex C

DBS (NUS) SCIENTIFIC DIVING RELEASE AND WAIVER FORM

For and in consideration of permitting _____ to enroll and participate in SCUBA diving activities, given by the reagents of the National University of Singapore, beginning on the _____ day of _____ (month), _____ (year), the Undersigned hereby voluntarily **releases, discharges, waives and relinquishes** any and all actions of causes of action for personal injury, property damage or wrongful death occurring to him/herself arising as a result of engaging or receiving instructions in said activity or any activities incidental thereto wherever or however the same may occur and for whatever period said activities or instructions may continue, and the Undersigned does for him/herself, his/her heirs, executors, administrators and assigns hereby **release, waive, discharge and relinquish** any action or cause of action, aforesaid, which may hereafter arise for him/herself and for his/her estate, and agrees that under no circumstances will he/ she or his/her heirs, executors, administrators and assigns or wrongful death against the National University of Singapore or any of its officers, agents, or employees for any of said causes of action, whether the same shall arise by the negligence of any of said persons, or otherwise.

The Undersigned, for his/her executors or administrators, agrees that in the event of any claim for personal injury, property damage or wrongful death, shall indemnify and save harmless the reagents of the National University of Singapore, from any claim.

The Undersigned acknowledges that he/she has read the foregoing two paragraphs, has been fully and completely advised of the potential dangers incidental to engaging in the activity and is fully aware of the legal consequences of signing the within instrument.

_____

(Name / NRIC / Signature of Scientific Diver / Date)

_____ (if below 21 years of age)

(Name / NRIC / Signature of Parent or Guardian / Date)

Blood group: _____

Allergies: _____

Date of birth: _____

Next-of-kin address and contact no.: _____

_____

_____