Section 6 — Plan Dive Operations

"And so you just threw everything together?... Mathews, a posse is something you have to *organise*."[1]

[1] Copyright © The Far Side, Last Impressions, 2002, Larson. (Stolen and used without permission!)

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1 CHAPTER 1 – INTRODUCTION

DIVE PLANNING

ADAS COMPETENCY

Plan dive operations.

Apply legislation, regulations and guidance directly applicable to diving operations.

Identify scope of dive operation, based on client requirements and with reference to the requirements of relevant diving standards and guidelines.

Organise physical and human resources for the dive operation.

Describe the roles and responsibilities of each dive team member.

Prepare a written dive plan.

The Dive Supervisor is generally responsible for planning dive operations. The more thought and effort you put into the planning phase, the easier it will be to conduct the actual dive operation and the greater the likelihood of success.

You will need to:

- ✔ Apply legislation, regulations and guidance directly applicable to dive operations.
- ✔ Identify scope of dive operation, based on client requirements and relevant diving standards and guidelines.
- ✔ Organise physical and human resources for the dive operation.
- ✔ Allocate roles and responsibilities.

Generally, the diving operations manual of the company will have documented procedures for the planning and conduct of dive operations. Make sure that you follow these procedures and that you comply with the requirements of AS/NZS2299.1:1999, which gives guidance in Section 3, page 13.

In this section, we first look at the requirements of the diving standard AS/NZS2299.1:1999 for dive planning, as well as the general guidance and information provided by the diving standard. We will briefly expand on each of the headings of the typical dive plan. Next, there is a case study of an actual dive operation carried out by Descend Underwater Centre (Albury). This is followed by general guidance for planning complex dives.

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1 CHAPTER 2 – PLANNING ACCORDING TO AS/NZS2299.1

INTRODUCTION

For the onshore dive supervisor, your “bible” for diving operations is the joint Australia and New Zealand Standard, AS/NZS 2299.1:1999 Occupational Diving (along with this manual of course!!). This Standard is called up in Regulations throughout most of Australia and it is good practice to abide by the requirements in the Standard as a minimum.

COMPLYING WITH THE STANDARD

As you develop your plan, you will need to check the details of the AS/NZS 2299.1 Standard to ensure that you are complying with the requirements. The Standard was developed to standardise the conduct of occupational diving operations. The 1999 revision is updated from the previous 1992 version and reflects the requirements of the regulatory authorities.

Briefly, the sections covered in the Standard are as follows:

- ✔ Section 1 – Scope and General
- ✔ Section 2 – Personnel, Training and Records
- ✔ Section 3 – General Procedures and Equipment
- ✔ Section 4 – Compression (Recompression) Chambers
- ✔ Section 5 – Specific Requirements for SSBA Diving Operations
- ✔ Section 6 – Specific Requirements for SCUBA Diving Operations
- ✔ Section 7 – Accident Reporting
- ✔ Section 8 – Medical Requirements
- ✔ Appendices
  - A. List of regulatory authorities
  - B. Divers record of dive
  - C. Employers record of dive
  - D. Hazard identification, risk assessment and risk control

E. Contents of diving operations manual

F. Decompression tables for diving

G. Treatment for decompression illness

H. Typical compression chamber medical kit

I. Female NATO N1079 flange

J. Hand signals for SCUBA diving operations

K. Guidance for medical practitioners

L. Diving medical examination forms

M. Medical practitioners with training in diving medicine

DIVE PLAN REQUIREMENTS

AS/NZS 2299.1:1999 mandates that a written dive plan shall be prepared for each diving operation and a copy retained for seven years. As the standard is called up by OHS legislation in most of Australia, this makes this requirement law for construction diving and good practice at the very least for other occupational divers.

The overall intent of dive planning is both to develop a logical and practical method for undertaking the task to be performed and ensuring that a methodical hazard identification and risk assessment is undertaken, appropriate, and adequate risk controls are put in place. It entails undertaking an analysis of the problem - the task to be undertaken, the environment it will be undertaken in and the hazards expected to be encountered. The analysis and compilation of the plan is broken down into logical “bite-sized” chunks as detailed in AS/NZS 2299.1:1999 Section 3.1.3 and explained in the following sections.

The final written dive plan may be quite brief, but it should be supported by a solid foundation of task analysis and risk assessment. How you do this is a matter of personal preference. You may find the broad headings given by AS/NZS 2299.1 are useful for the final summary and appropriate for relatively simple tasks. We will go through each of these headings in the next section and provide an example dive plan. The example of a written dive plan is the outcome of all the steps detailed in AS/NZS 2299.1:1999 and described in the following sections.

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3 CHAPTER 3 – DIVE PLAN DEVELOPMENT

IDENTIFY SCOPE AND NATURE OF OPERATION

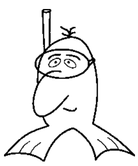
The success of any diving operation is directly related to careful and thorough planning.

You may not get all the information you need from the client. You will need to communicate will with the client to obtain as much detailed information as possible and may need to obtain necessary information from other sources. Detailed drawings or maps are useful, although in practice, you may only receive a simple sketch. Never assume that all the details are accurate and ask questions to confirm as many details as possible. If you are unsure of something, ask!

You will also need to research the dive site, obtaining local knowledge where possible. If there is any assumption that needs to be double-checked on the day, make sure that this is clearly stated in the dive plan.

The nature of each operation will determine the scope of the planning effort, but certain considerations will apply to every operation. An operation that is delayed for reasons that were not previously anticipated may well become an operation that is a failure. Changing weather conditions, for example, may prevent resumption of an interrupted or postponed operation. Careful contingency planning is the best insurance against unnecessary disruption.

AS/NZS 2299.1:1999 states that the dive plan should address the following aspects:



- ✔ The method of performing the task
- ✔ The duties of each person involved
- ✔ The diving equipment, breathing gases and procedures to be used, including intended bottom times and decompression profiles
- ✔ Specific hazards and the methods used to address them
- ✔ Emergency procedures

The planning process is supported by the diving operations manual, which is required to have documented procedures for responsibilities, duties and competency of persons involved in the diving operation, operation of plant used, decompression procedures and an emergency response plan. Everyone involved in a diving operation must be trained in and have access to the diving operations manual. An up-to-date copy must be provided at the dive site.

■ THE METHOD OF PERFORMING THE TASK

Divers should not be used if the objective can be more safely and efficiently accomplished by other means.

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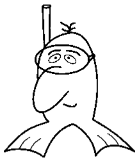
If the decision has been made to use divers, the dive plan should include a general description of how the job will be done. In an uncomplicated single dive task, this could be a simple reference to the contractor's Operations Manual and standard operating procedures (SOPs). In a more complicated multi dive, multi diver project, there will need to be a more detailed description of the overall scope of the project and the outcome(s) to be achieved.

■ THE DUTIES OF EACH PERSON INVOLVED



Roles and responsibilities must be clearly defined.

In the dive plan, this will normally only be an outline description of team member duties. There is usually a full description of the roles and responsibilities of dive team members in the diving operations manual for the organisation.

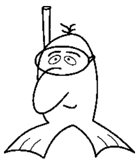
■ THE DIVING EQUIPMENT

The diving equipment, breathing gases and procedures to be used, including intended bottom times and decompression profiles must be considered.

Bottom time is always at a premium and any planning inputs that will conserve bottom time or increase the effectiveness of the diver should be given high priority.

Equipment and supplies must be appropriate and adequate.

This section covers the specifics of how the diving project/operation will be undertaken. It needs to include detail of such things as:



- ✔ The order of the divers (taking into account such things as the specific expertise of the divers and their additional roles, their decompression loading etc)
- ✔ The equipment to be used
- ✔ The dive profiles and relevant decompression information
- ✔ Method of decompression (surface decompression on oxygen, in-water, lazy shot, wet bell etc)
- ✔ Special equipment or diving procedures to be used
- ✔ Specific work issues to be addressed (equipment to be used, tools needed, special techniques to be developed, PPE needed)

This section should reflect the actual procedures to be used in undertaking the operation and will form the basis for the hazard identification, risk assessment and controls.

■ SPECIFIC HAZARDS AND THE METHODS USED TO ADDRESS THEM

Diving operations must not be conducted under extreme environmental conditions or whenever the safety of the divers or of the support facility will be jeopardised.

Divers must be given protection against hazards, extremes of temperature, and dangerous pollution at all times.

This section covers the area of hazard identification, risk assessment and applying appropriate risk controls. AS/NZS2299.1:1999 and OHS legislation mandates the undertaking of these procedures (AS/NZS 2299.1:1999 Section 3.1.1).

In undertaking dive planning, it is normal to conduct a preliminary risk assessment on the strength of what is known about the nature of the job to be undertaken and the environmental and dive site conditions. This will be updated on the first visit to the site prior to undertaking the first dive, and then updated prior to every dive depending on any changes to weather, current, water levels or visibility or other environmental conditions or objective risks.

It is important to ensure that the risk assessment procedure is comprehensive and encompasses all hazards involved in all aspects of the job to be done. It should include consideration of:

- ✔ The travel to and from the site
- ✔ The type of diving and diving work including the plant and equipment to be used
- ✔ The use of boats
- ✔ The job itself
- ✔ Overhead lifting
- ✔ Environmental and dive site conditions including water depth, access to the water, dive profiles, current, visibility, contamination, entanglement, loss of surface
- ✔ Working hours including travel time
- ✔ Pressure differentials including inlet and outlet valves, locks, irrigation valves, trash racks, sealing gates, water-cooling inlets etc.

The ADAS Risk Assessment Pro Forma provides guidance and an effective way to undertake this process, and in preparing this part of your dive plan, all you would need to do is to attach the Risk Assessment Pro Forma to the formal dive plan.

■ EMERGENCY PROCEDURES

The availability of emergency assistance, both from within the diving unit and from outside sources as necessary, must be ensured.

Emergency procedures must be included in the dive plan.

A diving organisation may have pre-prepared emergency procedures for dive sites at which they regularly conduct dive operations. In this case, it is still important to check that the details are current.

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4 CHAPTER 4 – CASE STUDY CORIN DAM

DIVE PLAN ACCORDING TO AS/NZS 2299.1:1999

DIVE PLAN SUMMARY

Site	Corin Dam – via Canberra		
Structure	Inlet tower		
Task	Bolt sealing plate to tower to rectify water leak		
Team	Ashley, Geoff, Andrew, Des, Scott		
Supervisor	Des Walters	**Water Temperature**	8°C
Dive Depth	24m +6 (30)	**Gas Mixture**	Air/40% EAN Deco
Duration proposed	40 mins	**Decompression**	9@6 16@3 (25) J
Chamber availability	On Site	**Altitude**	950m = + 6

Emergency Planning Sheet completed	DW	**Yes**		**No**
Risk Assessment completed	DW	**Yes**		**No**
Communication Established	DW	**Yes**		**No**

Special Equipment	Hot water suits – video – chamber on site – biodegradable oil in hydraulic pac
Specific consideration of Risk Assessment	Isolation – remote location – manual handling – decompression – compressor intake - boats

EXTRA STAFFING RESPONSIBILITIES

Log Keeping	Des Walters	**Operate panel/comms**	Des
Operate other plant	Scott - compressor	**First Aid/DMT**	Des/Ashley
Boat Handling	Ashley (coxswain)	**Chamber Operation**	Ashley

Chamber Attendant	Andrew	**Extra Standby**	Andrew
Extra Attendant	Geoff	**Crane or winches Boat winch**	Ashley
If not specifically nominated:	Supervisor – controls panel, comms, First aid & log keeping. Attendant – Looks after compressor and other plant.		

DIVE PLAN DEVELOPMENT

METHOD

The method of performing the task - Corin Dam Tower Wall

The job is to repair a leak in the Corin Dam tower wall. It will be undertaken in two phases:

Phase 1 - The dive team is to undertake an underwater assessment of the damage to the dam wall, take video record for water board engineers, ascertain dimension of the fault area, and agree work method with engineers. This is estimated to take 4 dives.

Phase 2 – The dam is a sensitive water catchment and storage and requires that the oil used in the hydraulic system be biodegradable. Appropriate oil must be identified and agreed with the Board engineer. The job involves the setting of anchor bolts using chemical anchors. The Board engineer will specify the type of chemical anchor, particulars of using the method of using them on site will need to be ascertained from the manufacturer and agreed with the engineers.

The main task is to undertake rectification of a leak in wall of the dam tower. This involves cleaning the surface of the concrete wall, ascertaining best placement for steel template, drilling bolt holes as per template, fixing bolts with chemical anchors, fitting template, attached rubber membrane, and tightening down nuts, checking for residual leaks using dye test. This is estimated to take 12 dives.

DUTIES

The duties of each person involved - Corin Dam Tower Wall

The operation will be undertaken using a seven-person team. The dives will be undertaken with a single diver or in pairs as required by the task and directed by the supervisor. Team member responsibilities will be as follows:

Divers - as per SOPs - undertake video survey/quality control recording, cleaning, fix template and membrane, undertake leak testing, clean up work site

Stand by Diver - emergency response as per SOPs on immediate notice for all dives

Attendants - as per SOPs

Supervisor - as per SOPs

EQUIPMENT

The diving equipment, breathing gases and procedures to be used, including intended bottom times and decompression profiles - Corin dam tower wall.

DIVING EQUIPMENT

The diving operation will be conducted on air using surface supply equipment and will be conducted as per SOPs. All working divers will wear hot water suits, and protective overalls and gloves when dispensing chemicals. Lead divers will wear Superlite 17 plus helmet cam and 240-volt surface supplied lighting. Standby diver will use band mask.

BREATHING GASES

Primary air supply will be LP compressor. Secondary supplies will be two independent 3000 litre HP banks.

1 x 1500-litre oxygen with 100% demand valve delivery system will be in the support boat. Additional 1500 l oxygen will be in the truck as reserve. 2 X 10000 litre oxygen will be connected to the chamber.

COMMUNICATIONS

All divers will have hard wire communications. Failure of diver communication will result in dive abort until failure is corrected.

Site communications. External comms will be via TMR (trunk mobile radio) supplied by the Board. Communications between the dive site and the Dive Control will by hand held two-way radio. Two hand held radios will be in the truck as reserves.

Land line telephone is available on request at the Ranger station.

PROCEDURES - GENERAL

The divers and support will operate from support boat moored at tower base.

For Phase 2, the senior supervisor with the video monitor station will be stationed at top of the tower with the compressor attendant/general hand, the Board engineer and client representative. The standby diver's attendant will be a qualified supervisor and will undertake pre and post dive checks. The senior supervisor will control the dive.

Communications between the dive control position (DCP) and the dive site will be by hand held radio, with direct (shouting) voice contact as a back up.

The comms panel will be at the DCP, with a remote speaker at the dive site.

DIVE/WORK PROCEDURES

For Phase 2, the senior Dive Supervisor will be Dennis Waters

Dive site supervisors will be Steve Martin and Pierre Bollinger

General diving procedures will be as SOPs.

The dive depth is 24 metres with an altitude increment of +6metres.

All work dives will be planned decompression dives and in-water decompression will be undertaken as per SOPS.

Work dive bottom times will be 40 minutes. The DCIEM 40mins/30 metre schedule will be used.

The RCC will be sited in the shed at the edge of the dam wall and will be prepped as per SOPs with the inner lock blown down to 45 metres.

Only one dive will be conducted by each diver per day.

THE ORDER OF DIVING

Phase 1

1st dive	Bollinger	SB	Sexton
2nd dive	Sexton	SB	Martin
3rd dive	Carruthers	SB	Michaels
4th dive	Michaels	SB	Bollinger

Phase 2

1st dive	Miller/Bollinger	SB	Martin
2nd dive	Martin/ Carruthers	SB	Sexton
3rd dive	Sexton/Halliburton	SB	Michaels
4th dive	Miller	SB	Bollinger
5th dive	Bollinger	SB	Martin

HAZARD IDENTIFICATION AND RISK ASSESSMENT

SPECIFIC HAZARDS AND THE METHODS USED TO ADDRESS THEM - CORIN DAM TOWER WALL

Hazard identification, risk assessment and proposed controls are as per the following ADAS Risk Assessment Pro Forma for Corin Dam.

Location	Corin Dam	**Date**	14/11/01
Structure	Inlet Tower		
Job Description	Video Inspection		
Risk Rating	6		

ENVIRONMENTAL FACTORS	PROBABILITY	SEVERITY	COMMENTS AND CONTROLS
Wind	—	—	
Current/tide	—	—	
Visibility	1	4	
Maximum depth	2	3	Check on site 24 m - corrected
Water temperature	1	4	10° C Dry suits required
Atmospheric temperature	1	1	Approx 20° C
Time of day	1	1	Daylight hours
Underwater terrain	1	2	
Contaminants/biological hazards	1	1	
Entrapment hazards	1	2	
Isolation – remote sites	2	2	40km 1 hour by road to Canberra
Floating hazards	1	1	
Dangerous marine hazards	1	1	
Noise	1	1	
Sea state	—	—	
Sun/ice	—	—	
Altitude	1	4	950m @ full Rh = + depth

TASK RELATED FACTORS	PROBABILITY	SEVERITY	COMMENTS AND CONTROLS
Cutting	—	—	
Welding	—	—	
Dredging	—	—	

TASK RELATED FACTORS	PROBABILITY	SEVERITY	COMMENTS AND CONTROLS
Explosives	—	—	
Inspection	1	1	
Overhead environments	2	1	
Cranes/winches/cables/rigging	—	—	
Airlifting	—	—	
Hydraulic/pneumatic tools	—	—	
Search patterns	—	—	
Reservoir cleaning	—	—	
Unstable structures	—	—	
Boat handling/unguarded propellers	3	1	Boats isolated while divers in
Shipping movement	2	1	restricted
Manual handling	2	2	2 men on compressors and umbilicals
Water pressure differentials/suction	4	1	ensure isolation
Entrapment	3	1	
Electric currents	4	1	use earth protection
HP Jetting	—	—	
Sonar	—	—	
Entry and exit methods	2	1	Boat entries
Sufficient trained personnel	2	2	4
Lifeline entanglement	1	1	
Dive profiles	1	1	single dives - not repetitive

HYPERBARIC/PHYSIOLOGICAL FACTORS	PROBABILITY	SEVERITY	COMMENTS AND CONTROLS
Barotrauma descent			
Barotrauma ascent			
Decompression illness			
Hypothermia			
Hyperthermia			
CO poisoning			
CO_2 poisoning			
Narcosis			
O_2 toxicity			

HYPERBARIC/PHYSIOLOGICAL FACTORS	PROBABILITY	SEVERITY	COMMENTS AND CONTROLS
Drowning			
Exhaustion			
Cross infection			

PRE AND POST DIVE FACTORS	PROBABILITY	SEVERITY	COMMENTS AND CONTROLS
Pre-dive fitness			
Dehydration			
Drugs/alcohol			
Exercise			
Sleep deprivation			

EMERGENCY PROCEDURES - CORIN DAM TOWER WALL

EMERGENCY INFORMATION/CONTACTS FOR CORIN DAM	
EMERGENCY PHONE NUMBERS	
EMERGENCY SERVICES by hardline phone	000
(Police, Fire, Ambulance) by Trunk Mobile Radio	999
Diver Emergency Service	1888 088 200
ALTITUDE AT SITE	940 metres
ALTITUDE EN ROUTE	1230 metres
NEAREST PHONE	TMR at dam in Water Board vehicle Hard line phone in Rangers cottage at top of hill NB – Mobile phones do not work at site
MOBILE PHONES (en route only)	Dennis Waters 0422 275 291 Steve Martin 0409 621 788 Pierre Bollinger 0438 791 432
DIRECTIONS TO SITE	Cotter Road to Tidal River – left at CORIN Dam turn off, continue for approx 40kms

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EMERGENCY INFORMATION/CONTACTS FOR CORIN DAM	
EMERGENCY PHONE NUMBERS	
NEAREST HOSPITAL	Wonnongatta Base Hospital Main Street Wonnongatta 02 678 224422
DIVING DOCTORS	Dr Des Knight 21 Coromandal St GANNAR 02 675 4321 Dr John Gorman 76 River St Christchurch 02 791 776 6543
AMBULANCE	000
HOME BASE	Waters Diving Services 76 Gray St Sydney 02 9766 43879
RADIO	No
AIR AMBULANCE	For diving emergency request air evacuation to Prince of Wales hospital via Wonnongatta CareFlite
EMERGENCY PROCEDURES	CAGE – recompress immediately, notify diving doctor, and follow instructions. Notify ambulance asap – request evacuation by helicopter air ambulance with TUP facility. Critical hyperbaric injury – DMT on site provide 100% oxygen and life support. Arrange asap transport of patient by helicopter air ambulance. Non-critical hyperbaric injury. Arrange road transport through ambulance or provide private transport.
RESERVOIR LEVELS	Height at full R.L. 955.56 metres On 1.4.02 – 940.25 metres
ACCOMMODATION	Country Comfort Inn, 46 Greenway Crescent, Rowland Rees, 2060 02 392 6636
CUSTOMER CONTACT	Andrew WIGHT 02 79 624 7981

5 CHAPTER 5 – COMPLEX DIVING OPERATIONS

INTRODUCTION

This section provides a comprehensive guide to effective planning for any size of operation. Operations that are more complex require a greater emphasis on collecting and analysing data and considering hazards and risk controls at every step of the planning process.

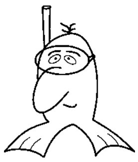
The material is organised for clarity into separate sections that form an appropriate sequence of steps in the planning process (see Figure 1). The final summary should preferably be in a format that includes each of the sections required by AS/NZS 2299.1:1999 as detailed in the previous section.

The section also presents a series of suggested worksheets and check lists that may serve as a basis for the preparation of detailed worksheets for use in specific operations. Recording full details of both the planning process and the actual dive is a continuing responsibility at all stages of an operation.

1. **Define Objectives**
2. **Collect and Analyse Data**
3. **Establish Operational Tasks**
4. **Select Diving Technique**
5. **Select Equipment and Supplies**
6. **Select and Assemble the Diving Team**
7. **Make Final Preparations and Check all Safety Precautions**

Figure 1: Steps in planning the diving operations

DEFINE OBJECTIVES



Establish a clear statement of the objective: why is the operation being undertaken, and what is to be accomplished. This statement can be brief and specific.

Example: "Locate, recover and deliver lost anchor to TSMV Hero at Wharf 8".

The statement of the objective can be of a more general nature.

Example: "Assemble all possible data on underwater conditions in the vicinity of Point X".

COLLECT AND ANALYSE DATA

A body of pertinent information should be assembled and studied as suitable to each particular operation. This will aid in:

✔ Selection of Technique, Equipment, and Divers

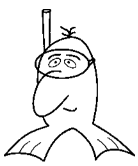
✔ Identification of Potential Hazards and the need for Emergency Diving Procedures

✔ Making allowances for contingencies

The extent and type of information that must be gathered will be influenced by such factors as the size of the operation, the location of the diving site, and the time of the year. Some operations will be of such a recurring nature that most of the required information will be already at hand.

An example of such an assignment might be the removal of a propeller from a particular class of ship, located in the shipyard where the diving team is regularly stationed. However, for even such a "standard" operation, there is always the possibility that the ship in question may have been modified and might require a change in procedure or the use of special tools. This possibility should not be overlooked during the planning effort.

Some operations will require the collection of a great deal of information in advance. For example, in planning for the salvage of a sunken or stranded vessel, the diving team will need to know about the construction of the ship, the type and location of the cargo, the type and location of fuel, the reason for the sinking or stranding and the nature and degree of damage sustained. The sources of such information may include ship's plan, cargo manifests, and loading plans, interviews with witnesses and survivors, photographs, and official reports of similar accidents.



If the operation is to involve the recovery of an object from the bottom, the team will need to know at least the dimensions and weight of the object. Additional useful information (as available), might include volume (or water or air holding capacity), established lifting points, construction material, length of time on the bottom, probable degree of embedment in mud or silt, and the type and degree to the object. Combined, this data will help define the type of lift to be used (boom, floating crane, lifting bags, pontoons), will indicate the need for high-pressure hoses to jet away mud or silt, and will determine the disposition of the object after it is brought to the surface. Proper planning may find the object too heavy to be placed on the deck of the support vessel, therefore specifying the need for a barge or heavy towing equipment.

For any operation that will involve a search for an object or underwater site, data gathered in advance will help to limit the area of the search and minimise the time required for the search. This is most important, since underwater searching by divers is inefficient and can add to hazards of an operation.

Whenever the object of a search has been found, the site should be marked with a buoy that has been rigged in advance, ready for immediate use.

Under OHS law, information must be collected as an aid in identifying hazards and communicated to the diver. For example, if a diver is to be working around a ship (whether for salvage or for a simple hull inspection) he or she must know the location of all sea-suction and discharge points, and of propellers, rudders, diving planes and sonar transducers. If working in or near a damaged ship, divers must be informed of the kinds and locations of it cargo and the possibility of toxic or explosive fumes in its compartments or tanks.

A diver should know in advance what sort of underwater conditions to expect, ranging from temperature to the type of marine growth common to the area. Information about conditions on the surface is equally important. Extreme weather conditions jeopardise the safety of the divers and the unit, and even moderate changes in the weather may cause changes in the work schedule.

Most of the data gathered in the planning phase of an operation will come from outside sources or surface observations, and will be gathered long before the actual diving phase begins. However, if time and conditions permit, preliminary dives by senior, experienced members of the team can be of great value in refining the database and in improving the dive plan.

■ PLANNING DATA SOURCES

Listed below are planning data sources:

- ✔ Coast & Geodetic Survey Charts
- ✔ Coast Pilot Publications
- ✔ Construction Drawings
- ✔ Electronic Analysis
- ✔ Flight or Float Plan
- ✔ Flight or Ship Records
- ✔ GPS Bearings
- ✔ Hydrographic Publications
- ✔ Light Lists
- ✔ Local Yachtsmen/Fishermen
- ✔ Log Books
- ✔ Nautical Almanac
- ✔ Notices to Mariners
- ✔ Photographs
- ✔ Radar Bearings
- ✔ RDF Bearings
- ✔ Sailing Directions
- ✔ Ships Equipment

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- ✔ Ships Logs & Records
- ✔ Ships Personnel
- ✔ SONAR Readings and/or Charts
- ✔ Tide Tables
- ✔ Visual Bearings
- ✔ Weather Reports
- ✔ Witnesses

For all diving operations, data should be collected and analysed in the following general categories:

- ✔ Surface Conditions
- ✔ Underwater Conditions
- ✔ Resources
- ✔ Assistance Safety and Emergencies

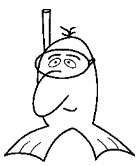
■ SURFACE CONDITIONS

Conditions on the surface in the operating area will affect both the divers and the members of the team working topside. These conditions, influenced by the location, the time of year and the weather, include wind, waves, tide, current, cloud cover, temperature, visibility, and the presence of other ships.

Normal conditions for the area of operations can be determined from published tide and current tables, sailing directions, notices to Mariners and special charts that show seasonal variations in temperature, wind and ocean currents.

Weather reports and long-range weather forecasts must be studied to determine if conditions will be acceptable for diving, and weather reports must be continually monitored while an operation is in progress.

Diving should be discontinued if sudden squalls, heavy seas, unusual tide, or any other condition that, in the opinion of the Supervisor, jeopardises the security of the mooring.



The most critical weather factor is the state of the sea. Wave action can affect everything from the stability of the mooring to the vulnerability of the crew and divers to seasickness or injury. Unless properly moored, a ship or boat will drift or swing around an anchor, greatly increasing the possibility of fouled lines and often dragging a diver along with it. Because of this, any vessel being used to support surface supplied or tended diving operations must be secured by at least a two-point moor. A four-point moor, while more difficult to set is preferable.

Divers are not particularly affected by the action of surface waves unless operating in surf, in shallow water, or if the waves are exceptionally large. Below a certain depth (which will vary with the surface conditions), a diver will not be aware of any wave action. However, surface waves may well become a problem when the diver enters or leaves the water, as well as during decompression stops near the surface.

Effective dive planning must provide for extremes of temperature that may be encountered on the surface. These will normally be more of a problem for tending personnel than for a diver. The particular problems that must be guarded against are:

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✔ Sunburn

✔ Windburn

✔ Frostbite

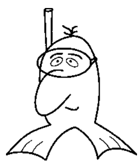
✔ Heat Exhaustion

In cold, windy weather, the "wind chill factor" must also be considered. Any movement of cold air over exposed areas of skin will have an effect equivalent to that of much colder air. For example, if the actual temperature is 20°c and the wind velocity is 60 kilometres per hour, the equivalent chill temperature is -15°c.

Since many diving operations are necessarily conducted in harbours, rivers and major shipping channels, the presence of other vessels is often a serious problem. At times, it may even be necessary to close off an area or limit the movement of other vessels. This should be taken into consideration during the planning effort and, if time permits, a local "Notice to Mariners" should be issued. At any time that diving operations are to be conducted in the vicinity of other vessels, they should be properly notified by message or signal. If the operation will be carried on in the middle of an active fishing ground, the presence of small boats operated by people with varying experience and competence must be anticipated. The diving team should assume that these operators are not acquainted with the meaning of any diving signals and take the necessary precautions to ensure that they remain clear of the area.

The degree of surface visibility is important. Reduced visibility may seriously hinder or force postponement of diving operations. For operations to be conducted in a known fog-belt, the diving schedule should allow for probable delays because of low visibility. The safety of the diver and support crew are the prime consideration in determining whether surface visibility is adequate or not. For example, a surfacing SCUBA diver might not be able to find his support craft, or the diver (and the craft itself) might be in danger of being run-down by surface traffic.

■ UNDERWATER CONDITIONS



Underwater conditions will have a major influence on the selection of divers, diving technique and the equipment to be used. Those conditions of particular concern are:

✔ Depth

✔ Type of Bottom

✔ Tides and currents

✔ Visibility

✔ Temperature

✔ Pollution

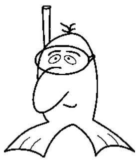
✔ Obstacles or Hazards

DEPTH

Depth is a major factor in the selection of both diving personnel and apparatus, and will influence the decompression profile for any dive. Operations in deep waters may also call for the use of special support equipment, such as underwater lights.

Depth must be carefully measured by two separate methods to ensure accuracy. In addition, the depth should not be measured at just one point but must be plotted for the general area of the operation. Soundings by a ship-mounted fathometer are reasonably accurate - but must be verified either by a lead-line sounding or with a pneumofathometer. Depth readings on a chart are only to be taken as an indication of probable depth.

TYPE OF BOTTOM



The type of bottom may have a decided effect upon a diver's ability to move and work both efficiently and safely. Advance knowledge of bottom conditions is important in the scheduling of work, in the selection of dive technique and equipment, and in anticipating possible hazards. The nature of the bottom is often noted on the chart for an area, but conditions can change within just a few feet. Independent verification of the type of bottom should be obtained by sample or observation. The table below outlines the basic types of bottoms and the characteristics of each.

TYPE	CHARACTERISTICS	VISIBILITY	DIVER MOBILITY ON BOTTOM
Rock	Smooth or jagged minimum sediment.	Generally unrestricted by diver movement.	Good, exercise care and prevent line snagging.
Coral	Solid, invariably sharp & jagged, found in tropical waters only.	As Above.	As Above.
Gravel	Relatively smooth, granular base.	As Above.	Good, occasional sloping bottoms of loose gravel impair walking & cause falls.
Shell	Composed principally of broken shells mixed with sand or mud.	Shell-sand mix does not impair visibility when moving over bottom. Shell - mud mix does impair visibility. With higher mud concentrations, visibility is increasingly impaired.	Shell-sand mix provides good stability. High mud content can cause sinking & impaired movement.
Sand	Common type of bottom, packs hard.	Generally unrestricted by diver movement.	Good.
Mud	Common type of bottom composed of varying amounts of silt & clay, commonly encountered in river & harbour areas.	Poor to zero, work into the current to carry silt away from job site, minimise bottom disturbance, increased hazard presented by unseen wreckage, piling's & other obstacles.	Poor, can readily cause diver entrapment, crawling may be required to prevent excessive penetration, fatiguing to diver.

Figure 2: Table of bottom conditions

CURRENT

Three basic types of currents affect diving operations:

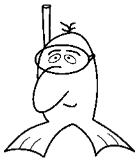
✔ River or major ocean currents.

✔ Current produced by the ebb and flow of the tides (which may add to or subtract from any existing current).

✔ Undertow, or rip current, caused by the rush of water returning from waves breaking along a shoreline.

The direction and velocity of normal river, ocean and tidal currents will vary with the time of the year, phase of the tide, configuration of the bottom, depth of the water and the weather. Tide and current tables show the conditions at the surface and should be used with caution in planning diving operations, since the direction and velocity of the current beneath the surface may be quite different. Usually there is much less current on the bottom than at the surface. Consequently, although the surface tidal current may be strong, bottom conditions may be well within permissible range for diving.

Rip-currents will vary with the weather, the state of the tide and the slope of the bottom. These currents may run as fast as 2 knots and may extend as far as a half-mile from shore. They are not usually identified in published tables, and their location and force can vary significantly from day to day.



A diver wearing lightweight SSBA, with a lifeline and heavy weights, can usually work in currents up to 1.5 knots without major difficulty. A scuba diver, who is essentially floating in the moving water, is severely handicapped by current of greater than one knot. If planning an operation in an area of high current, it may be necessary to schedule work during periods of slack water, to minimise the tidal effect.

VISIBILITY

Underwater visibility varies with depth and with turbidity. Horizontal visibility is usually quite good in tropical waters, where a diver may be able to see more than 30 meters at a depth of 50 meters. Vertical visibility is usually less than horizontal visibility. Visibility is usually poorest in harbour areas, because of large quantities of river silt, sewerage and industrial wastes usually flowing into the harbour. Agitation of the bottom caused by strong currents and the passage of large ships is also a factor.

The degree of underwater visibility will influence selection of dive technique, and may greatly influence the time required for a diver to complete a given task. For example, a diving team preparing for a harbour operation should plan for extremely limited visibility. A direct result could be an increase in bottom time, a longer period on station for the diving unit, and a requirement for additional divers on the team.

WATER TEMPERATURE

Water temperature can drastically affect a diver's performance. In cold water, his or her ability to concentrate and his or her working efficiency will drop off rapidly. Even in water at moderate temperature (15.5°c - 21.5°c) body heat loss to the water can soon bring on excessive fatigue. In water above 30.0°c the diver might suffer from overheating, causing exhaustion.

Usually, a diver may expect to work in waters that range in temperature from cool to very cold. Appropriate protective clothing is available to offset the effects of the cold and minimise heat loss. However, in some parts of the world the normal water temperature is quite warm. Occasionally, a diver may be called upon to work in the vicinity of a sewer or in industrial outfall discharging high temperature wastes. In such situations, the diver and the Dive Supervisor must be particularly alert for the possibility of exhaustion. To date, no practical diving apparatus or dress has been designed to protect the diver against unusually warm waters.

POLLUTION

Divers may encounter dangerous or unpleasant forms of pollution that can cause severe problems. A diver working near sewer outlets or industrial discharges may be exposed to the hazards of disease or chemical poisoning. Oil leaking from underwater wellheads or damaged fuel tanks can cause fouling of equipment and seriously impede a diver's movement. Toxic materials or volatile fuels leaking from barges or tanks can irritate the skin and corrode equipment. When using SCUBA, a diver may inadvertently take polluting materials into his mouth, posing both physiological and psychological problems. The diver is especially vulnerable to ear and skin infections.

In planning for operations in waters known to be polluted, full protective clothing and appropriate preventative medical procedures must be provided.

External ear prophylaxis should be provided to diving personnel to prevent ear infections. External otitis can be prevented by use of 2% acetic acid in aluminium acetate solution each morning, evening, and following each wet dive. The head is tilted to one side and the canal gently filled with solution. The solution must remain in the ear canal for 5 minutes. The head is then tilted to the other side to allow the solution to run out. The procedure is repeated in the other ear. The five-minute duration that the solution remains in each ear is critical to the success of the prophylaxis. The Dive Supervisor should observe and time ear prophylaxis when diving in water where external otitis is known to be a problem.

UNDERWATER OBSTACLES

Various underwater obstacles, such as wrecks offer serious hazards to diving. Wrecks and "formal" dumping grounds are often noted on charts, but the actual presence of such obstacles might not be discovered until an operation begins. This is one of several reasons for scheduling a brief preliminary inspection dive, before a final work-schedule or detailed dive plan has been prepared. The surface and sub-sea conditions that affect diving operations are numerous.

In addition to environmental hazards, and those that directly grow out of diving itself, a diver will from time to time be exposed to operational hazards that are not unique to the diving environment.

These include:

✔ **Electric Shock** - rare underwater but will sometimes happen when using electric welding or power equipment.

✔ **Sonar** - used by ships for object location and depth finding, is a high-intensity pulse of sound that can cause damage to the ears.

✔ **Marine Life** - may be dangerous to man, either from direct physical attack or because of poisonous venoms. Some of these are extremely dangerous, and some are merely an uncomfortable annoyance. However, the most important thing that a diver should know about marine life is that the dangers are largely overrated. In general, most underwater animals leave man alone. The diver's best protection against injury is knowledge. He or she should be able to identify the dangerous species that are likely to be found in the area of operation, and should know how to deal with each. Avoidance is the diver's best policy.

PREVENTION

✔ Be able to identify dangerous species - and know what it is about each that is dangerous.

✔ Keep alert when diving or swimming. Watch where you put your feet and hands. Be particularly cautious when reaching into crannies or wrecks.

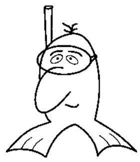
✔ Keep movements smooth and steady. Thrashing attracts certain species. If you sight a shark or any large fish, try to remain motionless and quiet. Noise is more likely to attract than scare away.

✔ Handle any underwater animal with caution, whether it is alive or apparently dead. Many species have hidden barbs.

✔ Big, "friendly" species can foul lines or cause other accidents - always be careful.

✔ Watch out for entangling plants - especially some varieties of kelp, which can trap a diver and are very hard to cut.

ENVIRONMENTAL CHECKLISTS



These environmental checklists are sample worksheets indicating data that might be gathered for a contract. Each planner should create a similar checklist to suit the particular operational situation.

SURFACE

ATMOSPHERIC	SEA SURFACE
Visibility	Sea State
Sunrise (set)	Wave Action
Moonrise (set)	Height
Temperature	Length
Humidity	Direction
Barometer	Current
Precipitation	Direction
Cloud Description	Velocity
% Cover	Type
Wind Direction	Surf Visibility
Force (knots)	Surf Water Temp
Other	Local Characteristics

SUB SEA

<table>
<tr><th colspan="2">UNDERWATER & BOTTOM</th><th>VISIBILITY</th></tr>
<tr><td colspan="2">Depth</td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td rowspan="4">Water Temp</td><td>Depth</td><td></td></tr>
<tr><td>Depth</td><td></td></tr>
<tr><td>Depth</td><td></td></tr>
<tr><td>Bottom</td><td></td></tr>
<tr><td>Thermoclines</td><td></td><td rowspan="3">Bottom Type</td></tr>
<tr><td>Current</td><td></td></tr>
<tr><td>Direction</td><td></td></tr>
<tr><td>Source</td><td></td><td rowspan="3">Obstructions</td></tr>
<tr><td>Velocity</td><td></td></tr>
<tr><td>Pattern</td><td></td></tr>
</table>

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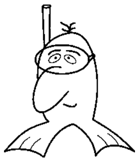
UNDERWATER & BOTTOM		VISIBILITY
Tides		**Marine Life**
High Water	time	
Low Water	time	
Ebb dir	vel	Other Data
Flood dir	vel	

RESOURCES



The manner in which an operation is planned and conducted will often depend upon variables not under the control of the diving team. In some operations, a time factor will take precedence over other considerations, while in other operations the availability (or non-availability) of equipment or personnel may be a vital factor. For any operation, the planning effort must identify resources known to be available, which include time, personnel, equipment, support or auxiliary equipment and supplies in order to:

✔ Ensure the safety of all personnel.

✔ Identify any shortages or inadequacies that should be remedied.

✔ Permit accomplishment of the operational objectives in a timely and effective manner.

ASSISTANCE AND EMERGENCIES

In the course of any diving operation, from the most routine to the most complex, two types of assistance may be required:

✔ Emergency assistance in the event of an accident or serious illness

✔ Additional equipment, personnel, supplies or services

Unexpected developments or emergencies usually are accompanied by a degree of confusion. The source and availability of any needed assistance, and the method for obtaining it as quickly as possible, must be determined in advance and be clearly understood by all members of the diving team as well as by other supporting personnel.

The nearest facility having a Recompression Chamber must be identified, and notified, before the commencement of operations. The sources of emergency transportation, military or civilian, must be established and alerted, and the nearest diving medical officer should be located and notified. Additionally, arrangements must be made to ensure a 24 - hour availability for such emergency assistance.

EMERGENCY ASSISTANCE CHECKLIST

RECOMPRESSION CHAMBER	SUPPLIES
Location	Location
Contact	Contact
Response Time	Response Time

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AIR TRANSPORTATION	COMMUNICATIONS
Location	Location
Contact	Contact
Response Time	Response Time
SEA TRANSPORTATION	**HOSPITAL**
Location	Location
Contact	Contact
Response Time	Response Time
DIVING MEDICAL OFFICER	**AMBULANCE**
Location	Location
Contact	Contact
Response Time	Response Time

ESTABLISH OPERATIONAL TASKS

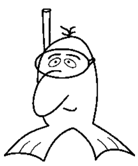
INTRODUCTION

With the objectives of the operation defined, the data gathered and studied to properly establish conditions under which diving will take place, a basic outline for the operation itself can be prepared. Each task should be identified, and placed in the context of an overall schedule, or job profile, so that the inter-relationships of all tasks will be apparent. This should be done for even the most routine operations.

Specific hazards associated with the task or procedure used need to be identified and the risks assessed. If the risk is too high, the task or method needs to be altered to reduce the risk, or other risk control measures put in place.

TASK SCHEDULE

In developing a detailed task-by-task schedule for an operation, the following points should be kept in mind:

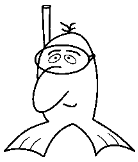


✔ All phases of an operation are important. A common failure in planning is to put all of the emphasis on the actual dive phases, while not fully considering pre-dive and post-dive activities. Another common failure is to treat many operations - especially those of a recurring nature - with an indifference to safety that comes from over-familiarity.

✔ The schedule should allocate sufficient time for preparation, transit to the site, rendezvous with other vessels, and establishment of a secure mooring.

✔ Bottom time is always at a premium, and all factors, which will in any manner affect bottom time, must be carefully considered. These would include depth, decompression requirements, number of divers available, size of the support craft, and environmental conditions both on the surface and underwater.

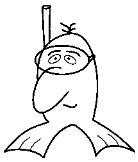
- ✔ The number and scope of repetitive dives that can be made by a diver in a given period are limited as discussed in the D.C.I.E.M. Tables or other appropriate tables.
- ✔ It has been observed that the incidence of decompression sickness is reduced with increased diving frequency. If divers have been inactive and operating conditions permit, "work up" divers by initiating diving activity in the shallower part of the operating area and gradually progress to deeper depths.
- ✔ Plan to work while weather permits, provided sufficient divers are available.
- ✔ The use of different diving techniques will require different levels of personnel support.



- ✔ The number of divers in the water at any one time should be kept to a minimum. The more divers underwater, working and/or decompressing, the greater the chance of an accident, and the heavier the burden on the support facility and crew.
- ✔ In determining tasks, topside support personnel should not be overlooked - especially those who might not be considered "members" of the diving team. These might include boat operators, winch operators, or an anchor watch - each of whom may have a role to play in the operation, and each of whom must be properly selected and briefed.
- ✔ Any schedule must be flexible, to accommodate unexpected complications, delays, and changing conditions.

■ CONCLUDING THE DIVE OPERATION

A diving operation is not completed simply when the task objective has been met, and good planning must carry the diving team through de-mounting the operation and the proper filing of all records and reports. Time should be allocated for:



- ✔ Recovery, cleaning, inspection, repair and stowage of all equipment
- ✔ Disposition of any materials brought up during the operation
- ✔ De-briefing of divers and other team members
- ✔ Analysis of the success of the operation, as planned and as actually carried out
- ✔ Preparation and submission of all required reports
- ✔ Re-stocking expended materials
- ✔ Ensuring the readiness of the team and equipment to respond to the next contract

SELECT DIVING TECHNIQUE

■ INTRODUCTION

There are two basic types of diving equipment in current use for air diving operations, and for certain operations, one or another of these two might be more suitable. In other operations, there may be no clear-cut choice, and the selection of diving technique may depend upon availability of equipment or trained personnel. These techniques are:

- ✔ Open-circuit scuba
- ✔ Surface-Supplied Breathing Apparatus

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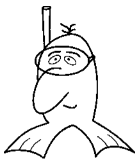
The following comparison of SCUBA and Surface-Supplied techniques highlights the significant differences between the methods, as well as indicates the influence these differences will have on planning.

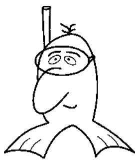
■ SCUBA

A close look at the advantages and disadvantages of SCUBA will best emphasise the basic factors by which it may be compared with Surface Supply equipment. The main advantages of SCUBA are:



- ✔ Mobility
- ✔ Depth
- ✔ Flexibility and control
- ✔ Portability
- ✔ Reduced requirement for surface support

The main disadvantages are:



- ✔ Limited depth (limited to 30 m)
- ✔ Limited duration
- ✔ No proper reserves of air
- ✔ Increased breathing resistance
- ✔ Lack of voice communications (although recent developments are dealing with this problem)
- ✔ Limited environmental protection
- ✔ Remoteness from surface assistance
- ✔ Negative psychological and physiological problems which may arise from isolation and direct exposure to the underwater environment
- ✔ No power tool usage

The scuba diver is not hindered by bulky or heavy equipment and can cover a considerable distance. However, the diver must be able to ascend directly to the surface in case of emergency.

Scuba equipment is designed to have nearly neutral buoyancy when in use, permitting the diver to change or maintain depth with ease. This gives the scuba diver a particular advantage enabling work at any level in the water column.

The portability and ease with which scuba can be employed is a distinct advantage. Scuba equipment can be transported by almost any means and can be put into operation with minimum delay. Within its operational limitations, scuba offers a flexible and economical method for accomplishing a wide range of tasks, with the exception of that requiring power tool usage.

The operational limitations must, however, be considered. The scuba diver must remain within the limits of the No-Decompression Table, except in an emergency. The bottom time is also limited by the fixed air supply of the scuba. The deeper a scuba diver operates, or the harder the work, the greater the air consumption will be.

Dead space in the scuba and resistance caused by the regulator and the exhaust valve make breathing an effort. The diver must expend energy just to breathe, thereby limiting the amount of work that can be accomplished.

The scuba diver, more directly exposed to the environment than a diver in surface-supplied gear, is not as well protected from cold or from contact with marine plants and animals. The diver is easily swept along by current. Even when accompanied by a buddy, the scuba diver usually swims in virtual isolation. The knowledge of being entirely dependent upon the scuba apparatus and its limited air supply, places an increased mental burden upon the diver.

No decompression should be carried out whilst wearing scuba, although this is not always possible in an emergency.

SURFACE SUPPLY

Surface-supplied lightweight gear allows the diver almost as much mobility, within limits, as with scuba. It provides unrestricted breathing, and it offers thermal and environmental protection superior to any equipment worn by the scuba diver. An example of this is Aga used on surface supply.

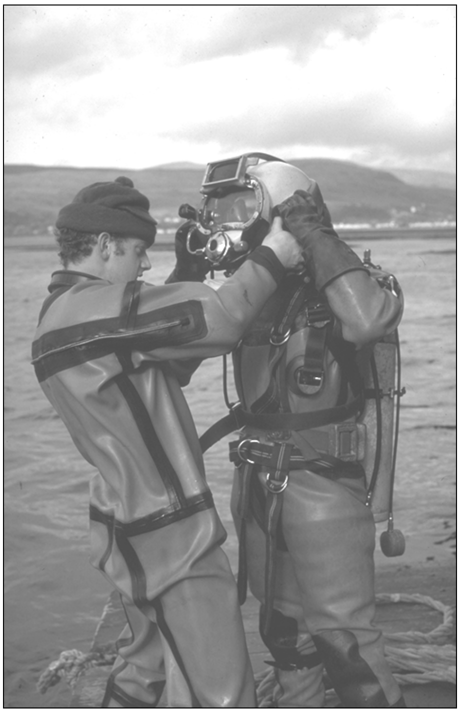
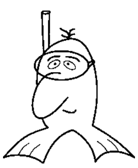


Figure 3: A commercial diver being dressed in surface supplied breathing apparatus. The diver is wearing a Kirby Morgan Mk17 Superlite Helmet. Note the welding mask attached to the helmet.

The SSBA equipped diver can move freely in the water column. This characteristic, coupled with the unlimited air supply, makes the use of SSBA lightweight gear a logical choice for shallow water repairs, inspections, searching and clearing lines.

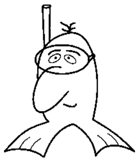


The advantages of using SSBA diving equipment are:

- ✔ Unlimited air supply
- ✔ Decompression diving (with chamber on site)
- ✔ Communications
- ✔ Greater control over the dive by the supervisor

- ✔ Better rescue capability
- ✔ Better work control by the diver when working in conjunction with surface equipment (e.g. cranes)

The main disadvantages SSBA has over SCUBA are:



- ✔ Less mobility for diver
- ✔ More ancillary plant and equipment required onsite
- ✔ Greater set-up time
- ✔ Less portability

Decompression diving should only be carried out where the diver has been properly trained and a recompression chamber is located on site. For any technique and for any duration a diver may not dive beyond the limits for which that diver has been trained and qualified.

SELECT EQUIPMENT AND SUPPLIES

An important item of supply is the gas used by the divers for breathing. All such gas supplies, whether provided to the diver in cylinders or from a compressor, must meet five basic criteria:

- ✔ The air must conform to established standards of purity
- ✔ An adequate volume must be available
- ✔ A back-up supply must be available for surface-supplied diving
- ✔ Adequate output pressure must be maintained at the dive station
- ✔ All gas supplies must be controlled via a Diver Control Panel

The standards for purity of the air supplied for breathing have been established by AS/NZS2299.1. Compressors, which are used for charging scuba bottles, for filling air banks or for supplying air directly to divers, must also meet certain specifications and must be specifically designated for use in diving operations. Such compressors are equipped with filters for removing contaminants from the air. When in use, they should be carefully positioned to prevent contamination of the air from compressor engine exhaust, other environmental atmospheric contaminants or from other engine exhaust.

Surface-supplied diving requires a heavy-duty, high volume, low-pressure compressor system. A back-up system might be a portable compressor and/or a bank of high-pressure air cylinders fitted with an appropriate reducing valve. Basic requirements for air compressors and cylinders used in air-supply systems are discussed in the ADAS Part II course.

A particular item of equipment, vital for many diving operations, is a diving support craft. Any craft used for diving operations, regardless of the technique being supported, must have seven basic characteristics.

- ✔ It must be seaworthy, both in design, condition and in current relevant survey
- ✔ It must be equipped with the required lifesaving and other safety equipment
- ✔ It must be in good repair, with a reliable engine (unless the craft is a moored float or barge)
- ✔ It must have ample room for the divers to dress and rest

- ✔ It must provide adequate shelter and working area for the support crew
- ✔ It must be able to safely carry all equipment required for the operation
- ✔ It must be properly manned by a well-trained crew

Scuba operations are normally best conducted from a small boat. This can range from an inflatable rubber raft with an outboard engine, to a motor boat, to a small landing craft. In planning for scuba diving, the availability of an appropriate small boat will be a factor to be considered for the safety of the divers. Even if the divers will be operating from a large ship or diving float, a small boat must be standing by, ready to respond as a rescue boat in the event a surfacing diver is in trouble at some distance from the support site. In this same regard, a boat used by scuba divers must be able to quickly slip any moorings and move to a diver needing assistance.

A craft intended to support surface-supplied diving operations must be fairly substantial, and will usually be specifically modified for the purpose.

At times, other support equipment may be needed in a given operation. This could include barges, tugs, floating cranes, vessels or aircraft for area search and so forth. The need for such additional equipment should be anticipated as far in advance as possible.

SELECT AND ASSEMBLE THE DIVING TEAM

INTRODUCTION

When planning diving operations, and matching the qualifications and experience of diving personnel to specific requirements of the operation, a thorough knowledge of the duties, responsibilities and relationships of the various members of the diving team is essential.

The ultimate responsibility for the safe and effective conduct of all diving operations rests with the Dive Supervisor. The Dive Supervisor's responsibilities and authority as defined is confirmed by AS/NZS 2299.1. In order that diving operations may be efficiently conducted, the Dive Supervisor delegates appropriate authority to selected members of his team, who make up the diving team. These are, the Dive Supervisor, divers qualified in various techniques and equipment, support personnel such as tenders (who should be qualified divers if possible), timekeepers, and medical personnel as indicated by the type of operation. Other members of the support crew, properly instructed, will provide support in varying degrees, in such roles as boat crew, winch operators and line handlers.

THE DIVE SUPERVISOR

You, as dive supervisor, are the person in charge of the actual diving operation. No diving operations may be conducted without the presence of the Dive Supervisor on site. The diving organisation must appoint a Dive Supervisor in writing and that person must be a qualified diver of demonstrated abilities and experience (according to AS/NZS 2299.1, which has force of law in most of Australia). The role of the dive supervisor is covered in detail in chapter 1.

DIVER

The diver has a general duty of care for his or her own safety as well as for other members of the diving team. The diver may, under certain rare circumstances, where self-employed, also be the Diving contractor in which case there would be additional responsibilities.

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ADAS REF: This Section corresponds to Module 6.6, Plan dive operations.

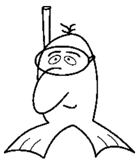
Before taking part in any diving operation, a diver should:

- ✔ Have a valid certificate of training or competence.
- ✔ Have a valid AS/NZS 2299.1:1999 diving medical certificate.
- ✔ Be competent to carry out safely the work required.
- ✔ Inform the Dive Supervisor of health concerns or if unfit, or if there is any other reason why he or she should not dive or remain under water or pressure.
- ✔ Maintain diver's logbook containing the required specific information. The diver should sign every entry and ensure that it is countersigned by the Diving Supervisor. At medical examinations, the logbook should be presented to the doctor. The diver must retain the book for at least two years form the date of the last entry, but is advised to keep these records for five years to prove experience to employers.
- ✔ Carry out work in accordance with the instructions of the Diving Supervisor.
- ✔ Find out the requirements of company policy and instructions, the requirements of Government Regulations relating to the qualifications for engaging in diving operations, to the use, fitness for use, and limitations on the use of diving equipment (including safety equipment), and to procedures for operations.
- ✔ Prepare personal equipment before each dive, ensuring that it has been maintained and tested correctly and report any defect in diving equipment to the Dive Supervisor.
- ✔ Be at least 18 years of age.
- ✔ Not dive in any circumstance where he or she has consumed alcohol or intoxicants in the 8 hours preceding the dive.

■ STANDBY DIVER

A Standby Diver is a qualified diver whose role is to assist the diver or divers in the water in an emergency. He or she has responsibilities identical to those of the diver actually carrying out the work.

The standby diver is also responsible for the following:



- ✔ Being available at all times to enter the water and lend immediate assistance to the diver. The standby diver must not be assigned to any other task, which would interfere with those duties while the diver is in the water.
- ✔ Being positioned adjacent to the diving control position and in communication with the Dive Supervisor and diver.
- ✔ Ensuring that he or she is fully kitted, with the exception of the weight belt and helmet, which should be immediately available.
- ✔ When a trainee diver is undertaking AS 2815 training, a fully qualified and experienced standby diver must be at each dive site. The standby diver's degree of readiness and responsibilities will be determined by the outcomes of the dive risk assessment and will be communicated by the Supervisor.

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DIVER'S ATTENDANT

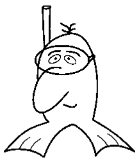
INTRODUCTION

The divers attendant or tender is to give full time and attention to attending to the diver from the time the diver commences preparation for the dive until the diver has exited from the water or the chamber, and has stated that he or she is fit and well. The attendant is not to be employed on any other task while the diver is in the water or under pressure. The attendant shall be 18 years of age or over.

The attendant is the link between the Dive Supervisor and the diver.

ATTENDANT'S DUTIES

In this regard, duties are:



- ✔ To assist the diver to prepare personal equipment
- ✔ To assist the diver to dress
- ✔ To check:
  - ☞ the cylinder pressure
  - ☞ the line pressure
  - ☞ that the diver has correctly secured the lifeline/buddy line/umbilical to him/herself
- ✔ To secure the inboard end of the lifeline to a suitable fixed point
- ✔ To report to the dive supervisor, when directed, the attendants report for the equipment in use
- ✔ To fully understand the task that the diver has been directed to perform
- ✔ To assist the diver into the water
- ✔ To report to the dive supervisor the results of the tests for leaks
- ✔ To report to the dive supervisor:
  - ☞ that the diver has left the surface
  - ☞ the progress of the diver during descent
  - ☞ that the diver has arrived on the bottom
  - ☞ that the diver has left the bottom
  - ☞ the progress of the diver during ascent
  - ☞ that the diver has surfaced
- ✔ To keep the lifeline or air hose firmly, but not restrictively in hand and clear of obstructions
- ✔ To make and answer all necessary signals throughout the dive including frequent checks on the diver reporting each to the dive supervisor
- ✔ To ensure that the dive supervisor is fully aware which diver it is that the attendant is reporting on
- ✔ To assist the diver to return to the surface when this is required
- ✔ To ensure that the diver remains at the correct depth during decompression stops

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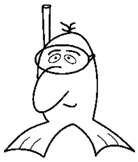
- ✔ To assist the diver out of the water
- ✔ To check whether or not the diver is well as soon as the diver can speak
- ✔ To help the diver out of his or her equipment
- ✔ To assist the diver to remove his or her diving clothing as required

The diver's attendant must have a working knowledge of:



- ✔ Standard lifeline signals
- ✔ The requirements of underwater work
- ✔ Decompression procedures
- ✔ All diving plant and equipment in use
- ✔ First aid including CPR and the use of the oxygen resuscitation equipment

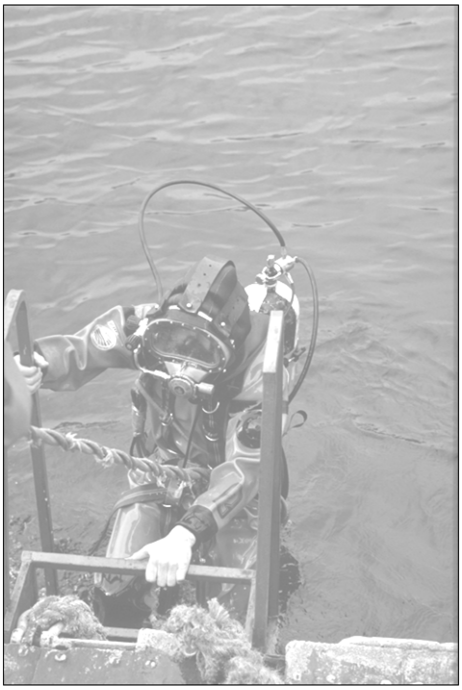


Figure 4: A diver entering the water via a ladder. Note how the tender is holding the umbilical and is supporting the divers weight

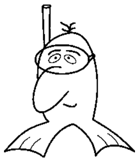
CHANGE OF ATTENDANTS DURING A DIVE

Any changes of attendants during an actual dive must be done only with the prior approval of the Dive Supervisor.

■ RECOMPRESSION CHAMBER OPERATOR

The recompression chamber operator must be a fully trained, qualified and competent person, preferably a diver, with adequate knowledge and experience in the operation of a recompression chamber. He or she must hold a current First Aid certificate and a Dan oxygen administrator qualification or equivalent.

Duties are:



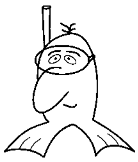
- ✔ Ensure chamber cleanliness
- ✔ Complete the pre-dive and post-dive chamber check lists
- ✔ Operate the recompression chamber in accordance with the compression and decompression standard and decompression tables
- ✔ Complete all time keeping, logging all compression, decompression and details accurately and in full
- ✔ Ensure no dangerous materials are taken into the recompression chamber
- ✔ Ensure correct clothing is worn in the recompression chamber
- ✔ Ensure the air quality in the chamber by monitoring the analysis and flushing the chamber in accordance with operational procedures

The chamber operator must give full attention to the task and must not be delegated any other task while a chamber run is progress. The chamber operator must be located at the chamber console and attend the communication system during entire duration of the chamber run, from the start of compression until the end of decompression.

(See Supervise on site chamber operations in section 11).

■ RECOMPRESSION CHAMBER ATTENDANT

The chamber attendant must be a qualified diver whose role is to assist a patent inside the chamber during recompression and decompression. Responsibilities include:



- ✔ Have a valid medical certificate
- ✔ Have a valid First aid qualification which includes resuscitation
- ✔ Have a valid oxygen administrator’s certificate
- ✔ Operation of all internal valves including, the medical lock, under the direction of the chamber operator
- ✔ Patient observation and airway management and to communicate these observations to the recompression chamber operator
- ✔ Ensure the seals on the Oxygen BIBS
- ✔ To protect the patient in the event of an Oxygen convulsion
- ✔ To assist the patient with reassurance and instruction of equalising ears
- ✔ To communicate with the chamber operator
- ✔ Resuscitate the patient if necessary
- ✔ To check the medical equipment and supplies in the chamber first aid kit prior to compression

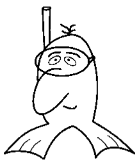
Ideally, the chamber attendant would also hold a qualification as Diver Medical Technician (DMT). If not, a DMT must be on call at the chamber to assist if required.

(See Supervise on site chamber operations section 11).

MULTI-SKILLING AND SUBSTITUTION

GENERAL

As far as possible, each member of the diving team should be qualified to act in any position on the team. Operational plans should provide for an opportunity to gain such across-the-board qualifications, wherever possible. If, at any time during an operation, personnel changes must be made - whether temporary or permanent - the individual assuming the duty must first be certified by the Dive Supervisor as acceptable for that duty.



That person must be thoroughly briefed on the operation, the status of operations, upcoming evolutions, and any anticipated problems. Since it is probable that substitutions will made at some point during a lengthy operation, the general and diving schedules should organise personnel and work objectives so that highly experienced personnel will always be available on site. Additionally, all personnel who will participate in the operation should be included in initial briefings.

PERSONNEL LEVELS

The size of the diving team may vary from one operation to the next, depending upon the type of equipment being used, the numbers of divers needed to complete the operation and the depth. Other factors, such as weather, planned length of the operation, the nature of the objective, and the availability of various resources will have an influence on the size of the team.

Recommended personnel levels for a variety of diving teams are found in AS/NZS 2299.1. These are minimum levels, and should be adjusted appropriately to meet anticipated operational conditions and situations.

PHYSICAL CONDITION OF DIVING PERSONNEL

Before a person can even begin training as a diver, that person must meet the specific physical requirements for divers set forth by AS/NZS 2299.1. Once qualified, it is that person’s own responsibility to keep in good health and in top physical condition.

The Dive Supervisor must verify the fitness of each diver immediately before a dive. Signs of any irregularity, such as a cough, nasal congestion, apparent fatigue, emotional stress, skin or ear infection, intoxication or any indication of the use of narcotics or other dangerous drugs, should put a diver on the sick list until the problem is corrected.

The diver is often the best judge of his or her own physical condition. If that person does not feel fit to dive, they are obligated to report the fact to the Dive Supervisor, a diver who, for any reason, sincerely does not want to make a dive should not be forced or penalised.

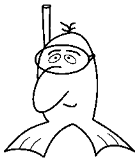
BRIEF THE DIVE TEAM

Plan for your briefing to make sure that it is effective and includes all the information you and the team need.

The operations plan, no matter how well organised, will not result in a successful operation unless each member of the diving team fully understands the plan, their role in the plan, and the roles of other members of the diving team and of various supporting personnel.

A briefing, just like a diving plan, can be elaborate or it may be very simple. For large operations, involving a number of teams, a formal briefing with charts, slides and diagrams might be required. However, for most operations, the briefing need not be complex and may take the form of an informal meeting.

The person conducting the briefing will normally be the Dive Supervisor - this is the person who will be in charge of all diving operations at the scene. During the briefing, the Dive Supervisor should cover all of the major points of the operation, including (but not limited to) the following:



- ✔ The objective and scope of the operation
- ✔ Conditions in the operating area
- ✔ Diving techniques and equipment to be used
- ✔ Personnel assignments
- ✔ Particular assignments for each diver
- ✔ Anticipated hazards
- ✔ Reiteration of normal safety precautions
- ✔ Discussion of any special considerations
- ✔ Group discussion period, questions from the diving team. In this period, the briefer should also direct questions at the team members, to verify that his briefing has been understood

■ DEBRIEFING THE DIVE TEAM

Make sure that you allow time in the dive plan to debrief the dive team.

Prompt debriefing of divers returning to the surface will provide the Dive Supervisor with information, which may influence or alter the next phase of the operation. Divers should be questioned about the progress of the work, bottom conditions, and anticipated problems. They should also be asked for any suggestions they might have for immediate changes.

After the day's diving has been completed, all members of the diving team should be brought together for a short debriefing of the day's activities. This offers all personnel a chance to provide “feedback” to the Dive Supervisor as well as to other members of the team. This group interaction can be of great help in clarifying any confusion, which may have arisen because of faulty communications, distractions, or misunderstandings from the initial briefing.

MAKE FINAL PREPARATIONS AND CHECK ALL SAFETY PRECAUTIONS

Prior to the commencement of actual diving operations, the Dive Supervisor must review all progress and be satisfied that all appropriate preparations have been made. In summary, these are:

- ✔ A comprehensive diving plan has been prepared, and all data pertinent to the operation has been collected and analysed for its impact on the operation and safety precautions.

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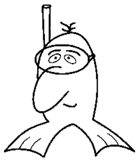

- ✔ A task schedule has been prepared, with diving assignments clearly delineated and the sequence of events determined.
- ✔ Requirements for both scheduled and emergency logistic support have been determined, and appropriate arrangements made.
- ✔ Required equipment has been obtained, checked for proper operation, and is on station ready for use.
- ✔ Emergency equipment (life jackets, fire extinguishers, resuscitator, first aid kit, etc.) has been checked for condition and is ready for use.
- ✔ All personnel, including any members of back-up teams, have been notified of their assignments, and a comprehensive briefing has been held.
- ✔ The general safety checklist has been reviewed.
- ✔ The On-Site Emergency Checklist has been prepared and posted.
- ✔ The qualifications and physical condition of all divers have been reviewed and certified.
- ✔ Personnel are on station and ready to work.
- ✔ The support vessel is properly moored and an anchor watch set.
- ✔ Weather conditions are satisfactory for diving operations.
- ✔ Higher authority (as appropriate) has been notified of the operation; other ships in the vicinity and the Harbour Master (if appropriate) have been notified.
- ✔ Proper visual signals are displayed.
- ✔ The officer of the deck has been notified; who, in turn, has notified the Master, and has been given permission to commence diving operations.

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6 CHAPTER 6 – SUMMARY

DIVE PLANNING SUMMARY

The Dive Supervisor is responsible for planning the dive operation.

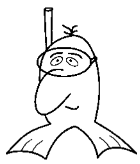
✔ Planning involves applying legislation, regulations and guidance directly applicable to dive operations, identifying the scope, organising physical and human resources for the dive operation and allocating roles and responsibilities.

✔ A written dive plan must be prepared for each diving operation and retained for seven years.

✔ The diving operations manual provides support material for dive planning, but must be checked for currency for every dive operation.

✔ The dive plan needs to address the method of performing the task, the duties of each person involved, the diving equipment, breathing gases and procedures to be used, including intended bottom times and decompression profiles, specific hazards and methods used to address them, and emergency procedures.

✔ Complex diving operations have a greater need for collecting and analysing data and considering hazards and risk controls at each planning step.



✔ Appropriate planning steps are to define objectives, collect and analyse data, establish operational tasks, select diving technique, select equipment and supplies, select and assemble the diving team, make final preparations and check all safety precautions.

✔ A standby diver's role is to provide assistance to the diver or divers in the water in an emergency and he or she must not be assigned to any other task that would interfere with these duties.

✔ A diver's attendant attends the diver and is the communication link between the Dive Supervisor and the diver.

✔ A recompression chamber operator must be trained and qualified in the operation of a recompression chamber, hold a first aid certificate and an oxygen administrator's certificate.

✔ A recompression chamber attendant must be a qualified diver with a first aid qualification and an oxygen administrator's certificate. Ideally, he or she would also be qualified as a Diver Medical Technician (DMT) – if not; a DMT must be on call to assist.

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