Section 7 — Conduct Dive Operations

Larson.[1]

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1 CHAPTER 1 – INTRODUCTION

INTRODUCTION

ADAS COMPETENCY

Conduct dive operations.

Supervise and coordinate dive operation activities according to dive plan.

Conduct briefings / debriefings.

Identify and analyse problems and emergencies.

Respond to problems and emergencies, according to organisational policies and procedures.

Conclude dive operation, according to organisational policies and procedures.

Diving is an inherently risky activity with very little margin for error. Diving safety relies heavily on following appropriate procedures.

If the dive plan has been well thought out and documented, conducting the dive operation should be relatively straightforward. The main responsibilities are to:

- ✔ Supervise and coordinate dive operation activities in accordance with the dive plan.
- ✔ Identify, analyse and respond to problems and emergencies.
- ✔ Conclude the dive operation.

GENERAL PROCEDURES FOR CONDUCTING THE DIVE OPERATION

AS/NZS 2299.1 sets down the minimum requirements for occupational diving operations. Note that these are minimum requirements. In many cases, the dive operation requires more comprehensive procedures based on the risk involved, or the policy of the diving organisation or the client to follow best practice.

It is important to make sure that you are following the appropriate procedures. If the company procedures do not meet the minimum requirements of the legislation, then you must follow the procedures outlined in the legislation (AS/NZS 2299.1 is called up in legislation in most Australian States, so has the full force of law). In this case, the procedures that do not comply should be reported to management for correction.

Procedures need to be clear and simple. Most diving operations manuals use a combination of a dot point style and a more explanatory approach. The style used is a matter of personal preference, although dot point style or checklists are commonly used.

APPLICATION OF CHECKLISTS

GENERAL

Checklists are designed to be a list that you work through for a specific task, to ensure that you do not forget any part of the process. They also provide a written record for audit purposes.

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They break down a complex task into each separate step, and are generally ordered so that inter-dependent tasks are performed in the correct sequence.

Some of the main applications of checklists are to ensure that every possible effort has been made to conduct dives safely and to adhere to the relevant regulations.

ADVANTAGES AND DISADVANTAGES OF CHECKLISTS

Checklists are very rigid. They are a very necessary part of diving operations, particularly to manage the safety aspects of a dive. They ensure that nothing is left to chance and that every contingency is catered for. They also, very importantly, provide a written record after the event to demonstrate that the correct procedure was followed.

They also ensure that no matter who the dive supervisor and team members are, the exact same procedures are followed in every case.

However, checklists only record whether someone has performed a task or not. There is no way of recording the actual details of a discussion or decision. For example, a checklist might ask you to evaluate the surface conditions. If it is foggy, you may decide that there is no risk to the dive operation, or you may decide to cancel the dive because the risks are too high.

So, checklists are simply used to show whether a task has been done or not. You will need to use another mechanism, such as a form with room for recording details of your decisions.

Another common problem with checklists is that people become so familiar with them that they do not take them seriously, or they tick the boxes mechanically without really considering the requirements of each step. You will need to supervise their use on an occasional or random basis, and provide a good role model when you are filling out a checklist yourself. Even talking it through aloud with your team is good reinforcement of the fact that it should be done properly, and allows for any input from the team.

Figure 1: President Bushes pre-war check list.

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HAZARDS, RISKS AND RISK CONTROL

Refer back to section 5 on risk management. This gives an overview of how to identify hazards, assess risks and apply risk control methods. Section 6, on dive planning, also gives an example of risk management associated with a specific dive operation.

It is sometimes necessary to consider a new procedure or change an old procedure during the conduct of the dive to achieve a difficult task.

When introducing any new procedures, or modifying a procedure for any reason, it is vital to identify any special hazards that may have been introduced by the change in procedures. If there are any special hazards, you will need to reassess the risk and apply appropriate risk control measures. In some cases, you may need to get outside help in assessing the risk and selecting the risk control measure – especially for new procedures or procedures associated with new equipment.

This is most difficult when you are at the dive site and need to change a procedure due to an unforeseen circumstance. Here you are under time and cost pressure – the divers are ready, the client may be present, and every minute is costing money. The temptation here is to go ahead with a change in procedures without going through a rigorous process of hazard identification and risk assessment. DON'T.

> **Remember**: You are responsible for the safe conduct of the dive operation. Stick with the tried and true procedures where you can. Otherwise, identify hazards and assess the risks - get help with this if you need it.

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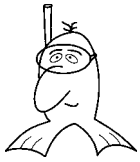
1 CHAPTER 2 – SUPERVISE AND COORDINATE

THE KEY TO SUPERVISING



The key steps in supervising and coordinating the dive operation are as follows:

- ✔ Ensure risk assessment is still accurate, taking into account any changes in environmental conditions or variations to tasks.
- ✔ Conduct briefings/debriefings to communicate essential information for the safe execution of the dive operation to dive team members and other necessary persons.
- ✔ Understand the appropriate and correct use of communications technology during a dive operation.
- ✔ Monitor progress and provide progress reports to client and/or manager of organisation.
- ✔ Investigate proposed variations, taking into account any new risks, and negotiate in consultation with dive team and client.
- ✔ Record all job details accurately and at the appropriate time.

A very good way to ensure that you do not forget anything in coordinating the activities is to use checklists.

VALIDATING RISK ASSESSMENT

The first step in conducting the dive is to check that the risk assessment that you have prepared in the planning phase is still valid. This will include checking assumptions you have made against the realities of the site and the environmental conditions.

An example of this is the wind level. To try to gain some consistency in how wind is measured, there is a scale of wind strength called the Beaufort Wind Scale. Your organisation may use this scale as part of its risk assessment guidelines.

We are told that the decimalised scale has only ten points, having deleted “High wind” and “Hurricane”. Sailors, and indeed all of us, must be grateful that the decimalists have abolished hurricanes; it must be a little unnerving, however, to jump straight from a strong wind to a gale![2]

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[2] Don Hammond, Dozenal Journal No.4, Spring 1986
http://www.shaunf.dircon.co.uk/shaun/metrology/beaufort.html accessed Dec 2002

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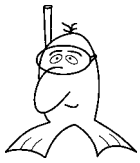
The original scale is of twelve points:

Force	Wind speed (knots)	Description
0	0 - 1	Calm
1	2 - 3	Light air
2	4 - 6	Light breeze
3	7 - 10	Gentle breeze
4	11 - 14	Moderate wind
5	15 - 18	Fresh wind
6	19 - 24	Strong wind
7	25 - 30	High wind
8	31 - 36	Fresh gale
9	37 - 42	Strong gale
10	43 - 48	Severe gale
11	49 - 56	Storm
12	57+	Hurricane

BRIEFINGS AND DEBRIEFINGS

GENERAL

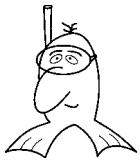
To ensure that briefings and debriefings are effective, you should:



- ✔ Plan the briefing/debriefing beforehand.
- ✔ While conducting the briefing/debriefing, ensure that all relevant information is presented and that everyone has understood the information.
- ✔ After the briefing/debriefing, ensure that findings are recorded and that any follow up actions are identified and acted upon.

Briefings and debriefings are an essential part of any dive operation. Briefings ensure that the critical information that people need to do their job is passed on to all the team members. Debriefings ensure that lessons are learned from each operation so that future operations can benefit.

A briefing is held before the operation to:



- ✔ Make the objectives of the operation clear.
- ✔ Ensure that everyone understands their own role in the operation and the role of others.
- ✔ Ensure that everyone knows exactly what is expected of them.

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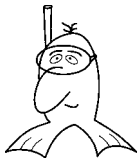
- ✔ Ensure that everyone is fully informed about all aspects of the operation, including the dive site, potential hazards and fallback plans.

A debriefing is held after the operation to:



- ✔ Reflect on the success or otherwise of the operation.
- ✔ Get everyone's input on how they thought the operation went, including any problems encountered.
- ✔ Document and action work practice improvements.
- ✔ Compile a list of "lessons learned" so that future operations can learn from previous experiences.

■ PLANNING FOR A BRIEFING/DEBRIEFING

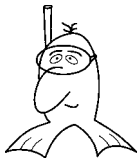
To effectively plan for a briefing or debriefing, you must make sure that all relevant personnel are informed of when and where the briefing is to take place, and that all the materials you need have been collected.

You need to make sure that time is not wasted during the briefing/debriefing looking for information. At the minimum, you should do the following:

- ✔ Send out a notice well beforehand informing people of the purpose of the briefing, the date, time and venue.
- ✔ Get together any material that you may need to refer to during the briefing. Make copies of any reports or information required by all participants.
- ✔ Make sure the venue is available, that there is enough seating and that any equipment you need is available and working. For example, 5 minutes searching for a whiteboard marker that works while 8 people are sitting waiting costs the company money!
- ✔ Consider the timing of the meeting. Work out what suits most of your staff best. For example, perhaps first thing in the morning so as not to disrupt the rest of the day, or a lunchtime meeting with lunch provided might suit you best.

■ CONDUCTING A BRIEFING

Some of the topics to include in a briefing are:



- ✔ **Background:** Why the job is being done?
- ✔ **Objective:** What has to be achieved?
- ✔ **General outline:** General description of how it will happen.
- ✔ **Specific tasks:** Details of the jobs for each person.
- ✔ **Administration:** Any reporting issues, supporting resources required, transport, accommodation etc.
- ✔ **Timing:** Start and finish times and any stages required.
- ✔ **Questions:** At the end of the briefing, ask if anyone has any questions. This is to ensure that everyone understands what is expected of them before the operation starts. It is essential that all members of the team are completely clear on all aspects of their role.

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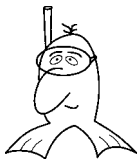
Another commonly used briefing format can be remembered using the acronym **SMEAC**:



- ✔ **Situation**: Describe the task to be undertaken clearly and include the where, when and why – but not the how at this stage.
- ✔ **Mission**: Clearly state the overall aim or objective of the task.
- ✔ **Execution**: Describe in detail how the job will be performed. This includes the size of the dive team, the type of equipment, specific roles, exactly how the job should be done, risk control measures, emergency considerations, dire retrieval and evacuation, and so on.
- ✔ **Administration and Logistics**: Include start times, breaks for meals and drinks, paperwork considerations and so on.
- ✔ **Command and Communication**: Who is in charge, what communications will be used – both underwater and to call emergency services.

EXAMPLE CHECKLIST FOR A PRE-DIVE BRIEFING

Prior to every dive the supervisor will conduct a briefing for all personnel on site. The briefing will contain, but not be limited to the following information:

- ✔ **Aim**

  The Supervisor is to provide an overall description of task. This is in effect a mission statement.

- ✔ **Personnel**

  The role of each member of the team is defined for the dive or diving operations for the day. Roles to be included are that of the Supervisor, Panel Operator, Standby Diver, Standby Diver Attendant, Divers and Attendants. Every member of the team must be aware of his specific job. There is to be no confusion as to who is in charge of the diving operation.

  If two divers are used, appoint one diver to be the "Boss Diver" and confirm that all communications shall be through him.

- ✔ **Description Of Dive Site**

  Inform the dive team of the dive site name, depth range, main features, main biological features, bottom time, type of decompression, and likely currents and visibility. Any good points and hazards must be included. The results of the detailed risk assessment should also be discussed at this point of the brief.

- ✔ **Profile**

  A detailed brief on the specifics of the task is to be done. The brief shall include type of task to be performed, with direction and advice on how it is to be done. The Supervisor and diver shall, both through discussion or direction, agree on a plan of action and prepare for the dive based on that plan. The best sequence for this aspect of the brief follows the logical progression outlined below:

  - ☞ entry
  - ☞ descent
  - ☞ on reaching the bottom
  - ☞ tasks on bottom

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- ☞ on completion of task
- ☞ on returning to the shot/job line
- ☞ on ascent
- ☞ decompression stop
- ☞ on surface
- ☞ surface decompression
- ☞ exit

✔ **Dive Termination Procedures & Emergency Procedures**

Be aware of any likely hazards and difficulties and discuss them prior to the dive, incorporating a plan of action should they occur.

- ☞ review emergency plan; this should include diving emergency, non diving emergency, contact details, medivac points and job safety analysis
- ☞ equipment malfunction
- ☞ entanglement
- ☞ lose job line / shot
- ☞ cold
- ☞ need assistance – emergency
- ☞ need assistance to the surface
- ☞ low on air
- ☞ out of air
- ☞ unexpected hazards

✔ **Communications**

The Supervisors shall review hand and lifeline signals, voice communications procedures (including call signs) and what to do if communications fail.

✔ **Special Equipment**

The Supervisor should outline the list of special equipment to be used. If rigging is involved or tools have to be lowered to the job site, prepare them before the dive commences and ensure the diver is familiar with them.

■ CONCLUDING THE BRIEFING

At the end of a briefing, it is essential that everyone has understood the messages you have delivered. A good way to do this is to summarise all the main points of the briefing, and then ask questions of the team members to ensure that they have the message.

CONDUCT OF THE DIVE

■ GENERAL

Checklists are often useful for the conduct of the dive. These may be included in the operations manual for the organisation.

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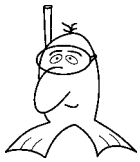
CHECKLIST FOR CONDUCT OF THE DIVE



- ✔ Check that all pre-dive checks are completed and satisfactory.
- ✔ Fly the dive flag.
- ✔ Establish communications.
- ✔ Attendant and stand by diver ready, safety personnel ready.
- ✔ Diver enters the water.
- ✔ Record the time.
- ✔ Constant communications with the diver are required. If voice communications fail, revert to line signals or terminate the dive.
- ✔ The dive will be terminated:

  - ☞ if all communications are lost
  - ☞ if environmental conditions deteriorate
  - ☞ at the completion of the planned time
  - ☞ when the breathing air supplies are switched to secondary or reserve air
  - ☞ if the diver switches to his emergency air
  - ☞ in the event of equipment malfunction
  - ☞ in the event of unexplainable free flow or absence of exhaled bubbles
  - ☞ at the diver's request
  - ☞ at the discretion of the dive supervisor
- ✔ The Supervisor will order the stand by diver into the water:

  - ☞ if all communications are lost and the diver not responding to line signals
  - ☞ in the event of the diver having equipment failure or malfunction
  - ☞ in the event of unexplained free flow or the absence of exhaust bubbles
  - ☞ at the diver's request
  - ☞ at the discretion of the dive supervisor
- ✔ Secondary air supply or reserve air should always be kept full and only used for cylinder changes, or when the standby diver is ordered in.
- ✔ The diver will be notified when he approaches the end of his planned time and again when the time has expired and he is required to surface.
- ✔ A standard routine is to check the kluge gauge against the diver's computer. In the event of a discrepancy, use the reading that requires the most decompression and provides the diver with the greatest safety. A safety stop must be included on every dive where compulsory decompression is not required.
- ✔ The attendant assists the diver from the water and with the removal of his equipment and notes the air consumption.
- ✔ The attendant asks, "is the diver well", and reports the reply to the Supervisor.
- ✔ The Supervisor logs the time out, depth and air consumption.
- ✔ When all divers have left the water, the Supervisor advises the stand by diver that he can leave the dive ready position.

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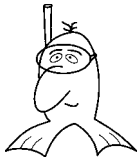
- ✔ The Supervisor will de-brief the divers on the extent of work completed and reports to the client.
- ✔ All personnel clean, pack, dry and maintain all equipment. A written report must be made on any equipment malfunction.

USING COMMUNICATIONS TECHNOLOGY IN A DIVE OPERATION

GENERAL



Good communication is fundamental to the safety of any operation. Communication may be by voice, written document or by a variety of signals, including hand signals, and rope signals.

You, in your role as diving supervisor must have reliable communications with everyone involved in the operation and need access to all of the communications of the vessel or installation. Communications include:

- ✔ All available systems for in-water communication
- ✔ Word of mouth
- ✔ Documentation
- ✔ Radio
- ✔ Telephone
- ✔ Mobile phone
- ✔ Satellite phone
- ✔ TMR (trunk mobile radio)
- ✔ Hand held walkie talkies
- ✔ Fax
- ✔ Email
- ✔ Video

Remember: You are directly responsible for communications with the diver. You must have voice communication and be able to monitor the diver's breathing pattern at all times. You MUST NOT hand over communication to any other person except another properly appointed and qualified diving supervisor.

COMMUNICATIONS CHECKLIST

- ✔ Check all connections are secure
- ✔ Test the communications to and from the diver. Ensure diver 1 is connected to communications post 1
- ✔ Test the stand-by comms set

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- ✔ Ensure at least one spare battery is available
- ✔ It is normal to use two wire communications by plugging both Banana plugs into the bottom microphone outlet on the comms panel

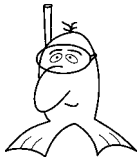
VOICE COMMUNICATION

You must pass clear, complete and accurate information in plain language. English is the internationally accepted language of communications and consequently voice procedure and phonetic codes are based on English.

COMMUNICATION RULES

- ✔ Only speak if necessary. If you do not have anything to say, do not say anything!
- ✔ Think before you speak.
- ✔ Speak slowly and clearly.
- ✔ Say who you are and where you are speaking from.
- ✔ Ask the recipient of the message to repeat all instructions back to make sure there is no misunderstanding.
- ✔ Use the standard words and phrases correctly. If in doubt, use plain English.
- ✔ Let the other person know when you have finished speaking, usually by saying “Over”.
- ✔ Have a procedure to deal with communication breakdown. In most cases, the procedure would be for the diver to carry out the last instruction received and then stop the operation. Alternative methods of communication can then be used.
- ✔ On a multinational worksite, agree communications language and procedure before an operation. Keep written memory aids at each communications site.

COMMUNICATION WITH THE DIVER



- ✔ There must be two way communication with the diver at all times. Voice communications are made more difficult by the noise of the diver’s breathing and other noises such as water jetting, burning and hydraulic tools. Communications from the surface should, as far as possible, be fitted around these noises. It is time wasting and tiring to try to talk over a loud noise.
- ✔ If you need to talk to the diver urgently, switch off underwater tools at the surface if possible to reduce noise, provided of course that there is no hazard to the diver.
- ✔ Do not talk to the diver during lifts, lowers or other operations where the diver may need to warn the surface urgently of any problems.
- ✔ Plan all tasks so that they involve the minimum amount of voice communication.
- ✔ Before the dive starts, agree names for tools, equipment, locations and procedures that will be involved. Sending down the wrong tool can waste time and frustrate both the diver and the surface team. Two or three syllable names are clearer than single syllable names.
- ✔ Keep messages short and simple. Break a long message down into sections. The diver may have to turn off his or her free flow or stop breathing to listen.

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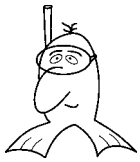
- ✔ Be aware of the time lag in the chain of communication. An instruction from a diver may take 30 seconds or more to reach the crane driver via the diving supervisor, and more time before the instruction is acted upon.
- ✔ Make sure that all divers know the procedure for lost communications. This should be covered in the Operations Manual.
- ✔ Record all voice communications, starting with the pre-dive checks. Keep the recording until it is clear that there have been no problems during or following the dive. It is recommended that you keep recordings for at least 24 hours. If an incident or accident occurs, the tape must be kept in a safe place for the investigation.

READABILITY CHECK



After establishing contact, you should do a readability check, by saying "How do you read?"

The standard replies are:

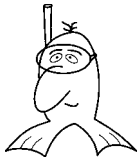
- ✔ Loud and clear
- ✔ Broken
- ✔ Distorted
- ✔ Faint

There is a standard readability scale that is more precise, and should be used in preference to the above list, provided all team members are familiar with the system.

TABLE SHOWING VOICE COMMUNICATION READABILITY SCALE

SCALE	MEANING
1	unreadable
2	readable, but with difficulty
3	readable now and then
4	readable
5	perfectly readable

WORDS AND PHRASES USED IN VOICE COMMUNICATION



WORD/PHRASE	MEANING
Acknowledge	I understand your message
Affirmative	yes, you are clear to proceed
All stop	stop the action and wait for further instructions
Come up or down	lift or lower on a winch or crane
Correction	an alteration to the previous message
Easy	lift or lower slowly on a winch or crane, "slowly" is also used
Go ahead	proceed with your message
How do you read?	how are you receiving me?

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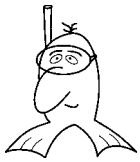
WORD/PHRASE	MEANING
I say again	repetition of your message
Negative	no, or you are not clear to proceed
Over	message ended and waiting for reply
Out	message ended and no reply expected
Read back	repeat the message as received
Repeat	similar to "say again" but usually used to emphasise a word or phrase, for example: "do not, repeat, do not, come up on the winch"
Roger	I have received all of your last transmission. **note**: this is probably the most misused phrase in voice communication
Say again	repeat your message
Say again from...	repeat your message from...
Slowly	lift or lower slowly on a winch or crane, "easy" is also used
Speak slower	
Standby	wait for another message
That is correct	
Verify	confirm the accuracy of your last message
Wilco	I have understood your message and will carry out the instructions, use this only after you have verified the instructions by repeating them

PHONETIC ALPHABET

When you spell out words, use the phonetic alphabet below so that there is no ambiguity.



LETTER	PHONETIC SPELLING
A	Alpha
B	Bravo
C	Charlie
D	Delta
E	Echo
F	Foxtrot
G	Golf
H	Hotel
I	India

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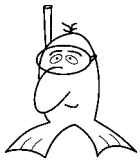
LETTER	PHONETIC SPELLING
J	Juliet
K	Kilo
L	Lima
M	Mike
N	November
O	Oscar
P	Papa
Q	Quebec
R	Romeo
S	Sierra
T	Tango
U	Uniform
V	Victor
W	Whisky
X	X ray
Y	Yankee
Z	Zulu

PRONUNCIATION OF NUMBERS

The following pronunciation of numbers should be used so that there is no ambiguity.



NUMBER	PRONUNCIATION
0	Zero
1	Wun
2	Too
3	Thuh-ree
4	Fow-er
5	Fiver
6	Sixer
7	Sev-en
8	Ait
9	Niner

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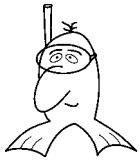
Numbers must always be said carefully. For example, it is very easy to confuse "thirteen" with "thirty".

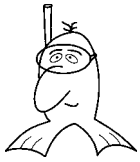


- ✔ Always say a number twice, once using the name and once spelling out the individual digits. For example, "Thirteen that is wun, thuh-ree" or "Thirty, that is thuh-ree zero".
- ✔ Always request confirmation of a number.
- ✔ Always specify the unit of measurement - metres, feet, tonnes, kilograms, pounds.
- ✔ Try to avoid using
- ✔ fractions. It is better to say "Fow-er point fiver" than "Fow-er and a half". If you have to use fractions, describe the fraction as well to avoid confusion, for example, "Wun third, that is, Wun over thuh-ree".

ROPE AND HAND SIGNALS

Rope and hand signals may be used routinely for tender to diver and diver to diver. Different signals may be used by divers trained in different countries and if you have a multinational team, signals must be standardised.

Hand signals are frequently used to control lifts and lowers on winches and cranes. The signals given below are generally accepted, but must be confirmed before an operation.



OPERATION	SIGNAL
Lift	point one finger up and rotate it
Lower	open palm, face down, move slowly left and right from the wrist
Left	point left
Right	point right
Stop	open palm, fingers up held out to the crane driver like a traffic police officer

REMOTE OPERATED VEHICLES (ROV)

When an ROV is in use, you have overall responsibility for the safety of the whole operation. Close communication with the ROV supervisor is vital. There should be a dedicated communications link and a repeat video monitor showing the same picture as the ROV pilot.

EMERGENCY COMMUNICATIONS

In addition to rope and hand signals, guidance notes and company manuals contain various emergency communication procedures for maintaining contact with the divers. See the operations manual.

In any diving emergency, you must have full access to all communications systems available to seek advice and transmit information to the shore. Company manuals may contain forms for transmitting other information about diving incidents.

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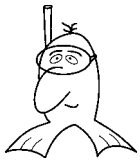
MONITORING AND RECORDING

Checklists can be used to monitor progress. Checklists are designed to be a list that you work through for a specific task, to ensure that you do not forget any part of the process. This is particularly important for safety critical items, such as risk assessments, or pre-dive equipment checks. They also provide a written record for audit purposes.

They break down a complex task into each separate step, and are generally ordered so that inter-dependent tasks are performed in the correct sequence. Some of the main applications of checklists are to ensure that every possible effort has been made to conduct dives safely and to adhere to the relevant regulations.

KEEPING RECORDS



Keeping written records is necessary in terms of accountability. They should be consistent in their format, and be filed so that they can be easily found by anyone who needs them. At the minimum, you should keep appropriately filed copies of:

- ✔ The dive plan
- ✔ The record of dive
- ✔ Logbooks
- ✔ All completed checklists
- ✔ Meeting agendas
- ✔ Meeting minutes
- ✔ Results of debriefing sessions
- ✔ Written reports
- ✔ Memos
- ✔ Recordings of voice communications taken during a dive

Note

These must only be kept until you are sure that there has been no problem during or after the dive. The recommended minimum time to keep these is 24 hours. Keeping adequate records will ensure that an audit trail of all actions is available.

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3 CHAPTER 3 – IDENTIFY, ANALYSE & RESPOND TO PROBLEMS & EMERGENCIES

INTRODUCTION

The way you recognise and handle problems and emergencies is where the real test of your skills as a dive supervisor lies. The key steps are to:

- ✔ Identify actual and potential problems in a timely manner.
- ✔ Analyse nature and extent of problem within an appropriate period.
- ✔ Recognise when a problem escalates to an emergency.
- ✔ Decide on appropriate response to a problem or emergency in a timely manner and according to organisational policies and procedures.
- ✔ Allocate roles and responsibilities in accordance with organisational policies and procedures.
- ✔ Initiate contact with emergency services, in accordance with organisational policies and procedures.
- ✔ Liaise with the media, in accordance with organisational policies and procedures.

We will look first at diving emergencies and then at what we would do in an emergency which does not have a standard, planned response.

IDENTIFYING AND RESPONDING TO DIVING EMERGENCIES

GENERAL

For most diving emergencies, there are responses that have been identified as being the most appropriate way to handle the emergency. These have been carefully planned, or are general knowledge circulated amongst the diving industry because of years of combined industry experience.

Some of these are described below.

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UNCONTROLLED BREATHING

Increase in breathing rate is the normal body response to physical effort. At the surface, this is of little consequence as air comes in unlimited quantity and with negligible resistance.

Underwater the process of breathing through a demand valve is more deliberate and requires semiconscious efforts.

Depending on the characteristics of the breathing equipment and of various restrictions, there is a variable amount of breathing resistance present.

This situation affects voice communications as the work of breathing increases, speaking becomes less natural and requires more self-discipline to fit in with the breathing rate.

As physical exertion increases, the rate of breathing increases and no time can be spared for communications. In addition, unless controlled consciously, breathing becomes shallower and less efficient, leading to deterioration of the situation.

This is a mistake commonly made by amateurs or by young inexperienced divers, eager to please or prove themselves. As a rule, dive supervisors must monitor the breathing rate of divers, slow them down if breathing increases above 25 times a minute and advise them to breathe deeply.

PANIC

Panic does not often correspond to the popular image of running around in circles and shouting. When an individual is faced with a threatening situation, his first reaction is a physiological one, the flight or fight response, when large quantities of adrenaline are secreted into the system.

This can be summarised as the alarm stage followed immediately by the resistance, and if no change of status occurs by the exhaustion stage, as the stress rises a vicious circle situation can develop as follows:

- ✔ Fatigue rapidly develops because of the increased energy demands associated with struggling during the resistance stage of the biological stress reaction.
- ✔ A rapid shallow breathing pattern develops. The result is an increase in the respiratory dead space. This causes the amount of oxygen in the blood to diminish and the amount of carbon dioxide in the blood to rise.
- ✔ This contributes to the victim's fatigue state and intensifies the state of panic.
- ✔ A secondary consequence is a reduction in buoyancy because the lungs are no longer inflated to the maximum with each individual.
- ✔ Swimming movements become inefficient due to fatigue and loss of control. When working at maximum energy levels exhaustion occurs in only a few seconds, even in the well-conditioned individual.

This panic syndrome reaction may even continue after the cause has been remedied. If uninterrupted, it leads to physical exhaustion where the victim stops fighting and to moral exhaustion, as the victim gives up trying or deliberately takes any course of action right or wrong.

The underlying factor to the whole process is stress, physical or physiological.

Failure to resolve the stress during the stages of resistance can result in panic.

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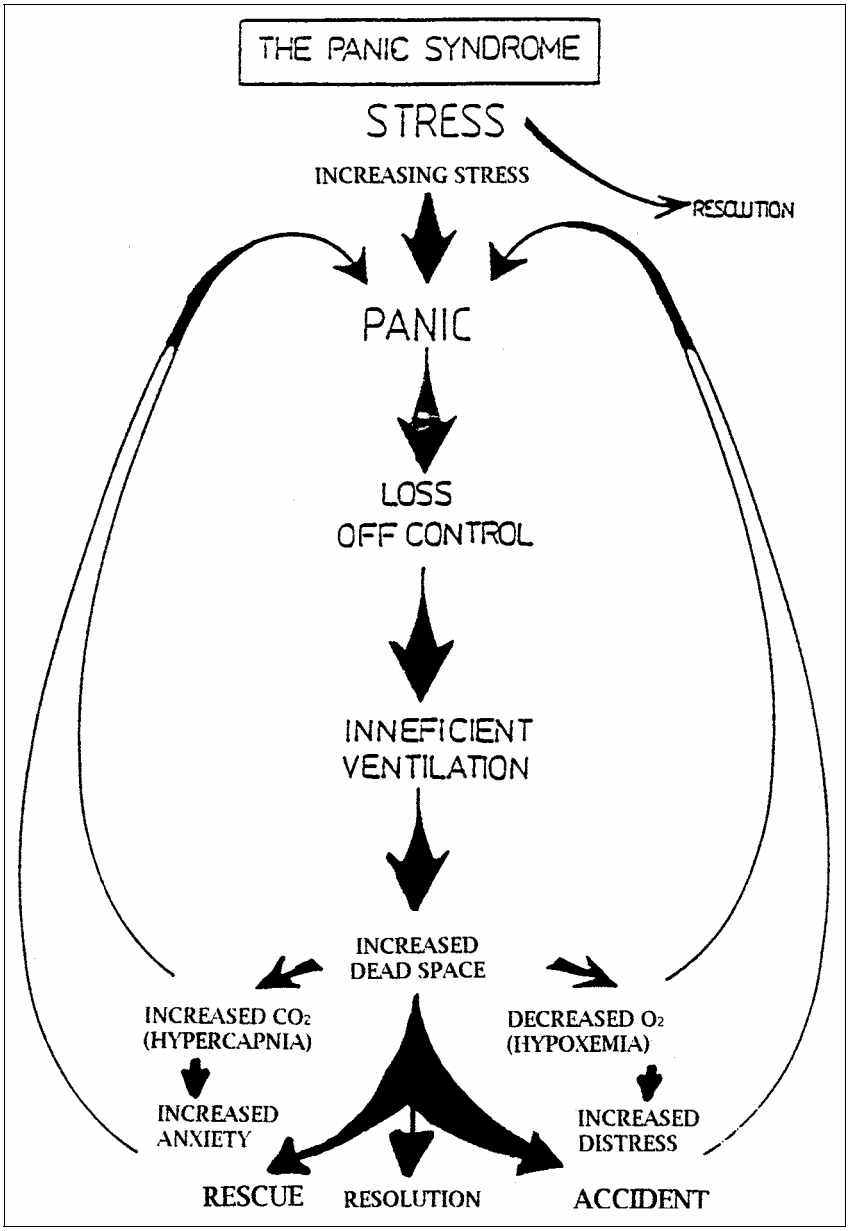

Figure 2: The Panic Syndrome.

PREVENTION OF PANIC

- ✔ Education
- ✔ Predetermined emergency procedures
- ✔ Briefing of divers to include information on potential hazards and emergency procedures
- ✔ Regular emergency drills, including topside emergency drills
- ✔ Voice and breathing rate monitoring
- ✔ Supervisor to sense a stress build up and to advise calmly:

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- ☞ to rest
- ☞ to breathe deeply
- ☞ possibly to re-adjust buoyancy
- ☞ to re-evaluate the situation

DIVER UNCONSCIOUS UNDERWATER

SURFACE DIVING

In a surface diving accident, the diver has to return to the surface for safety. In doing so there is a high risk of lung rupture due to expansion of the gas as the diver is coming up or is pulled up. The situation is aggravated by the fact that he or she is in distress and is very likely to hang on to their breath.

Invariably in the case of a diving accident, the reaction of everybody present is to pull the diver out as soon as possible. This course of action is almost certain to result in lung barotrauma.

You, as dive supervisor, are responsible for making sure that the appropriate course of action is taken to avoid further risk to the diver.

A better procedure would be to:

- ✔ Send the standby diver down as soon as possible.
- ✔ Meanwhile help by pulling the diver up as long as it can be established that he or she is breathing.
  - ☞ if the diver can be heard breathing
  - ☞ if the diver is speaking, or crying, screaming etc.
  - ☞ if and when the diver cannot be heard breathing or talking, crying, screaming etc. STOP PULLING
- ✔ Wait for the standby diver to reach him/her.
- ✔ Resume lifting or pulling only on the instruction of the standby diver.
- ✔ The standby divers action may be:

  - ☞ assess the situation and level of consciousness of the diver
  - ☞ try to restore or to ascertain the presence of a supply of gas to the diver
  - ☞ open the bail out value, reserve or free flow valve and purge the helmet
  - ☞ if necessary pass the end of the pneumo hose into the helmet of the distressed diver and ask the surface to open the pneumo valve on full
  - ☞ free the diver if snagged, entangled or trapped etc.
  - ☞ during the ascent make sure the diver breathes out
- ✔ If the diver is found to be unconscious when back on the surface, remember that there can be two main reasons:

  - ☞ He or she might be drowned or asphyxiated, in which case resuscitation manoeuvres are imperative and urgent. Recompression may be useful by raising the partial pressure of oxygen but transportation to the chamber must not be allowed to delay the resuscitation.
  - ☞ He or she may have suffered from lung barotraumas in which case recompression is vital and urgent. Resuscitation although beneficial must not be allowed to delay the recompression.

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It is extremely difficult to differentiate between a diver unconscious because of drowning asphyxiation and a diver unconscious because of embolism due to lung barotraumas.

Thus the diver will have to be transported towards the chamber but in such a way that cardio pulmonary resuscitation can be performed on the way.

You should have included plans for transportation to the chamber in the dive plan, and these should have been communicated to all personnel during the briefing. First aid certificates should have also been checked for currency prior to the dive.

PANIC COMMUNICATION

Very often a diving emergency is caused by a failure of the breathing system. The most common cause is the interruption of the gas supply to the diver. When the diver notices the problem, it is invariably while trying to inhale, and the prime reflex is to try to hold on to his or her breath. In such a situation, it is obvious that what little gas is available in the lungs will not allow a long conversation, however it will allow for screams. The surface will invariably get the message when a scream is heard, so a diver should "scream to survive".

You should reinforce this message at every briefing.

It is also vital that you ensure that the diver's breathing is monitored at all times – distractions must not be permitted to interfere with this.

DITCHING VERSUS CUTTING

In selecting the diving equipment, safety issues of the presence of a lifeline and communications make surface supplied the preferred choice of most dive supervisors.

Scuba technique presents the following drawbacks:

- ✔ A limited gas supply
- ✔ Usually no communication
- ✔ Location unknown to those people on the surface if diving untethered
- ✔ Half mask easily dislodged and lost
- ✔ Gas supply held in the mouth is easily lost
- ✔ No possible heating
- ✔ In case of emergency the standby diver may:
  - ☞ not know there is an emergency
  - ☞ not know where to find the diver

For all these reasons, you should select SCUBA only if essential due to the presence of entanglement hazards or other hazards making surface supply impractical. For example, in a bottom search of a river with many entanglement hazards, surface supply may be impractical.

The diver will then be supplied either from the surface or from a bell by a diving umbilical.

In case of the umbilical becoming fouled or trapped and the gas supply being interrupted at the same time, the diver is faced with a real emergency. You need to respond rapidly to an interruption to the diver's breathing or a problem with supply. You should recognise that the diver may panic and may forget to switch to his bail out bottle – it may be necessary to calmly ask if he or she has switched to the bail out bottle.

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The diver may also be tempted to free himself. Remind divers during briefings that this is a risky endeavour. If this does not succeed, it may put the diver in a worse situation. If the diver has decided to free him or herself, there are two options.

✔ To ditch his or her gear. This will involve:

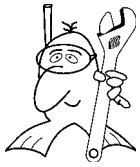
- ☞ disconnecting snap shackle, attaching his lifeline to his harness
- ☞ disconnecting his hot water hose
- ☞ removing his helmet or mask
- ☞ removing his bail out bottle

or

✔ To cut the umbilical, this will invariably require a sharp knife.

In option 1, ditching will take time and the diver will be left with nothing to breathe, his or her face will be in contact with water and vision will be impaired.

In option 2, the diver will be free more quickly and will still have his face protected by the helmet or mask. He or she will still have the contents of the bail out bottle to breathe. This is a comparably much better situation.



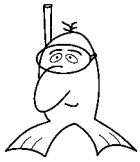
This raises the problem of the sharpness of diving knives. Traditionally diver's knives are used as a hammer, chisel, crowbar, lever spade, shovel etc. In other words, they are never sharp.

You should check that each diver owns a diving safety knife that belongs to them, is kept sharp as a razor, and is never used for anything other than emergencies.

ANALYSE AND RESPOND TO GENERAL EMERGENCIES USING THE APPRECIATION PROCESS

■ GENERAL

In the section on occupational health and safety, we introduced the appreciation process. This is a military term for undertaking a situation analysis and deciding on a course of action. It can be applied to analysing and responding to an emergency.



Ideally, all potential emergencies have been considered and planned for in the dive plan, or in the standard operating procedures of the company. However, there may be times when the emergency has not been predicted, or where the emergency has additional factors that were not considered in the initial plan. For example, you may have emergency procedures for a fire on a boat. Do these emergency procedures include what you should do if you have a fire on a boat as well as an injured person in the water? Which do you deal with first? In these instances, you may need to do an appreciation or situation analysis on the spot, when you are under pressure.

The more you practice the appreciation approach when doing your dive planning, the more comfortable you will be with applying the same approach under pressure in an emergency.

Let us look at the parts of an Appreciation. It is essential that you examine the task to determine what is involved and what limitations may have been imposed.

We will look in detail at each of the steps, which are: determine the aim, examine relevant factors, determine courses open, select the course of action, and formulate the plan. You will need to assess the plan for effectiveness and re-assess it if any factors change.

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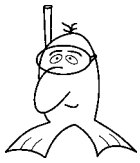
DETERMINE THE AIM

This is the objective or mission. Generally, in an emergency, this is to stop the spread of the emergency, minimise the harm and deal with any injuries that have already occurred.

The aim is a clear and concise statement of what you wish to achieve. Refer back to this aim throughout the appreciation.

You may have limitations on the aim (which could also be considered the critical factors, so may be considered in the next step).



In most cases, it is wise to avoid multiple aims within a single appreciation process. For example, in the midst of an emergency, you may initially think, "What do I do – I've got to get everyone out of here, I've got to put the fire out, I've got to treat the person that is injured, I've got to get the expensive equipment away from the fire." If you are untrained or unpractised in the appreciation process, you may jump from one aim to another and deal with each problem ineffectively.

You **must** prioritise each of these aims and do a rapid appreciation of each. Each of these appreciations may only take a few seconds, particularly if you already have standard procedures in place to deal with some components of the emergency.

You may need to re-assess your approach and your priorities as the situation changes.

EXAMINE THE RELEVANT FACTORS

These are facts or circumstances, which may influence the way the aim is achieved, or the urgency of the response.

Note all relevant factors and put aside all irrelevant factors.

Factors should be simple, logical, and to the point.

DETERMINE THE COURSES OPEN

Identify possible options or courses of action.

Look at the advantages and disadvantages of each and determine which one will achieve the aim most efficiently and effectively.

State concisely the advantages and disadvantages of each course, i.e. its chance of attaining or contributing the aim, and in particular the physical risks associated with each.

SELECT THE COURSE OF ACTION

Select the course of action that will achieve your aim.

Ask "What if.....?" to assist in determining which course is the most appropriate option.

Remember **SAFETY**.

Selecting the best course of action involves comparing each course and weighing the advantages and disadvantages against each other. The risks of each must be considered in making the judgement of the best course of action to take.

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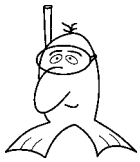
FORMULATE THE PLAN

Planning principles to keep in mind are:



- ✔ Keep it simple
- ✔ Ensure it relates directly to the aim
- ✔ Ensure it is based on logical deductions

Avoid too much detail in a written outline or verbal description of the plan.

Ensure it is clear, specific and practicable and outlines the selected course of action to achieve the aim.

The plan must be achievable and use sound logic and reasoning.

■ ASSESS/RE-ASSESS

If any factors change, or may change, allow for other contingencies and be prepared to change options.

Always consider the "what if's"? Factors will always change. You must be flexible in your planning.

■ EXAMPLE

What are these "What if's" – lets look at a possible emergency. We have listed some possible responses – can you think of more?

You are the dive supervisor of a very small dive team undertaking an SSBA diving operation in water 10m deep. Because of the comprehensive risk assessment you have documented in writing, AS/NZS2299.1 allows you to use a dive team of only three - one supervisor acting as the diver's attendant and carrying out minimal surface duties, one diver, and one standby diver. You are on the panel and the standby diver is attending the diver.

All of a sudden, the standby diver, who is also acting as attendant, complains of shortness of breath and pain in his chest, and then collapses.

WHAT DO YOU DO?

Let us use an appreciation process – remembering that on the dive site, you will need to do this in a few seconds.

AIM

- ✔ To get medical assistance for the ill standby

Limitations – you have another diver in the water, so you may need to restate the aim as:

- ✔ To get medical assistance for the standby, without compromising the safety of the diver

FACTORS

You do not know what is wrong with the standby and he is not responding to your questions.

- ✔ You need to go close to him to be able to check his condition.
- ✔ You suspect a heart attack from the standby's initial complaints.

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✔ You can make an instant decision to call for medical assistance.

You have a diver in the water.

✔ You need to ensure his safety.

You are within the Melbourne metropolitan area.

✔ You should have good access to medical assistance, and your mobile phone should work.

You do not have anyone else to operate the panel while you attend to the standby.

✔ You need to assess the risk of leaving the panel unattended for a few minutes.

You have set up the panel in close proximity to the standby and have good voice communications.

✔ You are able to hear the diver's voice and breathing pattern from where the standby has collapsed.

You are working from a jetty near a popular beach and there are a number of people within hearing distance.

✔ You could call out for assistance.

The diver is experienced, is wearing a buoyancy compensator and is well within the no decompression limit for the depth.

✔ The diver can safely stay in the water for at least another 10 minutes and can ascend safely.

COURSES OPEN

Course one - You leave the diver in the water and attend to the standby.

Advantages:

✔ You can attend to the standby quickly.

Disadvantages:

✔ The diver in the water will be unattended for some minutes.

Course two – You terminate the dive and get the diver out of the water.

Advantages:

✔ You are ensuring the safety of the diver in the water.

Disadvantages:

✔ The delay in attending to the standby could be fatal.

Course three – You call out for assistance in finding out what is wrong with the standby.

Advantages:

✔ You can attend to the diver in the water, while someone else attends to the standby.

Disadvantages:

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- ✔ The person(s) responding to your call for help may be inexperienced and prove to be a hindrance rather than a help.

SELECT COURSE OF ACTION

After considering all the factors, you decide to select course one – leave the diver in the water and attend to the standby.

Your plan is:

- ✔ Phone for emergency assistance immediately.
- ✔ Inform the diver that standby has collapsed.
- ✔ Direct divers to stay in same place for five minutes while you check standby's condition and commence first aid.
- ✔ Tell diver that if he does not hear from you within five minutes, he is to call out to ask for further directions.
- ✔ If diver does not hear within ten minutes, he is to ascend slowly to the surface.
- ✔ Turn communications up to full volume to enable you to hear the diver.
- ✔ Ensure lifeline and umbilical secured and not entangled around unconscious standby.
- ✔ Perform DRABC on unconscious standby.
- ✔ If CPR required call out for assistance from someone who can do CPR. "Help, I need someone who can do CPR".
- ✔ Commence one-person CPR, switching to two person CPR if someone experienced responds to calls for assistance.
- ✔ Hand over to emergency services when they arrive.
- ✔ If possible, inform in-water diver of situation before five-minute deadline and terminate dive.
- ✔ Attend to diver in water.

ASSESS/RE-ASSESS

You may need to re-assess your plan depending on the factors and if they change. For example:

- ✔ What do you do if the diver in the water panics and ascends rapidly to the surface?
- ✔ What do you do if you are suddenly crowded by onlookers if you call out for assistance, and some start to try to be "helpful" by offering to talk to the diver over the communications system, or hold the umbilical/lifeline?
- ✔ What do you do if the media turns up before the emergency services? How do you deal with them, without being distracted from the task?
- ✔ What if there is a delay in the arrival of the emergency services?

As you can see, it is quite conceivable that something unforeseen could happen, or there is a slight twist to the anticipated emergency – we are quite used to considering what to do if the diver is ill, but not the surface crew. We know what our own team is likely to do and how they will react, but what about onlookers or new team members?

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The more thorough our appreciation process is in the dive planning stage, the easier it is to prevent emergencies and to deal with any that does occur. The thought process is the most important practice – do not just rely on other people's checklists and emergency procedures – think through the "what if's" yourself.

Remember: In an emergency, an appreciation may need to be made in a matter of seconds.

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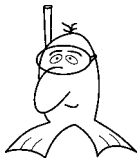
4 CHAPTER 4 – CONCLUDE DIVE OPERATION

INTRODUCTION

An often neglected area is concluding the dive operation in the right way and in accordance with organisational policies and procedures. Where the policies and procedures do not explicitly state how the dive operation should be concluded, your professionalism as a dive supervisor should encourage you to follow best practice. The steps generally include making sure that you:



- ✔ Ensure all required outcomes of the operation have been met.
- ✔ Ensure organisational procedures are followed for concluding the dive operation.
- ✔ Debrief personnel, identify follow up requirements and record details of debrief where appropriate.
- ✔ Ensure all follow up requirements are actioned within an appropriate period.
- ✔ Report on outcome of dive operation, including analysis of problems and near misses, according to organisational policies and procedures.

CHECKING OUTCOMES ACHIEVED AND CONCLUDING OPERATION

Refer back to the dive plan to ensure that the task has been completed as required.

It may be useful to have video footage of the operation to ensure that the divers have carried out the required task and that there has not been a misunderstanding or something omitted. Video footage is extremely useful for learning from the job to improve procedures for the next operation. It is also a very professional benefit item for reporting to the client.

Recordings of the voice communications may also be useful for checking outcomes and learning lessons.

Checklists remain a cheap and easy way of recording the outcomes of the operation and providing evidence of work completed.

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CONDUCTING A DEBRIEFING

GENERAL

Some of the steps in the section on conducting a briefing are relevant to conducting a debriefing. However, a debriefing is more about analysing the operation, what worked well, what did not, what problems were encountered and so on.

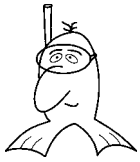
It is very important to encourage every member of the team to give constructive feedback in an atmosphere of team co-operation and "no blame".

You should appoint someone to take written notes so that all findings are recorded for future use and any actions for follow up are recorded and acted upon.

CONCLUDING THE DEBRIEFING

Although a debriefing serves a different purpose, the conclusion process is very similar to that of a briefing.

The person taking the notes must ensure that:



- ✔ All relevant information is recorded. For example, all tasks to be done, who is doing them and by when are listed.
- ✔ Any follow up actions are written down.
- ✔ The notes are written up as a formal record of the meeting. They must be circulated to all attendees, any other relevant stakeholders and a copy kept for the purpose of an ongoing record.

FOLLOW UP

The dive supervisor should make sure that follow up items are actioned. Particular attention should be paid to any safety critical items. These might include:

- ✔ Any incidents or near misses that should be reported
- ✔ Maintenance of faulty equipment
- ✔ Any suggestions for improving health and safety.

The section on occupational health and safety goes through the requirements for accident and incident reporting in more detail.

WRITTEN REPORT

As a dive supervisor, you may be required to produce a report for the client or management, to let them know the processes and outcome of a dive operation. It should, as a minimum, contain the following:

- ✔ Introduction or background (what was being done and why).

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- ✔ Body (how it was done and why, what outcomes were achieved, what problems occurred during the operation).
- ✔ Recommendations or lessons learned (what can be done better in the future).
- ✔ Conclusion or summary (what was achieved).
- ✔ Appendices (supporting information, such as drawings, photographs and videos).

The following example of a written report for a client is from an actual dive operation conducted by Descend Underwater Training Centre, Albury. One of the excellent features of this report is the lessons learned section. In some cases, it may not be something that is included in the report to the client, but is definitely a useful feature of an internal report to management.

Another important feature of the report is that it actually summarises what was achieved and that it was successful in solving the problem.

There is more information on preparing written reports in the section on managing people.

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5 CHAPTER 5 - CASE STUDY

WRITTEN REPORT FOR CORIN DAM DIVE OPERATION

Report on Diving Conducted at Corin Dam
April 2 - 5 2002

It is my pleasure to present the following report on diving operations carried out by Descend UTC at Corin Dam from 2nd to 5th April 2002.

Background

The repair of water leak in the inlet tower at Corin Dam had previously been attempted by another diving company. The repair at that time consisted of applying Hilti Hit 150 into a defect approximately 450mm long by 110 mm wide and was unsuccessful in sealing the leak.

In November 2001, Descend UTC was contracted to undertake a series of exploratory dives to investigate the extent of the leakage and to assist in providing a solution. A series of six dives were conducted (including a comprehensive video inspection, dye testing and measurements) and resulted in a plan being formulated for the installation of stainless steel frame with rubber sealing membrane. Descend UTC was again contracted to install the sealing plate.

Pre planning

Descend researched the project and formulated a dive plan which included a comprehensive risk assessment, emergency plan, equipment selection, staffing levels and work methods assessment. Hilti was contacted to obtain the requirements for the fitting of the chemical anchors.

The risk assessment dictated the use of hot water suits, a recompression chamber located on site, a minimum of at least a team of five divers, comprehensive isolation of the water outlet and the use of an earth leakage device on all electric current. Environmental sensitivities required drip trays to be used under all portable compressors and the hydraulic power pack was drained of oil, flushed and re-filled with biodegradable oil.

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The diving equipment selected all complied with AS/NZS2299.1 Australian Standard and included a surface supplied diving system with a low-pressure compressor as the primary air supply, high-pressure cylinders as back up and divers bail out system as an emergency supply. The air quality was analysed immediately prior to the operation. The lead diver wore a Superlite 17, hard shell full diving helmet fitted with a closed circuit TV, hard wire voice communications and 240-volt surface supplied lighting - all monitored for the dive control position.

The actual diving was conducted out of our 6m workboat, which is 2E surveyed and equipped with power winch, hot water generator and hydraulic power pack hoses and tools. Communications between the boat and the dive control position on the top of the inlet tower were achieved via hand held mobile radios and the dives speech was relayed to the boat via hard-wired extension speaker to allow faster reaction times for winch control and tool activation.

The dives

The dive team consisted of Des Walters, Andrew Weppner, Ashley Macaulay, Geoff Reed, Scott Haynes, Tony Baker and Ashley Bayley all of which are ADAS qualified to level 3. In addition Des, Andrew and Ashley are qualified ADAS Supervisors. The team travelled to Canberra on Monday April 1st and arrived on site at Corin Dam at approx. 0800 hrs on Tuesday 2 April 2002. The site was established, boat launched and chamber blown down before the group briefing where the risk assessment and dive plan were discussed and consultation undertaken with all workers present. The dam RL on 1.4.02 was 940.25 giving a depth at the base of the tower of 21 metres

Sequence and Methods

1. The frame was positioned as shown on the plan and the walls checked for irregularity. It was found that due to a 10mm step in the concrete that the frame could not be positioned against the float well and had to be moved approximately 160mm to the right of the well. The integrity of the concrete was tested with a hammer tap test. The wall was then cleaned with a hydraulic scrubber, however this proved too severe and hand cleaning with a wire brush proved a better alternative.

2. Three friction anchors were fitted to hold the template in place for drilling. In total thirty 12mm holes at 85mm deep were drilled to accommodate the channel anchors. The drilling was accomplished using a diamond core bit and hydraulic drill.

3. When drilling was completed the frame was removed so the membrane could be fitted. The holes were then cleaned with a brush and flushed with compressed air. The frame was then refitted with the three dynamic anchors after smoothing irregularities in the concrete using a pneumatic angle grinder.

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4. An attempt was made to fill the defect using Hilti Hit 150. However, on the test it was found that the grout set in approximately four minutes and was hard by the time it reached the diver. The Hilti 150 was then mixed on the bottom by the divers in a plastic bag and then bulk placed. It was found that the new grout would not stick to the old grout and this was abandoned under direction from the customers representative.

5. The chemical anchor were then fitted using fast set Hilti Hit 20 and the stainless steel bolts driven with the hydraulic drill and the Hilti setting tool. Three anchors on the bottom did not drive fully home due to the difficulty with the Hilti drive tool. The problem was rectified by grinding flats on the setting tool to present the tool spinning the chuck. The chemical anchors were then left to set overnight

6. The final phase of the operation involved cleaning the chemical overburden of Hilti 20 from under the frame so it could be pulled flat to the wall, then tightening all of the chemical anchors evenly. The frame was then leak tested with food dye and pre-tensioned. A final seal of Hilti 150 was placed around the external perimeter of the frame and the effectiveness monitored an ACTEW observer inside the tower who confirmed that the leak had stopped.

The dive sequence progressed as follows

2/4/02

1307 hours Dive 1 - 2 divers bottom time 50 mins. Total dive time 74 mins. Position frame, test integrity of wall with hammer taps, clean wall with hydraulic scrubber and commence drilling for dynamic anchors to locate frame.

1447 hours Dive 2 - 2 divers bottom time 50m - total dive time 65mins. Finish drilling and set two loxins to hold frame.

1615 hours Dive 3 - 2 divers bottom time 46 mins - total dive time 63 mins. Start drilling bottom loxin to hold it to the wall.

Summary of Day 1 - 9 ½ hours on site - 3 dives using six divers.

3/4/02

0912 hours - Dive 4 - 2 divers 50 bottom time 77 mins total dive time drill and fit bottom loxin and bracket to hold frame to wall.

1047 hours Dive 5 - 50 mins bottom time 67 mins total dive time drill holes for

1203 hours - Dive 6 - 60 mins bottom time 69 mins total dive time drill holes

1322 hours-Dive 7 - 47 mins bottom time 68 mins total dive time drill holes

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1423 hours Dive 8 - 50 mins bottom time 65 mins total dive time drill holes

1555 hours Dive 9 - 47 mins bottom time 86 mins total dive time drill holes

Summary of Day 2 - 9 ½ hours on site six divers by 7 dives

4/4/02

0854 hours Dive 10 - 50 mins bottom time 65 mins total dive time drill

1011 hours Dive 11 - 50 mins bottom time 71 mins total dive time drill

1018 hours Dive 12 - 55 mins bottom time 91 mins total dive time photography and drilling holes

1135 hours Dive 13 - 50 mins bottom time 70 mins total dive time finish drilling, remove frame, clean holes and blowout with compressor air.

1451 hours Dive 14 - 56 mins bottom time 93 mins total dive time. Clean perimeter re fit frame with three friction anchors

1510 hours Dive 15 - 60 mins bottom time 90 mins total dive times. Attempt to fill defect with Hilti Hit 150

1707 hours Dive 16 - 46 mins bottom time 78 mins total dive time - finish setting chemical anchors.

Summary of Day 3 - 10 ½ hours on site 7 dives by 7 divers.

5/5/02

0930 hours Dive 17 - 54 mins bottom time 91 mins total dive time clean off adhesive and tighten bolts

1116 hours Dive 18 - 44 mins bottom time 57 mins total dive time tighten bolts and dye test.

Summary of Day 4 - 7 hours on site two dives by 2 divers.

Lessons Learned

- A minor oil leak was experienced from the hydraulic tools. It was the correct decision to use biodegradable oil in the hydraulic power pack.
- Hilti Hit 150 is not appropriate as a bulk filling material
- The set time of Hilti Hit 150 is too quick to allow underwater working with the material
- The setting tool for the chemical anchors needs modification for use in a 3 jaw chuck

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- In retrospect, the frame should also have been fixed rigidly to the wall at the bottom.
- Value of the underwater video coverage was lessened by the loss of sound recording on latter parts of the video. In future, need to trial a section before each set-up change
- Surveillance video was immensely valuable to divers and client

Summary

A stainless steel frame and rubber membrane has been fitted to the defect on a construction joint at the bottom of Corin Dam and has been successful in stopping the long-standing leak.

This required 18 dives with 22 man diving totalling 1011 minutes (16.85 hours) of bottom time and 1619 minutes (26.98) hours of total in water time by seven divers over four days.

Attached to this report are three surveillance videos of the total job and an extra video that has been edited to approximately 45 minutes that shows all of the commercial work processes and a CD ROM with various digital images of the project.

Thank you for your confidence in selecting Descend Underwater Training Centre as your preferred diving contractor.

Yours faithfully,

Des Walters
Managing Director
Descend UTC

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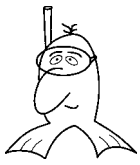
6 CHAPTER 6 – SUMMARY

SUPERVISE AND COORDINATE



- ✔ Conducting a dive operation successfully involves supervising and coordinating activities, responding to problems and emergencies and concluding the dive operation properly.
- ✔ You need to check the risk assessment is valid, conduct briefings to communicate task and safety information, monitor progress, investigate variations and record all job details.
- ✔ Briefings ensure that critical information needed by people to do their job is passed on to all team members.
- ✔ Debriefings ensure that lessons are learned from each operation so that future operations can benefit.
- ✔ Checklists are useful to assist in coordinating activities.
- ✔ Good communication is fundamental to the safety of a diving operation.
- ✔ Communications methods during a dive operation may be by voice, written document, or by signals, including hand signals and rope signals.
- ✔ The dive supervisor is directly responsible for communications with the diver.
- ✔ When communicating with an in-water diver, communication rules and protocols are essential for the safety of the diver.

EMERGENCIES

- ✔ An appreciation process of determining the aim, examining the relevant factors, determining the courses open, selecting the course of action and formulating the plan is useful for preparing for emergencies and for handling emergencies when they occur.
- ✔ Follow policies and procedures when handling problems and emergencies.
- ✔ To prevent panic in emergencies you need to make sure divers are trained, you have clear emergency procedures, divers are briefed on potential hazards and emergency procedures, you undertake regular emergency drills and you monitor divers voice and breathing rate.
- ✔ To prevent occurrence or escalation of diving emergencies, dive supervisors should
  - ☞ Select surface supplied diving wherever possible (umbilical and communications reduces risk of diving emergency occurring).

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- ☞ Carefully analyse potential for entanglement of umbilical.
- ☞ Provide information on potential hazards and emergency procedures at every briefing.
- ☞ Ensure that the diver breathing rate is monitored at all times.

✔ Entanglement is a common diving hazard. The dive supervisor should take the following steps.

- ☞ If entanglement occurs, check with diver to make sure breathable gas is still coming though the umbilical and tell the diver to wait for the intervention of the standby diver to free him.
- ☞ The dive plan should include calculations of the time available on the bail out bottle if the gas supply were interrupted via entanglement or severance of the umbilical. Emergency procedures should be clear on what the diver should do, which in most cases is to wait for the standby diver to arrive while breathing on the bail out bottle. The dive supervisor should remind the diver of this and try to keep him or her calm and the breathing rate down.
- ☞ Emergency procedures should also be clear on what the diver should do when entangled – for example, if he or she decides to free themself the diver should do so by cutting the umbilical rather than ditching his or her equipment.
- ☞ The dive supervisor should ensure that every diver has their own sharp knife at their disposal at all times, which should be maintained in a sharp and undamaged state.

CONCLUDE DIVE OPERATIONS

✔ To conclude the dive operation you should check that the task has been completed satisfactorily, debrief personnel, follow up on action items and report on the outcome to the appropriate people (client or manager).

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