DIVING AT WORK REGULATIONS 1997

ADVICE NOTES FOR THE

SCIENTIFIC AND ARCHAEOLOGICAL

APPROVED CODE OF PRACTICE

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SCIENTIFIC DIVING SUPERVISORY COMMITTEE - ADVICE NOTES FOR THE SCIENTIFIC AND ARCHAEOLOGICAL APPROVED CODE OF PRACTICE.

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PREFACE.

These advice notes have developed from the codes of practice for scientific diving issued by the Underwater Association (UA) and the Scientific Diving Supervisory Committee (SDSC). With the legislative changes in the Diving Regulations in 1997 requiring separate Approved Codes of Practice (ACoPs) for different sections of the diving industry the Health and Safety Executive (HSE) required each industry to provide sets of advice notes to enable diving contractors to instigate safety management procedures which enabled them to comply with the ACoPs. This is one such of these sets, and has been written in consultation with the HSE. It offers practical advice to both individuals and groups to enable them to identify many of the risks and hazards involved in scientific and archaeological diving. Further advice is given on suitable methods of undertaking a risk assessment of the diving operation so as to enable it to comply with the Scientific and Archaeological Diving ACoP (S&A ACoP). However no set of advice notes can cover every potential situation and diving contractors should issue a set of in-house rules to cover the safety requirements of their own particular envisaged risks.

Whilst appropriate experts have been consulted on relevant sections, it is realised that there will be errors, inconsistencies, and differences of opinion. The correctness is theirs, the errors are mine. Constructive feed-back is welcomed, it is intended that there will be an annual up-date every October, and any amendments can readily be included then.

Phil Lonsdale. 31st March 1998

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INTRODUCTION.

The purpose of these notes is to provide :-
1) a set of advice notes to support the Scientific and Archaeological ACoP
2) a set of guidelines to encourage the highest level of diving safety commensurate with the task in hand.
3) a code, the compliance with which ensures that the diving operation is taking place within the law (of the UK).
4) detailed recommendations on aspects of scientific and archaeological diving safety and conduct that are not covered by existing legislation.
5) a summary of general experiences, drawn from other manuals, as they affect scientific and archaeological diving.
6) recommendations in specific diving conditions where experience has already been gained, and where this experience can simply be passed on.

Some research diving consists, by definition, of undertaking tasks which have not been attempted previously. Thus a fundamental safety point is for divers to realise that they will be faced with situations which cannot be specifically anticipated in these advice notes. Advice on how to cope is supplied however, via three general steps.

1) The general safety levels which should be maintained are indicated by reference to various other manuals (such as the Code of Practice for Scientific Diving, edited by the Scientific Committee of the Confederation Mondiale des Activites Subaquatique (CMAS) for the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) Marine Sciences Division), and specific specialist cases. Where new situations are encountered local rules must be drawn up to maintain safety at an equivalent level.
2) A list of special conditions is given in section 6, where relevant safety procedures are outlined. Most new situations will tend to be either a combination or extrapolation of these. Safety precautions can then be based on this section.
3) When a totally new situation is encountered the procedure for devising safety rules is explained in section 9.
Copies of any rules drawn up to deal with situations outwith this code will be welcomed by the editor, for inclusion in subsequent revisions.

Whatever the circumstances the basic principle adopted in these notes is that existing practices and recommendations should be followed whenever possible. The recommendations of these advice notes are largely supplementary to other documents, (such as DWR 97 and the various diver training standards of competency), so as to provide safe guidelines in all circumstances.
In each section it is assumed that :-
All other relevant sections are being complied with.
The divers have been adequately and competently trained to the required level on the equipment that is to be used.

Various phrases have been used throughout the code, and should be interpreted as follows.

MUST - There are no circumstances when this requirement can be ignored.
WILL/SHALL - This recommendation should be followed unless there are exceptional safety circumstances preventing it.
SHOULD - Normal diving practice requires that this recommendation be followed, but there are circumstances when it is appropriate to relax it.
CAN/MAY - It has been experienced that scientific and archaeological diving will benefit from following this recommendation.
SHOULD CONSIDER - a hint to improve safety and/or efficiency.

The terms HE, HIM, and HIS, apply to both male and female.

SECTION 1. LAW AND ADMINISTRATION.

All diving in the United Kingdom, by employed or self-employed divers who are at work, is regulated by legislation issued by the Health and Safety Executive, the current legislation being The Diving at Work Regulations 1997, (DWR97). Scientists, archaeologists, and researchers who dive from time-to-time as part of their work, whether they receive diving allowances or not, are classed as at work.

DWR97 defines basic types of diving and the requirement for a stated ACoP to be followed. The regulations set standards for the equipment used, its maintenance, the competence of all personnel involved in a diving operation, and the chain of responsibility.
Institutions may apply for exemptions for any part of the regulations for a specific diving operation. All applications must be made to the HSE policy division (see section 10.12).

The **minimum team size** under the S&A ACoP is, in benign conditions, three for self contained underwater breathing apparatus (SCUBA) (a Supervisor, a Diver, and a Buddy - defined as a dive partner available to provide assistance to the other diver in an emergency), and four for surface supply diving equipment (a Supervisor, a Diver, a Tender, and a Standby).

Not all of the team needs to be "at work," but they must be competent to undertake their duty.

All of **the divers, standby divers and buddies require** a HSE approved diving qualification (see section 10.3) and a current medical. If the diver is at work then this medical must be issued by a medical examiner of divers and is valid for one year. However if the diver is not at work then the medical can either be as above, or an appropriate medical recommended by their recreational diving organisation provided that it is undertaken by a Medical Doctor.

If any **diving equipment other than** self contained, open circuit, air mixture (SCOA) is used the Diver, Standby diver, Buddy and Supervisor must have suitable training and/or qualifications in its use.

Any **diver that is not qualified** to one of the above standards, or is not in possession of a valid medical certificate may still dive, but not as part of the minimum required working team, and not as an employed or self-employed person at work.

At **all times during** the diving operation **there must be present**, on site and on the surface, sufficient suitably qualified first aiders and emergency oxygen administrators, together with sufficient quantities of suitable first aid and oxygen equipment and supplies to comply with the diving operation's risk assessment.

In addition to the statutory regulations advice notes such as these must be followed, which are relevant to the particular circumstances anticipated in scientific and archaeological diving. These advice notes can be supplemented with other guidance notes more specific to the institution, such as the Natural Environment Research Council's, the University Marine Biological Station Millport's, etc.

The employers of scientific and archaeological divers are represented nationally by the Scientific Diving Supervisory Committee (SDSC); and the Society for Underwater Technology (SUT) has an Underwater Science Group to represent the individual scientific diver, while the Institute of Field Archaeologists' Maritime Affairs Group represents the individual archaeological diver.

Scientists and archaeologists wishing to **dive abroad** must ensure that they are familiar with the relevant regulations in the host country, as these will, almost certainly, be different to those in the U.K.
Research **divers visiting the U.K.** must comply with all aspects and amendments of DWR97, unless an exemption has been issued, in which all aspects of the exemption must be complied with.

Care should be taken by divers to ensure that their third party, public liability, and personal, **insurance** is adequate, whether undertaken privately or through the diving contractor/parent organisation. Consideration must be paid to the following classes of risk.
1) Claims against the employer by an injured diver or his dependants.
2) The liability of the employer for claims against the employee by members of the public or other employees arising from diving accidents.
3) The liability of the employee for claims as above.
4) Personal accident insurance for the individual and his dependants.
5) Cover for liabilities arising from actions associated with the diving operation, but not part of it. (Such as boat handling, trailer towing, etc.).

Amateur divers helping in a research project should be regarded as temporary employees of the parent organisation whether payment is involved or not. If such payment is in excess of reasonable expenses then the amateur must be regarded as being at work. If the amateur is not at work then he can still be used as part of the minimum, at-work, diving team if he is in possession of suitable qualifications. Scientific or archaeological divers assisting a group of amateur divers, with a scientific or archaeological project, can only dive if the minimum, DWR97 diving team is present. **Volunteer divers**, diving as volunteers with a specific diving operation, must dive to an acceptable amateur standard and must be included in the diving operations log book.

Some organisations give specific **diving pay or allowances**. These pay schemes are usually based on one of the following systems.
1) A proportion of the daily pay added to each day on which diving takes place.
2) A surface equivalent time, based on (actual diving time X maximum pressure) + time for kitting and un-kitting.
3) A pre-arranged fixed sum, to compensate for discomfort, added personal costs, overtime, etc.

There are five main types of **restricted areas** in the UK. It is the responsibility of the diver to familiarise himself with the location of the areas, which are marked on Admiralty charts or published in the Notices to Mariners. Ignorance is not a legal defence.

These areas are :-

1) Sites designated under the Protection of Wrecks Act 1973.
2) Marine Nature Reserves.
3) Military areas, both "restricted" and "danger"
4) Port Authority areas.
5) 500m around offshore installations.

Permission must be obtained from the relevant authorities before any diving takes place in any of these areas, and it is advisable to inform them if you are diving just outside the area. At present permission is not required to dive in a Marine Nature Reserve, but the disturbance and removal of specimens is not allowed without prior permission.

SECTION 2. ORGANISATION.

DWR97 interprets a "diver" as a person who is classed as "at work" when diving. All other people who expose themselves to hyperbaric pressure are "persons that dive".
It should be noted that DWR97 only recognises the appointment of a Diving Contractor, Diving Supervisors, and Divers. All other personnel involved in a diving operation are classed as "other competent persons" necessary to ensure the safety of the Operation.

Any Diving Group made up of personnel from a variety of organisations must dive under the organisational system of the Contractor, and any delegations must be made, in writing, for a set period.

A **Diving Group** consists of all the personnel involved in a Diving Operation, including divers, maintenance, transport, support, etc.

A **Diving Team** consists of the divers, persons that dive, diving supervisor, medical and other competent personnel, whom are required for the safe undertaking of a Diving Operation.

A **Diving Project** covers the whole of the diving involved in a particular scientific or archaeological project. It is made up of a number of diving operations, which may occur over a period of time or in different locations.

A **Diving Operation** lasts from the beginning of the preparation to dive, (i.e.loading the transport), to such time that no member of the Diving Team is likely to require therapeutic recompression.

Diving Contractor. Diving groups operate under the authority of the Head of the employing Establishment. This may be the Director of a research institute, the Principle or Vice-Chancellor of a university or the Managing Director of a commercial company. If any "contracted research" is undertaken by a Research Establishment, then the Diving Contractor is the Head of the Establishment, or his appointee, not the contracting agency. A Diving Contractor can delegate authority to a competent individual to act on his behalf, but he cannot delegate his responsibility.
The contractor is responsible for ensuring that all diving practices are carried out in accordance with DWR97. Contractors must register as such with the HSE, and it is an offence to employ any non-registered contractor.

Chief Diver/Diving Officer. Although this position has no meaning or relevance in DWR97 almost all scientific and archaeological diving units have such a post. This should be a responsible, competent, senior person who is able to represent the Contractor in matters relating to the organisation of the Diving Group. Whilst he must have a good, working, knowledge of diving, he need not be a currently active diver. He is also responsible for the day-to-day running of the Diving Group and therefore must be well qualified and competent in all aspects of the diving work undertaken by the Group. He is also responsible for all matters connected with diving safety, including training and equipment. It is his discretion that anyone, irrespective of training or qualifications, dives with, or uses the diving facilities of, an organisation. (Remembering that the ultimate legal responsibility always lies with the Contractor).

In more active organisations this job may be have to be split between two people. In such a situation it is usual for the Diving Officer to be responsible for the organisation, and the Chief Diver to be responsible for the day to day running and safety issues.

Diving Supervisor. A Diving Supervisor must be appointed, in writing, by the Diving Contractor, for each diving operation. The Supervisor has full responsibility for the diving team, during the operation, and must also ensure that the operation complies with DWR 97. He must be adequately trained or fully experienced in both the operational and safety techniques that are used, or may be required, for the particular operation that he is supervising, although he need not have been trained as a diver. It is advisable that he has suitable and adequate first aid training and is competent in resuscitation and emergency oxygen treatment. There is no requirement for him to have a current HSE medical certificate.

Divers. All divers must have the necessary qualifications required for the operation (see section 3), and be acceptable to the Chief Diver and Diving Supervisor. They must work under the instructions of the Diving Supervisor, but any diver must always have the right to refuse to dive, if he is at all dissatisfied with any aspect of the operation.

Dive Leader. This also has no meaning under DWR97, but is the person chosen by the Diving Supervisor to be in charge of divers, working together, during the period spent in the water.

Dive Buddy. A term given to a dive partner who, in an emergency situation, would be available to provide assistance to another diver.

Ship's Master. The Ship's master is in charge of the vessel acting as mother ship for a diving operation. He is responsible for the safety of the vessel, and all personnel aboard. Consequently he has the final veto on the deployment of divers, standby boats, and equipment, if he feels that current or anticipated conditions would endanger his vessel, or prevent him rendering assistance if required. He must also ensure that no work is carried out on the vessel which may endanger any diver in the water, or prevent any assistance being instantly rendered in an emergency. In smaller vessels the coxswain takes on a similar role.

Scientific or Archaeological Project Leader. He is responsible for the scientific/archaeological objectives of the operation. Although he need not be a diver, he must closely liaise with the Diving Officer/Chief Diver at the earliest possible stage of planning. Irrespective of rank, he must defer to the Chief Diver/Diving Supervisor/Ship's Master/Coxswain on any, and all aspects, of safety. If the scientific or archaeological project leader is also acting as a Diving Supervisor then he must take great care to avoid any conflict of interest and always put the operational safety interests before the scientific or archaeological interests.

SECTION 3. CERTIFICATION AND TRAINING.

Any diver who is at work must be in possession of an appropriate level HSE approved diving certificate, and a current HSE approved medical certificate. (In certain circumstances an amateur diving qualification and/or an amateur medical certificate are approved. Refer to Sections 1 and 10.3 for details).
All other divers must have a sports diving certificate and a current sports diving medical. (See section 10.3 for several sports diving qualification comparisons).

Any certificate of medical fitness states that the diver was fit to undertake diving, subject to any restrictions or limitations listed on the certificate, on the day that the examination took place. It does not state that the diver is currently medically fit, neither does it state that the diver is competent to undertake any particular diving task.
It is the diver's responsibility to inform the Chief Diver/Diving Officer of any transient problem(s) that he may have which affect his diving ability.
Information given to a Doctor, or discovered during a diving medical examination, is subject to the ethical standards and rules regarding all medical information. When any medical condition is present which may affect the safety of the individual or the team, in any way, the Chief Diver/Diving Officer must be notified of this. Either the diver must divulge the information himself, or give permission for the Doctor to do so.

Care must be taken to ensure that both the diving certificates and medical certificates are appropriate to the type of diving operation planned.

It is realised that although the training involved in obtaining a diving certificate is suitable for obtaining the certificate, it may not be suitable for undertaking a particular task safely. Chief Divers/Diving Officers must always allow time for "on-the-job" training as and when it is required for any diver, and any task.
All diving personnel must become fully familiar with any new skills or equipment in sheltered, stress free, situations before using them elsewhere.

A Diving Operations Log, and an individual Divers Log, are obligatory, and must be kept for at least two years following the diving operation. The minimum information which must be recorded in them may be found in sections 10.6 and 10.7.

Various personnel in any diving operation may also require special certification for equipment such as boats, vehicles, radios, etc.

All divers must remain diving fit, and it is strongly recommended that an "in date" system be maintained for all research divers.
Any diver is deemed to be ready for a working dive if, within the last month, he has undertaken a working dive, or a dive with a simulated task of work, to at least 20 metres for at least 20 minutes.
If the diver lapses from in-date readiness, then the following table of work-up dives should be applied. These dives should be assumed to be the minimum required, and if a Chief Diver has any reservations as to the fitness of any diver then the series must be extended or repeated.

Time Lapse.	Working Depth.		
	10 metres.	10-30 metres.	> 30 metres.
1-2 months.		10 metres.	20 metres.
			30 metres.
2-12 months.	10 metres.	10 metres.	10 metres.
		20 metres.	20 metres.
		Working depth	30 metres.
			Working depth
> 12 months.	Pool Test.	Pool Test.	Pool Test.
	10 metres.	10 metres.	10 metres.
		20 metres.	2 X 20 metres
		Working depth	2 X 30 metres
			Working depth

Dry dives in a compression chamber are not suitable for maintaining diving readiness. They may, however, be useful to familiarise divers with certain complex tasks where nitrogen narcosis is expected to be a factor.

An important factor of safety in any diving operation is teamwork, and recorded qualifications of team members are not, in themselves, a measure of safety. Diving teams, particularly when specialised tasks are envisaged, should train together until the required level of cohesion and mutual trust is reached. The Diving Supervisor must be aware which pairs of divers work best together. It is important that any individual who turns out to be incompatible with more than one or two of the rest of the team be dropped from the team. This requires a great deal of tact from everyone concerned.

SECTION 4. SAFETY.

Individual and team safety is the responsibility of every individual on the diving team. A situation which may develop into an unsafe situation must not be ignored, but must be dealt with immediately. All members of the diving team must be aware that safety takes precedence over rules, and the blind following of any rule book is no substitute for common sense. If, however, any rule is broken or ignored in the interests of safety then the Chief Diver/Diving Officer should be supplied with the full details as soon as possible, to enable any necessary alterations to be made.

Diving safety may be considered under four headings, general, pre-dive, on-dive, and post-dive. However most accidents and panic situations occur on the surface and, as prevention is better than cure, all stages of diving safety require pre-dive planning and risk assessment. (Sections 10.4, 10.5, and 10.6).

4.1 GENERAL SAFETY CONSIDERATIONS.

4.1.1 The Project Plan.

Prior to the start of any dive it is the duty of the Diving Contractor to ensure that a Project Plan and primary Risk Assessment has been drawn up. (Sections 10.4 and 10.5). The Contractor need not undertake this personally, and it is usually delegated to the Chief Diver/Diving Officer or the Diving Supervisor.

4.1.2 Risk Assessment.

If, as is usual, the Project consists of more than one Diving Operation then it is probable that each Operation, or series of Operations, will require a site and date specific Risk Assessment. (Section 10.5). This can be much briefer than the Project Plan Risk Assessment and will cover the specific variables, such as weather, tide, boat traffic, darkness, etc., anticipated at a particular site or on a particular time/date.

4.1.3 Manual Handling.

The manual handling of all the larger and/or heavier items of equipment utilised in a diving operation involves a high risk as assessed under the Health and Safety Manual Handling Operation Regulations 1992 (see section 10.6). The main dangers involved are the weight and unwieldiness of the equipment, coupled with the fact that it must be carried outdoors, in all weathers, in varying light intensities, and over uneven ground or a deck with unpredictable, acute, movements. As there is, usually , no way to mechanise the handling of diving equipment it is the duty of the Chief Diver/Diving Officer to ensure that all members of the diving team are aware of the possible hazards involved in the physical handling of diving equipment, and have received any necessary training in lifting methods.

4.1.4 Maintenance.

All items of equipment used in any part of the diving operation must have a regular maintenance schedule. Any item of plant or equipment owned by, or rented or leased to the Diving Contractor and which affects the personal safety of the team must have an individual maintenance sheet showing the date of service, the level of service, any problems/repairs, any restrictions as to use, and the signature of the competent person checking it. Any certification issued by a test

house/service centre must be attached to this schedule. All such equipment must be checked every six months, or more frequently if required by either manufacturers recommendations or international or European standards.
Any diver using their own equipment must confirm to the Supervisor that it has been serviced and/or tested in accordance with the appropriate suppliers schedules and/or statutory requirements under any other Regulations. This must be recorded in the Diving Project Record.
Immediately prior to each dive every diver must carry out a pre-dive visual inspection and check of their equipment.

4.1.5 Purity of breathing gas.
Whatever the breathing gas used, it must be as pure as possible. Air compressors must be well maintained - at least to the manufacturer's standards - with an accurate log book showing filter and oil changes. Care must be taken to ensure that the incoming air is as clean and pure as possible. It may be prudent to set up the compressor so that the operator is always beside the inlet and able to smell any contaminants. Air tests, using a proprietary gas analysis kit, must be taken regularly. The recommended standards of air purity in the UK are as follows :-

BS 4001.	
Nitrogen.	As atmospheric.
Oxygen.	As atmospheric.
Carbon Dioxide.	500 parts per million.
Carbon Monoxide.	10 parts per million.
Oil.	1 milligram per cubic metre.
Water.	As dry as possible, and not give rise to condensation at temperatures above 4.4 degrees centigrade.
Solids and dust.	Free from dirt, dust, and metallic particles.
Odour and taste.	Free from odour and toxic or irritating ingredients.

If there is any doubt whatsoever over the purity of the air, then it must be tested, and the compressor operator informed, immediately. Refer to Section 5 for standards for breathing gases other than air. It should be borne in mind that food and drink, apprehension, or a contaminated demand valve may also be the reasons for an apparent bad taste to the breathing gas.

4.1.6 Physiological.

4.1.6.1 Food and drink.
A normal diet is sufficient for most diving operations, and is therefore best left to the individual's normal tastes. However, it is preferable that regular light meals be taken throughout the day rather than any heavy or large amounts at one sitting. Care must be taken to ensure that sufficient fluids are ingested to combat dehydration under all circumstances, and fluid intake must not be restricted in order to avoid the awkwardness or embarrassment of urinating when wearing a drysuit in mixed company. Salt supplements are only essential in hot climates, or during particularly warm spells in temperate climes.

4.1.6.2 Alcohol.
Alcohol is a drug which enhances the effect of nitrogen narcosis, alters thermoregulation, causes vasodilation, reduces the blood sugar level, increases the risk of vomiting, and induces dehydration - with the attendant increased risk of decompression illness. A hangover includes disturbances of the cerebral, cardiac, and glucose metabolic processes, all of which are potentially fatal in a hyperbaric aquatic environment. Alcohol should, therefore, be avoided during a diving operation, and must be avoided for 24 hours prior to any dive over 30 metres.

4.1.6.3 Fatigue.
A tired diver puts both himself and the rest of the team at risk, and must not be allowed to dive. Any diving programme must be planned to allow the diving team sufficient rest and sleep.

4.1.6.4 Cold.
Any member of the diving team who becomes excessively cold is liable to rapid fatigue and errors of judgement and will be unable to cope with usual diving tasks let alone emergencies. If hypothermia becomes a factor, then consideration must be given to abandonment of the current diving programme, followed by a major revision of it. The Diving Supervisor must pay attention to the cold and wind chill for all members of the diving team. If he is not seen to do this then morale will suffer, with a corresponding decrease in willingness and enthusiasm. A diving programme must be organised to enable the divers to remain as warm as possible up to the time of their dive, and regain warmth after a dive. A temporary shelter at the dive site may be necessary and showers/a bath should always be available at or near any site where hypothermia is a possible problem. In such a case it may also be prudent to include a supply of charged chemical heating sachets in the on-site first aid kit. Sufficient time must be allowed between repeat dives for the divers to be totally rewarmed, and hot drinks, together with a high-calorie diet, should be provided during cold-water diving. Body core-temperature monitoring may be considered for any prolonged cold-water diving project. A drop of more than 2 degrees centigrade, or a reading of less than 35 degrees is dangerous. Mouth temperature is very unreliable when trying to assess the thermal status of a diver because it is depressed by inhaling cold air from the compressed air supply and so core temperature should be monitored as rectal temperature. It must always be remembered that surface personnel are also at danger from hypothermia.

4.1.6.5 Drugs.
There are two basic categories of relevant drugs, those which are addictive or mood altering, and those administered for medical reasons.
Although alcohol is considered an addictive, mood altering drug, there is no prohibition unless the diver is actually under the influence of alcohol, or there is evidence of unusual behaviour owing to a drinking problem. Otherwise there are no circumstances when personnel who use addictive or mood altering drugs, or who have done so in the recent past, can be allowed to take part in any facet of any diving operation. Any potential member of a diving team who has a history of drug abuse must be cleared by a doctor competent to consider the physiological effects of diving on drug syndromes.
The medical use of drugs during diving should be avoided if at all possible, because of the considerable concern that the effects of many drugs in common use may change under hyperbaric conditions. Divers must inform their Chief Diver/Diving Officer if the are using any drugs, including self-medication for such common problems as headache, colds, seasickness, etc. The Chief Diver/Diving Officer may then wish to restrict the drug's use, or limit the diver's activities. Medical advice must be sought if there is any doubt as to an individual's ability to function safely.

None of the practices listed below are encouraged, but they are the most common forms of self-medication, with their side effects. Seasickness is usually alleviated using two groups of drugs, Hyoscine or Antihistamine. Both can cause drowsiness to a greater or lesser degree and should initially be tried during a period of non-diving sea-going.
Pain-relieving drugs should be avoided during diving, although the use of aspirin or acetaminophen is not prohibited. If the pain is severe enough to require drugs then the diver is probably not fit enough to dive, and the simple headache may be masking a more serious medical problem.
Using non-prescription nasal drops to clear nasal catarrh and facilitate ear-clearing may be permitted, but the use of prescription drugs for this purpose may only be used with medical supervision. Any form of upper respiratory tract infection, (common cold, sinusitis, middle ear infection, tonsillitis, sore throat, etc.), imposes an absolute ban on diving until the infection has cleared.

4.1.6.6 Menstruation, pregnancy and diving.
The physical and mental alterations immediately prior to, and during, menstruation alter many individuals' responses to the rapid-decision making often required in diving safety.
It is recommended that all diving ceases if pregnancy is suspected or confirmed.
Owing to the foetal deforming characteristics shown by hyperbaric oxygen, extreme care must be taken if any diving is undertaken whilst pregnant. As the major danger to the child occurs in the first trimester, caution must be exercised if there is any suspicion of pregnancy. At the very least the dives should not be deeper than 20 metres, and should be at least two stops clear of the no stop time allowed on the table. A standard therapeutic treatment for decompression illness has been shown to carry a very severe risk of causing some degree of foetal deformity.
Diving must not be resumed following pregnancy until a hyperbarically qualified doctor has recertified fitness.

4.2 PRE-DIVE SAFETY.
The importance of good planning, common sense, and keeping the equipment as simple as possible, cannot be overstressed.
Any dive plan must take into account the practical and physiological limitations of in-water working, as well as the scientific or archaeological objectives. Very few tasks involving divers working from either shore stations or boats go totally according to preconceived ideas, and hence every plan must have a degree of flexibility and adaptability built into it.
Check lists should be used to ensure that none of the essential equipment is overlooked. Particular attention must be paid to first-aid stores, including the oxygen-administration kit, spares, repair kits, and methods for obtaining emergency aid - flares, radios, portable phones, phone cards, etc. Gas and fuel levels must be checked, and spare batteries must be carried for any item of safety equipment that requires battery power to function.
At least two members of the team should be trained in diving first-aid, and one of them must be on the surface at all times. If the risk assessment indicates that a diver-medic is required then he must be on the surface at all times. All members of the team should be trained in expired air resuscitation, oxygen administration and external cardiac massage.
Every member of the team must have immediate access to a list of relevant emergency information. This list will vary from area to area, but must include such information as location, access routes and call-out routes for emergency services such as Coastguard, Ambulance, Recompression Chambers, Helicopters, Police, Lifeboats, etc. Usually all that is required is rapid

contact with the local Coastguard, and they - if they have been kept informed of the diving operation - will co-ordinate any and all other required services.
All equipment which is to be used in the water must be checked just prior to deployment and use, this can be part of the buddy check or a totally separate check and must be observed by the Supervisor. Individual divers are usually solely responsible for their personal gear, but if communal equipment such as cylinders are used, any item with a known fault must not be returned to the store. It must either be repaired immediately or labelled/removed to obviate the possibility of its use by another person.
All signals, diver to diver, diver to surface, surface to diver, and recall, must be agreed upon and fully understood by all members of the diving team.
The Diving Contractor should be aware of the contact addresses of the next-of-kin for all the diving team, including volunteers.

4.3 ON-DIVE SAFETY.
As previously stated no set of guidance notes can cover every situation, and it is the responsibility of the Chief Diver/Diving Officer to ensure that safety procedures followed take into account any localised surface or sub-surface hazards, and identify them in the risk assessment.
A minimum diving team should be at least three persons, at least one of whom must remain on the surface at all times. The divers normally should work in pairs, within physical or visual contact of each other, and close enough to render assistance in an emergency. If a diver becomes separated underwater the whole group should surface. Once contact is regained the Dive Leader must make the decision whether to terminate the task, or re-descend. In many circumstances a buddy line between the divers is advisable to prevent accidental separation.
It is strongly recommended that a fully kitted stand-by diver, with no decompression loading, fully trained and certificated in the diving equipment used by the divers, and with an independent life-line/buoy-line also be present. This fourth person is essential in any circumstance that presents an increased hazard to the divers, i.e. operations deeper than 30 metres, where in-water decompression stops are planned, where there are snag hazards or no clear surface, etc.
There are circumstances when it is safer for a diver to undertake a task alone, in such instances the diver must be firmly connected to a line to the surface, and there must be a fully kitted stand-by diver.
Wherever possible each diver, or at least one of the group of divers, must be connected to a line leading to the surface. This line should either be a tendered life-line or attached to a surface marker buoy of sufficient size that it cannot readily be pulled under by the diver. The line must be of a strength and size so that it can be used to recover the diver and his equipment to the surface, and then from the surface to the boat or shore, in an emergency.
Every diver should carry some type of independent reserve breathing system containing sufficient breathing gas to safely return to the surface, at any part of the dive, in an emergency. This emergency breathing supply must contain the same gas mix as the primary supply, and both sets must be clearly marked with the gas mixtures they contain. Oral communications should be used only when the use of the type of mask required does not decrease safety back-up, i.e. the reserve air system must be compatible and there must be no possibility of the diver requiring to use a snorkel on the surface.
A BC or ABLJ must be worn at all times when using SCUBA. This jacket must be capable of supplying sufficient buoyancy to lift the diver, with all equipment worn by or fastened to him, from 50 metres, and support him in a face-up position on the surface. The jacket must also have the facility for rapid venting. The buoyancy must be available for use in an emergency, and hence

the jacket should not be used to provide lift for any equipment carried. This could also lead to a dangerously rapid rate of ascent if the equipment was dropped.

All weight belts must be fitted with a quick-release buckle, which must be capable of being released with either hand.

All divers must be thoroughly familiar with both their own equipment and any possible buddy's equipment before commencing each dive.

4.4 POST-DIVE SAFETY.

Most accidents and panic situations occur on the surface, and as prevention is better than cure post-dive safety requires pre-dive planning.

Although a dive ends when the diver exits the water a diving operation is not finished until the possibility of a diver suffering from a pressure-induced illness is negligible- consequently, divers may require monitoring for up to 48 hours after surfacing.

No diver should enter the water without first being aware of the preferred exit. This must take into account all foreseeable changes in weather, sea-state, tide-height, etc., during the dive. The exit route must also be suitable for the recovery of an unconscious diver. This preferred route, and the method of utilising it, will have been established in the risk assessment. (Section 10.5).

The supervisor must be confident that the divers are carrying sufficient suitable diver-location aids to ensure that their position can be monitored at all stages of the dive, and that they can be re-called if required.

Any essential emergency equipment, such as first-aid kits, oxygen, lifting harnesses, radio, etc., must be at hand at the exit point.

All members of the diving team should be sufficiently well briefed, and practised, to enable them to take independent action in any aspect of any emergency situation.

SECTION 5. NON-SELF CONTAINED OPEN CIRCUIT AIR DIVING SYSTEMS.

For various reasons, prolonged exposure, compactness, absence of bubbles/noise, etc., it sometimes appears preferable to use diving systems other than the SCOA defined in the DWR97 Diver Training Standards. Reference must then be made to the appropriate training standards - either DWR97, an HSE recognised training school or a Military training establishment which complies with BR 2806.

Scientists or archaeologists who wish to utilise surface demand equipment must attend a training course recognised by the HSE. Their diving operations must comply with all aspects of the relevant certificate.

Scientists who wish to utilise any type of mixed-gas equipment must attend a course recognised by the HSE. Their diving operations must comply with all aspects of this certificate.

Oxygen diving can only take place following a full course of instruction from an MoD establishment authorised to train with this type of equipment. Diving must then comply with BR 2806. It is extremely unlikely that a civilian will be accepted for this training. Diving on pure oxygen is not possible under DWR97.

SDSC NITROX GUIDANCE NOTES

(Third revision - December 1996)

These Guidance Notes for use of Nitrox only relate to shallow water (i.e. not deeper than 30 m) scientific or archaeological diving, and must not be applied to any other form of mixed gas diving.

General

1. No Nitrox diving may be carried out unless having previously attended an approved Nitrox course specific to the requirements detailed in these guidance notes for scientific and archaeological Nitrox diving.
2. Before being allowed to undertake the Nitrox course, divers must hold the minimum standard qualifications for work diving.
3. Maximum partial pressure of oxygen (ppO_2) for use by open-circuit, semi-closed and closed-circuit SCUBA apparatus must not exceed 1.4 bar. (For Surface Demand Diving Equipment - SDDE - a maximum ppO_2 must not exceed 1.5 bar).
4. An oxygen tolerance test (2.8 bar ppO_2) should be considered for all divers intending to undertake Nitrox diving. Tolerance tests should be undertaken at regular intervals and records entered into the Nitrox log book.
5. Maximum working depth must not exceed 30 metres.
6. Dives involving decompression stops must not be undertaken.
7. It is not advisable for cumulative central nervous system O_2 toxicity percentages to exceed 80%.
8. No person may supervise a dive unless fully conversant with Nitrox techniques, and is qualified to do so.
9. Full face masks should be used where possible. Where half-masks are used, restraining straps should be attached to regulators.
10. Any secondary emergency breathing supplies must be filled with the same gas mixture as the primary breathing supply; the gas mixture clearly marked on the bottle. Emergency bottles and regulators must be dedicated to Nitrox use and maintained accordingly.

11. The stand-by diver or divers must be equipped with the same gas mixture as that being used by the in-water diver or divers.
12. Any diver convulsing underwater, should not be moved up through the water column during the convulsion. Immediate attention should be given to aiding the convulsing diver retain breathing gas supply. The diver should only be raised once the convulsion has subsided.
13. It is recommended that decompression for Nitrox dives is calculated using air tables, see section 8.2, incorporating the Equivalent Air Depth (EAD) for that dive.

Mixing

1. Person or persons responsible for gas mixing must have attended an approved gas mixing course.
2. Cylinders must be clearly marked with the mixture contained in them.
3. The mixture content of cylinders must be checked twice, once on filling the cylinder(s) and secondly, immediately prior to embarking on the dive. In both instances the diver and dive supervisor must confirm the content and register the result in the Nitrox log book. These two checks should be carried out using separate analysis equipment to reduce the risk of equipment error.
4. Equipment used in Nitrox must be designated O_2 cleaned and must not be used for any other purpose. When not in use, hose ends etc. must be capped or sealed.
5. Equipment designated for Nitrox use should be stored in a clean, dust and dirt free location separate from other items of diving equipment.

Semi- or Closed-circuit Rebreathing Equipment Operating Procedures

These guidance notes are generic for all rebreather sets. It is recommended that use of rebreathers is restricted to modern recreation-orientated sets. Training courses may be stipulated by the various equipment manufacturers and may have to be complied with prior to obtaining the equipment.

1. No rebreather diving, or supervision of that diving, may be carried out unless having previously attended an approved rebreather course specific to the requirements detailed in these guidance notes.
2. Before being allowed to undertake a rebreather course, divers must be able to demonstrate previous training and experience in open-circuit Nitrox use to a reasonable and acceptable level.
3. Maximum ppO_2 must not exceed 1.4 bar.
4. Maximum working depth must not exceed 30 metres.
5. Maximum possible counterlung O_2 content must be used for calculating depth limitations and cumulative central nervous system O_2 toxicity percentage.
6. Dive endurance should be governed using air decompression tables incorporating the Equivalent Air Depth (EAD) for that dive. Dives involving decompression stops must not be undertaken. Dive duration must not exceed 90% of the CO_2 absorbent duration time recommended by the manufacturer of the particular rebreather.
7. Divers should be marked with a conspicuous surface marker buoy of sufficient size to prevent submergence and be capable of supporting the weight of a fully equipped diver.
8. Buoyed swim lines must be tied off at the maximum depth relating to the nitrox mixture being used.
9. Full-face masks with integral mouthpieces should be worn.

10. Only CO_2 absorbent specific to the particular rebreather model should be used. The diver and supervisor should be aware of the any effects of storage, re-use, and in-canister time on the efficiency of the particular absorbent.
11. The flow rate of manually-set reducers should not be set until immediately prior to embarking on the dive. When using a rebreather with fixed flow-rate jets, the performance of the jet should be tested each time it is replaced. The flow rate being used on each dive should be confirmed by the diver and dive supervisor and noted in the Nitrox log.
12. A pre-dive pressure test is recommended prior to embarking on a dive. The counterlung of the rebreather should be observed to inflate fully and blow-off through the relief valve when the gas flow is turned on.
13. If the CO_2 absorbent being used requires activation prior to the dive then this must be carried out in accordance with the manufacturers instructions.
14. A leak test must be carried out on each rebreather unit at the surface by the supervisor. A second test may be conducted below water by the divers. Any leaks from the apparatus must result in termination of the dive.
15. If the diver remains at rest for any prolonged period, and on completion of the dive, immediately prior to surfacing, the counterlung must be emptied and re-filled, ideally more than once.
16. Divers should not undertake strenuous activities using rebreathers.
17. A separate bail-out system must be carried by divers using rebreathers, capable of supporting an ascent to the surface. Where bail-out would have to be carried out without a mask on (where full-face masks were being used), this action should be practised regularly. All divers should be made aware of the effects of full or partial flooding of the rebreather system being used.
18. The rebreather apparatus must be cleaned, disinfected and dried after use. It is recommended that rebreather units, and all the individual parts within, are marked unit-specific and, where possible, designated for exclusive use of an individual diver.

<u>Maintenance</u>

1. Person or persons responsible for the maintenance of Nitrox equipment must have attended an approved Nitrox equipment maintenance course. Records must be kept in a Nitrox equipment maintenance log.
2. <u>Open-circuit</u>. Maintenance of cylinders, demand valves and associated equipment should be carried out on a regular basis (not less than 6 month intervals) and the results recorded in the Nitrox equipment maintenance log.

   (i) *Cylinders*. The overall condition of the cylinders, pillar valves and 'o' rings should be noted in relation to external damage. When stored for a period of more than 6 months, cylinders should be emptied to 50 bar pressure.

   (ii) *Demand valves*. Attention should be given to valve cleanliness; condition of the diaphragm, first stage spring, valve seat, 'o' ring seals, LP and HP hoses; contents gauge accuracy; LP setting of the first stage; tilt valve and second stage valve seat operation; sintered bronze filter cleanliness; and that the diaphragms, seals, 'o' rings are oxygen compatible.
3. <u>Rebreathers</u>. Maintenance must be carried out on a weekly basis.

   (i) *Counter lung*. Visual inspection of the bag, clips and buckles. Inspection of any integral weight quick release mechanism. Removal and inspection of the counter lung blow off valve diaphragm. Check the operation of any blow off valve assembly. Inspect breathing hose/hoses for wear, and that all joints are secure. Inspect soda lime canister mesh sieves for damage and/or distortion. Inspect face mask, mouthpiece, spit cock and restraining strap for damage.

(ii) *Supply hoses*. Inspect end fittings for wear and replace as necessary.

(iii) *Cylinders*. Inspect threads for cleanliness and damage.

(iv) *Reducer*. Test the operation of the reducing valve using a flowmeter and high/low pressure (HP/LP) pressure gauges. Inspect the mixture jet for cleanliness.

SURFACE SUPPLIED DIVING EQUIPMENT GUIDELINES.

Surface Supplied Diving

Some scientists and archaeologists have recognised the benefits of using surface supplied diving equipment. Dives are not limited by cylinder capacity or the diver's rate of breathing gas consumption. The quality and reliability of hard wire voice communication allows an efficient flow of data from the specialist on the seabed to those on the surface. When linked with a video camera set up to cover the diver's field of view, meaningful discussions can be held between the diver and the surface team, with both being able to see what is being discussed. This helps improve the interpretation and understanding of seabed phenomena. Dive profiles can be monitored and controlled from the surface, allowing the divers to concentrate more on their scientific or archaeological work rather than the management of their dive.

In addition to the gains in efficiency, safety margins are increased. If a diver has a problem the supervisor can be informed immediately, and measures can be taken to improve the situation. If there is a serious incident, the supervisor always knows precisely where the diver is, and the standby can be easily directed to give assistance underwater.

Team Size when using SSDE

The minimum diving team size will be determined by the diving supervisor's pre-dive risk assessment but, in any case, should never ever be less than four if using SSDE, or SCUBA with tethered divers. The minimum team should be made up as follows:

1. Diving supervisor
2. Diver
3. Standby diver
4. Diver's attendant

It would be rare for the risks to be so low that a four-person team would adequate. It is recommended that five is the minimum team size so that an attendant is available for the standby diver.

All members of the team must be appropriately trained and competent to both undertake the task they are required to do and to operate any equipment they are required to use. The use of full face masks and helmets can make ear clearing more difficult compared to wearing a half mask. All divers, and particularly standbys, must be able to clear their ears easily when wearing such equipment in case of emergencies.

Additional divers

Where the risks from underwater hazards are above average, there must be another diver in addition to the standby diver. This additional diver should be fully suited ready to give assistance on the surface. The diving supervisor may consider using an additional tended diver to manage the divers umbilical on the sea bed. Every additional diver who is used for anything other than surface support must have voice communication, and must be on a lifeline with a separate attendant. This would increase the team size to seven.

Attendants
Attendants must be competent to do the work. They must ensure that the umbilical is adequately tensioned to reduce the danger of slack in the lifeline fouling on a snag, or excessive slack causing an increase in drag in the current.

Equipment
All SSDE equipment must be specifically designed for the use it is to be put. The equipment can be divided into five categories, these are: gas supply; gas control system/panel; umbilical; communications; general.

Breathing Gas supply
This can be in two forms, a bank or a low pressure compressor.

1 Breathing gas bank

Banks of gas can be made up from SCUBA cylinders or other high pressure cylinders, or from cylinders provided by suppliers of breathing gases. HP cylinders should only be filled with breathing gases to the appropriate British Standards. If air is the gas, the cylinders must be filled to the same specification as set out in 4.1.3 of these Advice Notes. If Nitrox or other breathing gas mixtures are used, it is best obtained from a reputable supplier of breathing gases. If individual SCUBA cylinders are filled by sources set up for recreational divers, extra care must be taken with checking the gas quality (see section 5 on Nitrox).

2 Low pressure compressor

Breathing air provided by LP compressors must be filtered to remove all contaminants to BS4001 (see section 4.1.3). If the filters are not automatically vented then these must be attended to at intervals no more than that recommended by the manufacturer. All venting systems must take care not to contaminate the environment with oily emulsions. These should be collected and disposed of in accordance with local regulations.

The air intake for the compressor must be sited to avoid taking in gases and contaminants that could endanger the health of the diver. Particular care must be taken if internal combustion engines are running in the vicinity. The air intake should also be secured so that it cannot fall into the water.

Breathing Gas Reserves
When a diver is using SSDE, two emergency reserves for use in the event of a supply failure must be immediately available, one on the surface and one with the diver.

Surface Reserve/Back Up
The surface emergency supply must be at least 2000 litres of free breathing gas for each diver, and will be connected to each diver's supply by a simple, dedicated valve controlled by the diving supervisor.

Diver bale out
There must be a bale-out cylinder on each SSDE divers' back. All SSDE divers must be trained to operate the emergency valve which switches this supply into the breathing circuit. Both the diver and the standby diver must demonstrate to the diving supervisor at the start of every diving operation that they can operate their bale-out valve.

The bale out must contain at least 1000 litres of breathable gas (see table). This would allow a diver at 50m on a no-stop schedule to comfortably reach the surface at a breathing rate of 15 Litres/minute per bar of ambient pressure. If there are risks from entanglement, or the need to do decompression stops, then the risk assessment should take this into account an specify a larger volume to be carried by the diver.

Typical cylinder water capacities	Working pressure	Maximum volume of breathable gas	Minimum pressure which provides 1000Litres of breathing gas
6 Litre	300 bar	1800 Litres	**170 bar**
10 Litres	232	2320 Litres	**100 bar**
12 Litre	232 bar	2784 Litres	**85 bar**

Gas Control Systems
Gas from HP banks will need to be reduced in pressure to the limits set by the manufacturers of the breathing equipment the diver is wearing. This intermediate pressure within the gas hose may fluctuate with changes of the depth of the diver and the pressure from the supply cylinders must be regulated. Pressure adjustments will normally be made by the supervisor unless there is an automatic pressure correction system. In any case there must always be plainly marked and visible gauges that allow the supervisor to constantly monitor the medium pressure and the high pressure parts of the system. Additionally the pressure of reserves of breathing gas should also be visible.

In its simplest form the, a gas control system might be an adjustable reducing valve attached directly to a SCUBA cylinder with two needles within one dial indicating high and intermediate pressures. However, most SSDE diving is controlled from a panel, sometimes contained within a portable case, which has separate gauges for the diver's supply pressure and for surface breathing gas reserves, as well as valves able to switch from different supplies and to different divers. The control panel normally incorporates instrumentation such as communications, depth monitoring (either electronic or by pneumo fathomometer). If Nitrox is the breathing gas, there must be an inline O_2 monitor.

Umbilical
The umbilical in its simplest form might be a single air hose, or it may be made up of a collection of hoses and cables bundled together to supply the breathing gas, communications, depth monitoring, or power for a lamp. The umbilical must be capable of supporting the weight of a fully equipped diver.

Gas supply hoses must be designed for diving, and must be kept clean internally, and be free from kinks, cuts and abrasions externally. It should have a minimum internal diameter of 9mm and conform to BS SAE 100R3. Other hoses and cables in the umbilical must also be suitable for the task. Ideally they should be plaited together, but they can be taped together at *c*.150mm intervals using a good quality 'duct' tape or similar.

The umbilical must be must be securely attached to the diver. This is best done with a locking carabiner on a 'Chinese finger' attached to one or more component of the umbilical, and then fastened to a D-ring on the diver's safety harness. The topside end of the umbilical should be similarly attached to a secure point on the diving platform.

Umbilicals should ideally be positively buoyant. If the weight of communication, video and other cables, makes the umbilical neutral or negatively buoyant, floatation collars or similar devices can be added. In practice if the 20m adjacent to the diver is buoyant, and the line is tended properly, most problems are eliminated in non-industrial diving unless many additional tens of meters of negatively buoyant umbilical are payed out. It is best to keep horizontal distances between the diver and the attendant as short as is practicable. The normal maximum length of an umbilical should be 100m.

Tending lifelines successfully is a skill that has to be learnt by experience. Recognising the difference in the feel of a taut umbilical caused by the diver moving, compared to it being pulled by the current, is not always easy.

Diver Communications
All SSDE divers should be in voice communication with the diving supervisor. Normally this will be a hard wire system integral to the umbilical and divers' full face mask or helmet connected to a proprietary diver communications system on the surface. Divers on surface supply should not use a half mask and a separate mouth piece of the cavity type that is held in place by a strap to allow speech. The cost, quality and reliability advantages of a hard-wire systems compared to through water communications makes the latter less desirable, but may be used in special circumstances. Should voice communications fail during a dive then the operation should be aborted. All divers using SSDE must be familiar with the *Single Lifeline Code of Signals* for use in an emergency.

The communication system should be permanently 'live' for diver to surface communication but 'press-to-talk' from the surface to diver. A crossover facility for diver to diver communication should be available to the supervisor. Voice communications between divers and the surface should be relayed to attendants, if necessary by a speaker capable of being switched off when required.

All voice communications should be recorded and stored until it can be reasonably anticipated that divers will not need therapeutic recompression, or until the consequences of any incident are resolved. The recording can be on video or audio tape, or other electronic means.

General Equipment

Buoyancy devices

All divers using SSDE must have the means of increasing their buoyancy by a quick release method of jettisoning weights. A suit inflation system should be regarded as a means of improving insulation and not as a primary buoyancy device. If the risk assessment suggests additional buoyancy may be necessary, then a proprietary buoyancy compensating device should be worn by divers.

Instruments

The diving supervisor must be able to monitor diver's depths when SSDE is used. Normally, this will be either an electronic depth sensor on the diver connected to a display adjacent to the diving panel, or a conventional pneumo fathometer. Depth sensors and the open ends of pneumo tubes should be attached close to the diver's chest, and the display must be easily visible to the supervisor.

Each diver should also be equipped with an underwater depth gauge that has facility to record the maximum depth, and should normally carry a compass.

Pollution and hygiene

All members of the diving team should help keep communal equipment clean. Oral-nasal masks should be rinsed with fresh water and disinfected after every dive. Helmet interiors should be kept aired and dried, special effort should be made to keep helmet liners clean and dry.

Operational procedures

Entering and leaving the water

The diving supervisor must ensure that diving equipment is checked immediately prior to the diver entering the water, and that the check is recorded in the diving operations logbook.

Divers should enter the water at a suitable safe entry point, and must normally be able to emerge unaided. On dive boats this will often mean re-boarding using an open rung diving ladder. Care must be taken to assess the feasibility of deploying surface supplied divers from an inflatable boat as the weight of some helmets out of water may make it impracticable to climb aboard over the sponsons.

Descent and ascent protocols using SSDE

Divers must not enter the water until instructed by the supervisor.

- Divers must inform the supervisor when they leave surface.
- Divers will normally ascend and descend on a shot line or down line.
- Divers must inform the supervisor when they make bottom.
- The diving supervisor will give divers adequate notice of the need to leave bottom.
- Divers must inform the supervisor when they leave bottom.

The supervisor must manage SSDE diver's ascent rate by giving necessary information verbally to the diver. The supervisor should instruct the diver at which depths stops should be made, and for how long.

All persons engaged in diving operations must be familiar with the protocols in use, and be issued with an individual copy of the diving rules applicable to the diving operation.

Decompression
Diving operations shall be conducted using an approved Air Diving Table (see section 10.3).

The supervisor shall calculate the schedule for the planned diving operation before the dive, and re-assess during the dive. These calculations must be checked by a second competent member in the surface crew and entered in the diving operations log.

SECTION 6. DIVING IN SPECIAL AND EXTREME CONDITIONS.

6.1 DIVING UNDERWAY.

For the purposes of this section the term underway shall apply to vessels moving through the water. A standby boat is required if the vessel is of such a size that it cannot rapidly approach divers for pick up, or if it's manoeuvrability is in any way restricted. The standby boat must be in radio contact with the mother ship. All vessels must display the light/shape signals appropriate to the International Regulations for the Prevention of Collision at Sea (IRPCS), 1972. A local broadcast to shipping on VHF may be helpful. All powered vessels should be fitted with propeller guards if this is at all possible to achieve.

The divers should wear more thermal protection than normal as body heat is rapidly lost when being towed through the water, there will probably be little body heat generated through exercise, and delays in recovery are possible.

Where appropriate the divers must carry aids to recovery, such as flares, whistle, dye pack, light sticks, strobes, collapsible flags, and inflatable buoys. Consideration can be given to acoustic communications or pinger/tracker devices.

When working on towed apparatus it should be equipped with a trailing line leading to a substantial surface float. This line can be fitted with quick releases to enable divers leaving the apparatus to either ascend the line, or detach it and take it with them. The divers' support vessel should be positioned alongside the float.

A dahn buoy should be prepared for rapid deployment if a diver is seen to be drifting away, or is missing. The buoy should be at least two metres high, brightly coloured, and fitted with a radar reflector, strobe, and drogue. (A two metre-high buoy is visible to a diver from about 200m.) The diver should make every effort to attach himself to this dahn if he sees it deployed. In the case of a missing diver the dahn should be used as a search area locum point, and must be allowed to drift until the diver is located.

If a diver drifts astern unnoticed he should not use more than half his flares without acknowledgement. He may proceed in the direction of the ship, looking for the dahn buoy, only if absolutely certain as to which direction the ship is in. If in any doubt, or after about half an hour, he should maximise buoyancy and conserve energy and heat. Dye packs should only be used after an aircraft is heard or sighted. In order to spread the dye it may help if the diver slowly swims over a small area.

A rescue aircraft/vessel, upon sighting a flare, will turn towards it, the diver should then fire a second flare to enable the crew to establish an exact course and direction.

It is important that the diver's flares are acknowledged as soon as they are seen, to prevent panic.

It is strongly recommended that all diving underway be planned within no-stop decompression limits.

6.2 TOWED UNDERWATER VEHICLES

TUVs enable divers to study objects in the water moving faster than he can swim. It also enables them to survey/photograph large areas of the seabed very rapidly. A streamlined fairing on the TUV enables the divers to be towed at speeds that would otherwise tear their gear off, but the diver must be very conscious of this if he has to exit the TUV.

The towing vessel should have a lookout in the stern in immediate contact with the wheelhouse.

A TUV without buoyancy control must only be used where the seabed depth is within a safe diving depth, as this type of vehicle will sink if the tow breaks or the towing vessel halts/slows down.

A TUV with buoyancy control must be able to return to the surface, unaided, at a safe rate of ascent for normal diving, whilst supporting the maximum length of cable deployed.

Ideally a TUV should carry two divers and an independent, emergency breathing system for each of them. It should be fitted with a communication system that enables each diver to communicate with each other, and the towing vessel. A location device must be fitted to enable the back-up team to rapidly locate the vehicle in the event of the tow parting.
TUV occupants must be able to wear SCUBA equipment, so they can exit the vehicle in an emergency, although they should normally remain with the TUV until it has surfaced and the stand-by boat has closed alongside.
Divers should not be attached to the TUV by buddy lines. Any communications leads must be equipped with passive quick-release connectors.
The divers must check the TUV and equipment before entering the water, and again after it is deployed prior to diving. They should not enter the vehicle until it is well clear of the towing vessel.
Following positive checks and a clear signal from the divers, the surface controller will then give clearance and permission for the dive to commence.
The surface control team should closely monitor dive times, depths and positioning of the vehicle, although the TUV occupants must have complete overall control of the dive, unless there is a breakdown in communications, when the surface controller will take over and take appropriate action to terminate the dive.
The task intended must be thoroughly understood by the divers, surface controller, towing vessel's skipper, and stand-by boat's coxswain.

6.3 DIVER PROPULSION VEHICLES.

These have their own power units, and are steered by the diver altering the position of his body and/or fins. The speed is variable, but as the diver is usually unprotected by a fairing, normally in the 1 - 3 knot range. A substantial surface marker buoy (SMB) must be firmly attached to the diver, both to mark his position and to prevent him inadvertently exceeding the predetermined maximum depth. Rapid ascents and descents should be avoided, as ear clearing can be difficult, with both the diver's hands engaged on the DPV. An appropriate support vessel must stand by and track the DPV from launch until recovery, the coxswain must be fully aware of the dive plan, time, and reserve power available, before launch.

6.4 REMOTE-CONTROLLED VEHICLES.

RCVs are also known as remotely operated vehicles (ROV). Divers are usually employed around ROVs when they are being launched and recovered. The thrusters on a large ROV can cause serious injury to a diver, and the ROV control room is usually out of sight of the launch/recovery site. Consequently the handling operations must be well ordered, and controlled by the dive supervisor, who must be in contact with the divers (visually if at all possible), and constant, immediate, contact with the control room. Small ROVs, equipped with lights and cameras (commonly called "snoopy" or "the flying eyeball") can efficiently work with divers, providing the supervisor with an overview of the job, enabling guidance to be given to the divers and increasing safety.

6.5 DIVING ON TOWED FISHING GEARS.

This should only be undertaken using divers who are very experienced in aqualung diving techniques, of above average fitness and strength, capable of maintaining increased breathing rates, strong in the arms(to enable them to hang onto fast-moving gear and withstand increased body drag), and not prone to sea sickness.

The supervisor should consider working-up a new team. This can be achieved by towing a heavily weighted rope behind a boat, the divers then entering the water, descending the rope to about ten metres, hanging-on, and attempting simple tasks. The towing speed can be increased (from about one knot to about five knots), and the task complexity increased, as the divers gain experience, ability, and strength.

Equipment should be carefully chosen to avoid snagging. Only the minimum amount of equipment should be carried to enable the job to be safely undertaken.

A dry suit with suit inflation, and a single cylinder fitted with an emergency reserve valve, on a quick-release harness have shown to be the lightest to handle on deck, and cause the least drag on the diver at normal towing speeds.

A single-hose regulator fitted with a contents gauge is preferable to a twin-hose regulator. It is not unknown for a single-hose regulator to purge due to the water flow, but this is easily overcome by either fitting a stronger purge button spring or attaching a small piece of easily removed tape over the purge button.

A depth gauge, watch, and cutting device are essential. The cutting device should be worn on the forearm to decrease the chance of it snagging and increase its accessibility.

A tape recorder with a bone microphone is strongly recommended as it not only allows the amount of information collected to be increased but it does not require the diver to take his eyes or hands off the gear.

An ideal team consists of five divers, with two in the water, one in the stand-by boat, and two remaining warm on the towing vessel.

A surface marker buoy attached to the diver is dangerous if it becomes snagged anywhere in the gear.

Through-water communications may cause distress to the divers due to the earphones picking up propeller noises, sonar, sounders, etc.

A lookout, in radio contact with the wheelhouse and the stand-by vessel, may usefully be placed at the stern of the towing vessel, in as high a position as practical.

The divers should be alert to unexpected changes in depth due to wind and tide altering the towing vessel's course/speed, and remain aware of the depth that they must not exceed.

There are three basic types of mobile fishing gear: seine net, pelagic or midwater trawl, and demersal or bottom trawl. In either case a total understanding of the geometry of the gear, by the divers, is essential, and a pre-dive briefing with skipper, deck crew, stand-by vessel crew, divers and supervisor must be undertaken to enable each person to understand what is expected of them.

a) Seine net, (Scottish fly dragging). With this the net starts from a stationary position, and slowly increases speed up to about two knots. The most hazardous time is at the start, when the netting is loose and floppy, but once the tow starts it rapidly becomes firm.

b) Pelagic net. This is potentially the most dangerous type of net to dive on as it can be towed over deep water. The water is often much clearer away from the shore, and can lead the diver into a false sense of security, as he can probably see the whole net. However the net can drop through the water column for a number of reasons, - changes in towing speeds, wind/tide changes, etc. If the diver becomes caught up as the net drops the ship will have to keep towing whilst shortening warp at a speed that the diver can endure, until he is hauled to the surface, where the standby diver can assist.

c) Bottom trawl. This is towed over the bottom, so in the event of a mishap the tow can be stopped without any danger of the diver sinking into deeper water. The main problem is sand and mud being thrown up by the otterboards and passing along both sides of the trawl, often completely obliterating parts of the gear. Towing a straight course minimises this problem

It may be simpler for the divers to enter the water from the stern of the towing vessel rather than to kit up in a standby inflatable bouncing along at four knots. In either case the diver should enter the water slightly negatively buoyant. This enables them to quickly locate and remain with the warp. The drop through the water column (as the warp passes them, and taking care to remain outside the net mouth), gives the divers time to sort-out gear, adjust camera settings, etc., before the boards, sweeps, and bridles pass them. Once the net approaches it should either be caught and rode, or allowed to pass by. The diver must never attempt to swim with it, as the towing speed cannot be maintained and a tired, breathless diver has nothing in reserve in the event of an emergency. After completion of the task the divers should take particular care to stay together, leave the net together, waste no time on the sea bed and ascend together. This helps to ensure that a pick-up, even on a choppy swell, is relatively simple.

6.6 SUPPORTING THE LAUNCH AND RECOVERY OF HEAVY GEAR.

Care must be exercised when diving around heavy equipment which is moving relative to the ship, and particular attention paid to the avoidance of swimming underneath it. Strops and lifting gear must be tested and maintained in accordance with appropriate relevant maintenance standards. Fenders must be large enough to leave at least 0.6 metres between the ship and the equipment when under maximum compression, and they must be fastened in such a way as not to roll along the ship's hull, nor be forced out. If the equipment is being worked from the side of the vessel, it should be on the up-wind, or down-current, side, whichever has the greater effect on it, so as to stream away from the vessel. With stern launches, it is customary to have way on the vessel, in which case the divers must always be aft of the propellers, and the supervisor in constant, immediate, communication with the bridge and the standby boat. The propellers must not be put astern. The divers must take care not to be caught underneath a pitching stern, especially with transom-sterned vessels. With cruiser sterns it has been found that the divers are displaced by the water, but this should not be relied upon. If at all possible all lifting gear should be fitted with remote releases, if this is not possible then grab lines should be fitted to the hooks. It is advisable for the divers to wear crash helmets, and it may be helpful for a tow rope to be attached between the equipment and the bows of the standby boat.

6.7 DIVING IN SHIPPING LANES AND FISHING GROUNDS.

Particular attention is required to pre dive planning. The IRPCS 1972 must be strictly adhered to. The Royal Navy Hydrographic Department (Taunton, 01823 3367900 Ext.465) must be informed well in advance of any prolonged (i.e. over two weeks) diving operation at one site. This enables them to send out an appropriate "Notice to Mariners", and arrange for Radio Navigation Warnings to be broadcast.

Harbour and Port Authorities must be informed, in advance, if the site is within their area.

The local Fisheries Officer and/or the local council's Sea Fisheries Committee should also be sent notification of the operations.

The Coastguard should be radioed at the commencement and termination of each day's work.

Whenever possible diving should be undertaken from a mother vessel with a standby vessel in attendance. This enables one vessel to remain covering the divers, if it is felt prudent to go to an approaching vessel. Both vessels must be in VHF contact.

Although all vessels should be keeping watch on Channel 16 it is strongly recommended that steps are taken to find the local fishing fleet's usual working channel, as a call to an approaching fishing vessel on this channel usually obtains a more rapid response.

A loud-hailer or megaphone may be useful.

Divers should always ascend straight up their SMBs or a buoyed shot line after signalling their desire to ascend. This signal should be confirmed from the surface before ascent is commenced.
Divers must always be roped, either via a lifeline or an SMB. In either case the line must be capable of supporting the weight of the diver and his equipment.
Diving involving decompression stops is not recommended.

6.8 DIVING IN AND AROUND FLOATING ENCLOSURES.

The particular hazards of diving in and around cages and flexible plastic enclosures are those of being entangled or trapped between adjacent systems. At least one pointed saw-edged cutting device should be worn, and it is best on the forearm. A pair of stout scissors are often the most efficient method of cutting slack netting.
Weighted shot lines, firmly attached at the surface, are a useful reference point for the working diver and may also be used by the diver to pull himself out of a collapsed enclosure.
Divers should be fully conversant with the layout of the system before commencing the dive, and be aware that shifting winds and tidal changes could cause adjacent enclosures to move in relation to each other.
Since most cages are suspended from surface flotation approach to the structures has often to be made from below. Similarly in an emergency escape often necessitates initial descent.
When working on the outside of cages the standby diver should stand clear and watch for his partner becoming snagged.
When working inside enclosures pair-diving is usually impractical, and normal tendered, roped diver practices should be adhered to.
Water-tight enclosures frequently collapse when damaged, and water movement induced by rising exhaust bubbles can draw material around the diver.

6.9 DIVING IN COLD WATER AND UNDER ICE.

Pre-dive planning is essential at low temperatures to ensure that the divers arrive at the site without becoming chilled, and have rapid access to re-warming facilities after the dive. (Also see section 4.1.6.4). When diving in water near its freezing point, air temperatures are often considerably lower, and attention must be paid to wind speeds and the chill factor (see section 10.2). In the event of repeat dives, care must be taken to ensure that the divers have thoroughly re-warmed before subsequent dives, and the equipment thoroughly dried, to prevent icing-up. Dives of up to 45mins duration are possible, but efficiency rapidly decreases after about 30 mins. All dives should be planned so as to be within no-stop decompression times because the inactive diver undertaking an in-water decompression stop will be most vulnerable to becoming hypothermic.
Well fitting 8-10mm wet suits and variable-volume dry suits can be used, but constant-volume dry suits, together with suitable undersuits, offer the best thermal protection, both on-site and during a dive. Hoods should either be attached or have a large overlap. Gloves should be of the mitten type. It is important to avoid leaks as the ingress of water dangerously impairs thermal protection. If a

suit becomes damaged during a dive, the dive should be terminated. Warm water suits are routinely used in commercial diving and have been used in Polar waters to offset the problems associated with prolonged endurance or exposure to very low temperatures. Such equipment should be considered for scientific diving projects where surface-demand equipment is already intended to be used or where routine prolonged exposure to low temperature is anticipated.

Low air temperatures often cause equipment to become unreliable, valves freeze, rubber and plastic components can become extremely brittle, seals harden and may leak. Demand valves should be fitted with environmental protection caps, where available, and be thoroughly dry before use. If the equipment is to be re-used in the field particular care must be exercised to ensure that no water enters the demand valve (DV) first stage. Icing up causing a DV free-flow is a common occurrence during very low temperature diving. A free-flow usually starts gently and becomes progressively worse if the dive is continued. Hence a dive should always be abandoned when a DV starts to free-flow as it rarely corrects itself and can become vigourous enough to empty the divers' cylinder in a short time. The diving cylinder should be turned on before leaving shelter and the demand valve tested immediately prior to descent. Icing-up can occur after an extremely brief return to the surface, an octopus rig may be helpful in this situation, but a totally independent cylinder and valve is preferable. For this reason a full face mask may be dangerous. Particular attention must be given to the supply of dry breathing air to avoid condensation causing icing up.

Care should be taken when travelling across ice, as the thickness often varies greatly and is subject to the effects of wind, current and swell. Sea ice is much weaker than freshwater ice, and needs to be, if in good condition, at least 15 cms. thick before it is safe to walk short distances on.

When the surface is covered with ice that the diver cannot break, then particular attention must be paid to buoyancy control, as a rapid ascent can lead to severe injury. Dry suits must be capable of being rapidly purged, and life-jackets/buoyancy aids used with extreme caution. In an emergency it is much easier and faster for the attendants to assist a diver vertically from the bottom than drag him horizontally under the ice.

The divers must always be roped to the surface, with the rope secured to the diver, and not to any item of his equipment. The surface attendant must be fully experienced in the task that the diver is performing, to enable him to understand not only the rope signals, but also the rope's movements, so enabling a quicker reaction time in the event of an emergency.

Diving underneath pack ice requires calm conditions and slack water, as movement of the ice may force the standby boat/attendant away from the diver. Icebergs should be avoided as they are unstable and liable to sudden readjustments or collapse.

Large marine mammals are possessive of their breathing holes in the ice, and their territories at breeding time. Confrontation should be avoided, and in general marine mammals should be avoided unless experiments or observations of them are being carried out under controlled conditions.

6.10 DIVING IN CAVES AND CONFINED SPACES.

There are many problems associated with diving in caves and confined spaces. Most of these are caused by environmental factors and increased levels of diver stress. Cave diving is an extremely hazardous form of scientific and archaeological diving, and should be treated as such.

Any divers considering scientific or archaeological work within underwater caves, or other environments which restrict horizontal and vertical escape, or limit their access to the surface must familiarise themselves with the appropriate procedures. The British Cave Diving Group and its equivalents overseas provide training in such techniques. Similarly the Nautical Archaeological Society have a training module in intrusive wreck diving. Proposals may need to be submitted to the HSE.

As escape to the surface may be limited by constrictions or distance the diver must be equipped so as to be completely independent. He must carry at least two independent breathing systems, separately valved - an octopus rig is not adequate. At least three underwater light units must be carried, with fully charged batteries, each able to last at least twice the planned dive time.

A guideline must link the diver with the surface, and be belayed so as to remove any chance of entanglement or displacement into areas too constricted for the diver to pass on exit. The line should be controlled by the diver from a suitable reel and coloured so as to be as highly visible as possible in the prevailing conditions. No equipment must be worn in such a way as to allow entanglement with the line.

Throughout the dive allowance must be made for the possibility of zero visibility, either through light failure or because of stirred-up sediments.

It is common practice in British cave diving for divers to work alone when *in situ*. All vital equipment must be duplicated. A time limit should be set for the dive and a standby diver ready to enter the water if this limit is exceeded. The air supply carried by any diver should comply with the "Thirds Rule", one third for the outward journey, one third for the return, and one third for emergencies. Any planned work period should take this rule into account.

If decompression diving is planned, a separate breathing system should be placed in the cave to provide sufficient breathing gas. The reserve "Third" should not be regarded as being available for use during decompression. However, as evacuation to a recompression chamber would be extremely difficult in a case of DCI, it is strongly recommended that dives should be planned within no-stop limits.

Currents and turbulence in caves vary considerably. Sediments stirred by a diver's movements may clear quickly, or may remain suspended in the water for a long time. Movement should be kept slow and careful, buoyancy control should be precise, avoid vigourous movements and stay mid-water wherever possible. A helmet must be worn to avoid injury caused by the head striking the roof, or falling debris.

Air in above-water passages or in pockets beyond flooded passageways may be foul, especially where organic materials are present, and should be treated with caution. Methane and other non-life supporting gas pockets are also possible.

Stress levels in underwater caves and overhead environments are generally quite high, and most diving accidents can be related, in some way, to this. The diver must be prepared to abandon the dive before stress levels become too high, and every effort should be made to reduce stress levels during and before a dive.

The exploration and study of underwater caves involves an understanding of the problems encountered in dry cave exploration as well as those encountered in diving. This should be born in mind if a programme of aquatic speleological research is anticipated. Both disciplines affect the equipment and techniques involved.

6.11 DIVING IN LOW AND ZERO VISIBILITY.

The diver's ability to orientate himself and navigate correctly is much reduced in low and zero visibility conditions. There is a danger of the diver unknowingly putting himself in a hazardous situation from which he may not be able to extricate himself without assistance. This risk, and the risk of the standby diver blindly swimming into the same hazard, must be adequately planned for.

In addition to the standby diver there should be a spare, full, breathing set available for instant use in the event of a diver becoming fouled and exhausting his air supply before being freed.

The diver should be equipped with a buddy line to the standby diver in the water as well as a life line. Apart from providing a communication link this allows the standby diver to easily remain in contact with the distressed diver. Cutting implements must be sharp and readily accessible.
The decision whether to use a single diver, or paired divers, should be taken after due consideration of such factors as the experience of the personnel, the task, currents, visibility, and particular known hazards.
Navigation around a work site may be simplified by the use of marked ropes, jackstays, and shot lines. All cordage used must be kept taut.
Torches are occasionally useful in conditions of low visibility, and, paradoxically, it often helps orientation if the diver shuts his eyes in conditions of zero visibility.

6.12 NIGHT DIVING.

All preparations should be made in daylight, and surface lighting rigged. To increase and prevent the loss of dark adaptation all lighting may be fitted with red filters, or the divers issued with red glasses at least half an hour before the start of the dive. It is recommended that the divers have dived the site in daylight, in order to familiarise themselves with it.
Light signals should be displayed in accordance with IRPCS.(Although it should be noted that the RN display two reds, visible all round, fixed with a horizontal separation of two metres).
Divers must descend down a shot line or along a swim line from the shore. All divers should be linked with a buddy line. If an SMB is used, as opposed to a surface tendered lifeline, then it must have a light attached to the uppermost surface, which remains on for the duration of the dive. Each diver must carry an adequate underwater torch, an alternative light source, and a flare pack. Chemical lightsticks are often useful. If any one torch fails, then the dive must be terminated.
Consideration may be given to attaching lights to the diver's forearm, helmet, life-jackets, etc., in order to leave the diver's hands free. Surface-supplied underwater flood and/or spot lamps may be beneficial, and powerful lights suspended above the water will provide a dim, but even, illumination over a wide area.
Points of access to the water must be clearly illuminated, in such a way as to be immediately apparent to a surface-swimming diver. Standby vessels should be equipped with a searchlight.
Care must be taken to ensure that no lights used can be mistaken for any local navigational aids. HMCG should be notified at the beginning and end of diving operations.

6.13 DIVING AT ALTITUDE.

For practical purposes, altitude diving can be divided into two ranges, low-altitude, 100m - 3,000m, and high-altitude, 3,000m - 6,000m. There are no known diveable bodies of water above 6,000m.
For decompression information relevant to altitude diving see Section 8.
Acclimatization, of at least 16 hours, should be carried out for all low altitude dives, and of at least 24 hours, must be carried out for all high altitude dives. This acclimatization period is in excess of any travelling time.
Altitude sickness is a real problem above 4,000m, and has occurred as low as 2,450m. It is preventable by correct acclimatization. All groups diving at altitude must familiarise themselves with its symptoms and treatment. It can kill.

Neoprene contains closed cell bubbles, which will expand at altitude, making the suit unwieldy and altering the buoyancy. Membrane dry suits are therefore preferable.
Be prepared for ice diving.
Seek expert advice on the breathing gas mixture.

6.14 DIVING IN FRESH WATER.

Fresh water may be moving or still, in either case a major consideration in dive planning being its density. A diver may require up to 3 Kg. less weight than when in the sea. The buoyancy of all research tools is also altered. If the water is foaming the density will decrease still further.

Although standard decompression tables were developed for use in sea water, no specific conversions should be made for fresh water, as this will reduce the safety factor.

The temperatures of fresh water bodies is often much less than that of the sea, at the same time of the year, and allowances must be made for this when planning dive times and tasks.

Still waters can be deceptive, and visibility often reaches zero. There is usually a layer of easily disturbed silt covering everything, so the use of lines for positioning and navigation is recommended, as is the use of buddy lines in paired diving. Many lakes and ponds have been used as dumps for many years, so divers must be aware of the possibility of locating old vehicles, bundles of barbed wire, etc.

Fast-flowing waters commonly have drastic depth alterations, with shallow rapids falling into deeper pools. Isolated, or areas, of boulders are a frequent hazard. So careful reconnaissance and widespread use of ropes is recommended.

Divers should be aware of the increased risk of contamination and disease in fresh water, and should seek specialist advice on required immunisation.

Any group planning freshwater diving must take care that they have obtained the advance permission of any landowner, over whose land they plan to access or swim.

6.15 DIVING IN FAST CURRENTS.

Diving operations should be planned to coincide with periods of minimum current velocity. A current of 0.5 knots, (0.25 m/s), should be taken into account when planning, at 2 knots, (1.0 m/s), a diver will make little headway, and at 5 knots, (2.5 m/s), there is the risk of a diver losing his mask. Surface currents are usually stronger than those on the seabed, and may be in a totally different direction. Each diver must be securely attached to the SMB, and the safety boat should maintain full manoeuvrability. Descending a shot line requires strength and endurance, and care must be taken to ensure that the shot line's weight is sufficient to prevent the line, with the divers on it, being moved in the current. The buoy must also be large enough to easily remain on the surface, the more vertical the line is, the easier it is for the divers. A sweep line should be attached to the shot, to enable the divers to move around the shot, without losing contact with it. The buddy diver, who is primarily responsible for the dive safety, as opposed to the dive science, should be the farthest out on the sweep line. Dives should be planned to be within no-stop limits, but if decompression stops are required, they are best undertaken hanging underneath a SMB, whilst drifting with the current.

6.16 DIVING IN LOCKS, CULVERTS, MAIN INLETS, AND NEAR SHIPS' PROPELLERS, DPV THRUSTERS, STABILISERS OR DOMES.

Permission to dive must be obtained from the appropriate authorities immediately prior to each dive, and they must be provided with a comprehensive dive programme. The supervisor must be acquainted with the location of all culverts, inlets, outlets, and their control panels. After ensuring that the systems are fully closed the supervisor must either place a "do not use" board on the controls, or post a competent person to liaise with the operatives.

Propeller guards should be fitted, and divers must be aware that many propellers revolve when the engines are running, even if the gearbox is in neutral.

6.17 DIVING IN CONTAMINATED WATER.

There are various types of contamination, but whatever the type
it is important that during decontamination, the environment is not fouled through the decontamination process. Washing with water may be sufficient, but provision for separate and environmentally safe disposal of soapy or detergent water away from the dive area might have to be made.

6.17.1 Sewage and effluent contaminated water

The main problems encountered are poor visibility and risk to health through bacterial or viral infection or subtle chemical attack. To minimize these problems, first determine whether the sewage or effluent can be reduced by the operators. It may be possible to reduce pollution significantly before diving.

Diving practices must reduce contact between the diver and the contaminated water. Minimize exposure of skin to water by using a dry suit with an enclosed helmet or a full face mask fitted with a positive pressure system. Use anti-mist on the mask, which must not be removed or flooded to improve visibility underwater. It may be possible to seal the face mask using silicon grease or a fibre pad. Tight-fitting gloves, such as surgical or rubber kitchen gloves, should be used, with possible stronger over-gloves to protect against scratching and cutting the skin. Use life-lines and diver telephones to maintain contact; ensure that typhoid and any other prophylactic injections as indicated by local conditions are up-to-date; avoid stirring-up sediment on the bottom by careful buoyancy control; do not dive with cuts or abrasions and avoid swallowing contaminated water. Immediately following the dive, wash all equipment and the diver in disinfectant; rinse eyes with optrex or similar solution; rinse ears with ear-wash solution of 80% iso-propyl alcohol, 5% glacial acetic acid and 15% water. Spit out saliva frequently after the dive.

If sewage is untreated (raw or only macerated) it is essential to wear a dry suit with a positive pressure full face mask providing full body cover and to be decontaminated before exiting the suit.
In rare emergency situations where a wet suit must be used, fill the suit with clean water or mixed weak disinfectant, immediately before diving to reduce water-flow by contaminated water.
When diving in enclosed vessels such as sludge digesters, roping and voice communications are essential. Supplied air should be breathed until well clear of the vessel, and the diver must be fully separated from the diving medium. If there is space above the fluid in the vessel, it will almost certainly be poisonous, not breathable, and may be explosive.

6.17.2 Naturally polluted water

Scientists are increasingly required to dive in polluted zones in order to study the impact of pollution caused by natural pollution. In addition to artificial pollution of water, many bodies of still, naturally unflushed water, such as lagoons and low tidal-flux estuaries contain areas that are 'polluted' with sulphate, methane, and oxygen-deprivation through natural processes accompanying restricted water circulation. All procedures associated with diving in mildly sewage-contaminated waters should be followed, but the risk of serious infection is not as great; and some medical precautions, such as certain inoculations, can be relaxed. Also, dangerous artificial chemicals are not present in any volume.

6.17.3 Severely contaminated water, toxic and non-aqueous liquids.

Engineering and scientific/archaeological projects sometimes require working with large quantities of polluted or toxic water, or with non-aqueous fluids such as diesel oil or paint, or in water with dissolved toxic gases. During installation of instruments or sensors, or in carrying out unexpected maintenance requirements, it may be useful to have specially trained divers to work in these unusual circumstances. Such circumstances may arise in studying pollution or leakage from dumped toxic wastes, or within large tanks or containers. The strictest safety precautions must be applied in all such circumstances. The Diving Project Plan can only be produced after careful consultations with experts familiar with the hazardous or toxic chemicals involved. The Diving Supervisor must be aware of, and fully familiar with, all hazards and decontamination procedures before the commencement of the Diving Operation.

Never dive in fluids containing highly toxic chemicals such as acetic anhydride, bromine, methyl parathion, acrylonitrile, epichlorohydrin, or chlordane. Never dive in fluids that contain contaminants that could dissolve the latex rubber or adhesives in diving suits. Always consult an expert chemist or pharmacologist to assess the risks from the known concentrations of potentially toxic chemicals in the water before diving.

Foam Neoprene suits are almost impossible to decontaminate after severe exposure and do not provide sufficient protection underwater. A membrane dry suit should be used, with integral boots, and gloves that can be sealed onto the suit at the wrists. Helmets must totally enclose the head and be sealed to the suit, and the helmet should have a slight positive internal pressure. Exhaust valves should have a double exhaust flap system so that droplets of fluid cannot leak back into the breathing circuit. The diver should be washed with decontamination fluid immediately upon exiting the water, and ropes should be doused with decontamination fluid as they are brought in. Suit materials and hoods must be smooth and slick on the outside so that they can be decontaminated easily. The surface attendants and line tenders should be protected by appropriate suits, gloves, eye protection and half masks, since the handling of lines and the diver's equipment will inevitably put them at risk. Before diving, the Diving Supervisor must ensure that the appropriate decontaminating and scrubbing agents are available on-site so that equipment can be cleaned immediately the diver exits the water.

6.18 DIVING IN SURF AND ROUGH SEAS.

The surf and near shore zone is the most dynamic and one of the most extensive and common marine environments encountered by divers. It is an area where waves and tides expend much of their energy and where most littoral sediment transport occurs. The wave and tide conditions expected and the probable type of surf zone must be identified prior to the dive. The divers must be briefed to expect low-to-zero visibility, especially as breakers and wave bores pass over. They must also be aware of the probability of bi-directional wave oscillations, especially seaward of break point, and unidirectional longshore, rip-feeder and rip-currents, which usually pulse at 30-90 second intervals. These currents must be used to advantage, as it will be impossible to make effective progress against them. It is usually easier to swim out close to the seabed avoiding surface turbulence and shoreward flows, and to return on the surface allowing wave bores to wash you ashore (avoiding rips). Orbital currents should be moved with, rather than fought, as they will return the diver close to where he started.

When using a boat it is preferable, for both safety and manoeuvrability, that it be twin engined.

There are three basic surf-zone types:

1. Reflective beach and surf zones are formed by long low waves and/or very coarse sediment. They have steep plunging breakers in a narrow but powerful breaker zone. Careful timing and quick movement between wave sets is required for entry and exit. The near shore zone extends close to the beach/breaker zone, and dive boats can safely anchor close inshore.
2. Intermediate surf zones (moderate energy) are characterized by transverse rips and sand bars parallel to shore. For entry to the outer surf zones use the rip currents, for entry to the inner zones use either the rips or the bars. When exiting use either the bars or areas of breaking waves, but ensure that the rips are avoided. The divers must be familiar with the overall pattern and size of bigger waves sets before entering the surf zone. The near shore zone extends to the outer bar. During low waves the dive boats can be placed in either a longshore trough or in a rip, but with caution, keeping to 'calm' trough water with the boat's bow always into the waves, while using the engines to manoeuvre sideways and backwards. Move the boat swiftly when crossing bars.
3. Dissipative surf zones (high energy and fine sand with wide breaker zones) tend to have vertically segregated flows. For entry and seaward travel it is best to use the seabed flow when it pulses seaward. For exiting and returning to the shore use the surface wave bores. The wave breaker zone is usually wide (100m plus) and highly transitory. Be very cautious when approaching from seaward as the larger sets of waves break well to seaward of the main breaker zone.

When working in surf all equipment must be kept as hydrodynamic as possible and to the minimum required for the task. It all must be tethered, whilst remembering the potential hazards involved with lengths of rope or twine. The divers may find it helpful to be at least 3 kg overweighted and use their buoyancy jackets to keep themselves upright or surface readily. Face masks are regularly knocked off or down, hold on when necessary. The regulator is rarely pulled out of the mouth; and fins can be pulled off, but usually only one at a time. Divers may consider lashing their essential equipment to life jacket straps for security. Tying to the weight belt is not recommended as the loss of weight belts is a regular event in surf-zone diving.

When deploying experimental equipment in the surf zone place a flagged dhan buoy to permit location of the equipment from shore, buoy and weight appropriately. Attach a weighted line from the equipment to the shore or to another buoy-line alongside the boat, and outside the surf zone. The weighted line can be used by the divers to readily re-locate the equipment when swimming along the seabed. To recover equipment, the divers can hold the equipment off the seabed or float it to the surface while others use the line to pull it ashore or onboard. If the divers are using the equipment to hold onto and stabilise themselves they should always hold the bottom of the equipment to reduce the chance of it toppling on them.

As a general rule when the diver has little or no control over his direction of movement, then it is time to get out. This can occur under relatively low waves on some reflective and intermediate beaches especially in the rip channels. Examine the surf carefully and, if necessary, swim out in snorkel gear to check currents before attempting to dive. A snorkeller may also be used to deploy a kedge anchor, giving the divers a bottom rope to assist their swim out. The waves and currents should be utilised for offshore, along-shore and onshore transport. The dive must be planned to use the current patterns, not fight them.If in difficulty the diver should surface immediately and always approach the shore on the surface.

6.19 DIVING OVER DEEP WATER.

The main danger to divers when diving over deep water is that they can inadvertently descend to a greater depth than planned, thereby increasing nitrogen narcosis and decompression loading. Precautions must be taken to prevent this happening. The simplest being to ensure that the divers are connected to a buoy of such buoyancy that it cannot be pulled underwater by a length of rope which is no longer than the planned depth of dive. Extra rope will be required if the diver has to swim or if there is a current. The dive must always be supported by a stand-by boat. The divers must not attempt to retrieve any dropped article by swimming down for it, and any item of equipment that is not tethered to a diver, or a surface buoy, or is not positively buoyant, must be regarded as expendable.

Each diver must have sufficient, controllable, buoyancy reserve to enable him to cope with any equipment that may be handed to him in the water and to enable himself and his partner to reach the surface in an emergency.

A marked shotline should be deployed and care taken to ensure that it remains taut and vertical. This enables the divers to have a visual reference for ascending and descending, provides a back-up check on their depth, and eases depth-holding for any decompression stops required. If necessary the shot line can also be used as a tether point for any equipment that will be used at a pre-set depth.

6.20 DIVING OFFSHORE.

Diving in water where depths substantially exceed the depth of the dive is referred to as blue-water diving because it commonly takes place in the blue waters of the open ocean. Diving in the open ocean must be done from a large ship, which is necessary to transport the diving party to the dive-site, with a small boat tending the divers in the water.

The most important operational procedure is that no mid-ocean diving operation should ever be carried out without a small manned boat of easy access (preferably an inflatable boat) located on the dive-site and fastened by a fixed surface line to the vertical line of greater length than the planned dive depth on which the blue-water dive is carried out. The shot-line can be stabilized against vertical heave by being attached to a damper disc or plastic bucket at the bottom, or a weight not exceeding 2 kilograms. Drift of the dive boat may be minimized by using a sea anchor. This boat needs only a small outboard because of the proximity of the ship, but it should be equipped with the normal diving first-aid kit and oxygen. Under no circumstances should the ship and the dive boat ever be out of communication, and preferably, sight. The position of the boat should be maintained using the ship's radar and a visual watch.

The primary concerns for a group of divers involved in tasks requiring close concentration are orientation and communication. Even very clear water is extremely disorientating without a sea floor for reference and extra precautions must be taken to avoid directional confusion or separation. Without a point of reference in the water, divers may accidentally descend deeper than planned; there is also the problem of vertigo that may be induced by the lack of a reference point. These problems are exacerbated if in addition the diver's line-of-sight visibility is hindered by special equipment or poor water clarity.

The methods for rigging lines for blue-water diving are complex and should not be attempted without consulting original references. It is strongly recommended that laboratories planning to use these methods make direct contact with divers already experienced in the method. For safety and operational efficiency all divers should be attached to light tether lines fair-leaded through clips to a 60 g weight. These clips are connected to a central ring fixed to the vertical down-line. This system allows the tether to be kept taut between the diver and the central ring.

In operations requiring more than two divers, one experienced diver should be designated safety diver and should devote the entire dive to monitoring position, air supply and status of the other divers. The safety diver should be positioned at the central dive line and be in reach of the ring holding the tethers for the other divers. Should the need arise the safety diver will be able to attract the attention of any diver by pulling on the tether. The safety diver should also be tethered, but on a 1 to 2 m line with a quick-release snap-clip or karabiner.

The tether lines are needed for communication, and because it is extremely easy in very clear water to unintentionally attain a depth in excess of that planned. The tethers serve primarily as a reminder to the divers that they have reached a previously agreed depth and define the horizontal limit from the down-line. The divers' trapeze and the diver's harness are very specialized and designed for safely holding even an unconscious diver. It is important that these line and divers' attachments should be fabricated and their use practised in shallow-water conditions prior to engaging in blue-water diving. Last minute lash-ups from tied ropes are not usually satisfactory because they often hinder diver movements and are more likely to malfunction. Tethers should never be attached to the diver's weight belt. At no time should a diver unclip from the tether and separate from the group, even for that specimen which is just beyond reach.

In the event that a shark or other large marine animal such as a marlin, sailfish or swordfish should appear in the diver area it may be prudent to terminate the dive prematurely and exit the water. If, in the judgement of any diver in the diving team, an ascent is desired, the divers should unclip, hold the tether in the hand, and move towards the down-line. At the centre they should form a circle, release their tethers and move slowly toward the surface. This allows someone to always have observation of the intruding animal(s). Shark billys should be carried if sharks are expected to be encountered.

Even when a recompression facility is available on the ship, diving involving decompression stops should be minimized. If in-water decompression is contemplated, note should be taken of the strong vertical shear that often exists in the water at recompression levels, which tends to force divers apart; buddy-lines to the shot-line are essential.

6.21 DEEP AIR DIVING.

Diving on compressed air at depths deeper than 30 m, which is the depth limit commonly taken by many institutions for diving operations, constitutes deep air diving.

An absolute minimum diving team for deep diving is four (two divers, plus the standby diver and supervisor) together with the boatman and compression chamber operator if necessary. The

standby diver must be fully equipped to dive at the working pressure. He should not have any inert gas loading.
In most countries the recommended maximum depth for employed divers diving on air is in the region of 50-60 m. Some countries enforce a legal maximum depth on air, UK, 50 m; France, 60 m; South Africa, 60 m; USA, 58.5 m (190 ft).
Dives in excess of recognized maximum working depths are inherently more dangerous because of the increased possibility of decompression sickness and nitrogen narcosis and the greater time that it will take a diver to reach the surface in the event of an emergency. Incidents at depth are simply farther away from surface support. Normally decompression diving should be kept to a minimum in deep diving and where decompression stops are necessary, they should always be carried out with very conservative interpretation of tables.

Bounce dives to just shallower than 50 m, not involving planned decompression stops may be made, provided that the divers are fully worked-up, the minimum diving team is the same as above. Deep diving must be preceded by recent dives of increasing depth to acclimatize diver's body with the greater pressures encountered. A bounce dive, however, is by definition a short dive which does not allow enough time for poorly vascularized tissues to become saturated with a higher concentration of dissolved nitrogen, and therefore these dives should not be more than 5 minutes bottom time. The divers are advised to follow a shot-line. In addition, there should be a fully dressed standby diver with no inert gas loading. The working divers should be instructed that an emergency situation will be considered to exist if they do not return to the surface within a few minutes of dive-plan time. Repeated short dives with short surface intervals must not be carried out.

As with any research air diving, bottom times must not be so long as to dictate a decompression time of more that 20 minutes. This time limit should be decreased if conditions are bad, i.e. cold water, heavy swells, strong currents, etc. A planned decompression time of more than 20 minutes involves the dive organizers in complying with stricter regulations concerning on-site compression chambers.

Where deep diving is taking place it is always safer to have recompression facilities on the support vessel, if possible. These facilities should consist of a two compartment recompression chamber with a medical lock and a trained operator whose sole responsibility is maintenance and operation of the chamber.
There must also be adequately trained medical personnel with sufficient suitable equipment.

Deep diving in remote areas should be carried out using dive plans that keep the divers on the conservative side of the normal decompression tables at all times, unless the support vessel or nearby base is fully equipped to treat decompression cases.

6.22 DIVING IN THE PROXIMITY OF DANGEROUS ANIMALS.

Although most large marine animals will attack a diver, if sufficiently provoked, the main danger is the increased psychological pressure due to the fear of attack. Sharks probably present the greatest actual threat to divers, although attacks rarely take place in water temperatures less than 20^0C; and of the hundreds of varieties of sharks there are probably only eight dangerous to man. The only certain thing about sharks' interactions with man is that they are totally unpredictable.

In the UK, the main hazards are comparatively minor (to a fit, healthy, person) and consist of weaver fish, conger eels, seals, and certain jellyfish. Basking sharks can be a danger to small craft, operations involving a lot of ropes, and inattentive divers. Care should also be taken if diving takes place in toxic phytoplankton blooms.

6.23 MEDICAL AND PHYSIOLOGICAL EXPERIMENTS.
Whilst there are no specific regulations governing the conduct of medical and physiological experiments on man, approval should be obtained from the ethical committee or similar body of the organisation for whom the experiment is to be conducted. No diver should participate in an experimental procedure where ethical approval has either not been sought, or has not been granted. If in doubt contact the appropriate Medical Research Council (MRC).

6.24 DIVING IN REMOTE AREAS.
A remote area is one where the population density and boat traffic is so low that the occupants of a diving boat stranded away from the main base would have no real chance of being picked up or of receiving assistance of any kind. Equally, the base camp is assumed to be so isolated that in the event of a serious accident it would take days rather than hours to get the injured person to a good hospital. Under these conditions, forward planning and anticipation of problems are vital. There are no known locations in the United Kingdom that fit this definition of remote.

In remote areas back-up medical, rescue and recompression facilities are generally absent. The diving programme must therefore be conducted in such a way that these services will never be required. Medical supplies must be extensive and of a far more complete inventory than would normally be kept. At least one member of the team at each dive-site should be qualified to use them, and he should not dive unless there is another qualified first-aider present. The presence of a paramedic or doctor is advisable.
Portable recompression facilities are desirable, but may be prohibitively costly.
Arrangements should be made, in advance, with whatever Military, Coastguard, Police or private interests that may be better supported logistically in the area to help get an injured diver to a doctor or hospital. At very remote locations, radio and/or satellite communication can be established with a diving support centre such as the Survival Centre in Aberdeen, Scotland, U.K. (Refer to Section 10.12).

All equipment should be kept as simple as possible to reduce problems with breakdowns and maintenance. If complex equipment has to be used, the fullest possible spares kit and repair tools should be carried, and a member of the group must be fully qualified in making repairs.
A member of the team must have specific responsibility to ensure that the boats contain working flares, dye-markers, hand-held compass, survival packs, drinking water, and other items determined by the region and logistics. It is now possible to have radio and a portable Global Positioning System (GPS) on even very small boats and inflatables. There should be at least two serviceable boats on the working site except when operating very close to base. For longer trips two boats should travel in convoy. Radio contact should be maintained between boats and the base camp at predetermined intervals in addition to potential emergency calls. Keep within anchor depth where feasible especially when there is an off-shore wind or tide and carry a sea anchor.

Even when a dive-site is not remote in a geographical sense from human habitation, it may have difficult or limited access from the landward side due to cliffs, dune fields, desert, strong currents or wave action. The main concern of a diving supervisor is the ability to deal with an emergency situation involving an injured diver. With difficult or restricted landward access, a diving operation is usually undertaken from the seaward side by boat. Should seaward access also be restricted, specialised emergency planning must be carried out in advance.

Local boatmen are usually reliable about local surface conditions. Do not trust them about underwater conditions, unless they are actually divers, and then be prepared to consider their suggestions while remembering that their experience probably was gained while carrying out commercial operations. Patiently make enquiries from likely locals when in an area, but do not appear to interrogate them as this may make them less than happy about your presence. Members of the party should go out of their way to help local fishermen and watermen wherever possible, as actions of this sort will be remembered.

6.25 ELECTRICITY UNDERWATER.

The physiological effects of electrical fields increase progressively with increasing field strength and depend on the direction of the diver's body within the field. The direct effect upon the body of electrical shock is related to the magnitude of the current passing through the body, especially the heart. This is known to be variable between people, and there is much variation in data published on the effects. However, the diver may sense the effect of an electrical field or observe progressively erratic behaviour of a compass or of fish. The effects of increased field strength and likely body current can be divided into three main reaction groups:

i). The first reaction or perception threshold or shock with no loss of muscular control, while in fish fright and discouragement are observed. This first reaction is often associated with low frequency pulsed DC fields and large anodes (less than 10 Ma DC, 2 Ma at 60 Hz or 20 Ma at 10 Khz).

ii). Painful shock, difficulty in letting go or muscular contractions.In fish electrotaxis is observed. Electrotaxis is a mixed reaction of attraction or repulsion and is associated with forced swimming of mid-water fish. It varies with the direction of the DC electrical field and its strength. Alternating current, as opposed to pulsed direct current, is rarely used for electrofishing as it causes rigid muscular spasm or tetanus. This second reaction is often associated with high frequency pulsed fields set up within the water (less than around 100 mA DC, 25 mA 60 Hz, 100 mA at 10 kHz).

iii). Ventricular fibrillation or in fish electronarcosis, immobilization, or with sufficient power or close proximity or contact, death by electrocution. This reaction is associated with short-term contact or close proximity to large power sources (3 seconds duration; greater than around 500 mA at DC, 100 mA at 60 kHz, 500 mA at 10 kHz. Or 0.03 second duration, 1300 mA at DC, 100 mA at 60 kHz, 1100 mA at 10 kHz).

The conditions which influence the currents passing through the diver are influenced by a great variety of factors which include the water conditions (temperature and water chemistry, particularly conductivity), the electrical signal (frequency, shape and duration of pulse), the electrodes (size, shape, orientation and separation) the diver's orientation in the electrical field and the distance apart of wetted areas (wet v. dry suits).

Divers and personnel with wet hands should not be allowed to handle batteries and electrical apparatus on the surface. Potentials that are not dangerous or even detectable to persons with dry hands may be dangerous to a diver whose skin is soaked with salt water.

6.25.1 Electrical installations.
Installations producing pulsed or varying electrical fields such as screens, barriers or 'guides' to control the movement of aquatic animals, and impressed current anti-corrosion cathodic protection systems are the main source of hazard to the diver. Military areas where electrical systems may be used are best avoided unless there is full co-operation.

Sites where electrical fields may be in operation comprise installations which are known to vary greatly in both the electrical power used and in the frequency of its pulsation or variation. These include:

- Near intakes to pumps and turbines to prevent the entry of fish. They are commonly placed upstream of the main debris screens.
- On complex watercourses or below dams to guide fish into 'passes' through or around obstacles.
- Near channel entrances or exits to prevent the entry of intruder or unwanted aquatic animals.
- On or around fish farms to isolate fish for management purposes.
- In general where fish are required to be captured by stunning. This technique has also been used experimentally for fish-shoal capture and the removal of burrowing animals.
- Recorders of fish activity or numbers by electrical methods are of little danger to the diver when functioning correctly, but can be associated with fish 'guides'.
- Cathodic and Impressed Current Protection systems particularly on installations intended for use offshore and large piers.
- Military and associated installations and vessels.
- In the proximity of large power-carrying underwater cables.

The most obvious hazards to divers occur when drifting with the current. In which case the diver may progressively be influenced by the electrical field and become unconscious or could be held on an electrode itself. This situation would include oblique or transverse pulse electrified screens in rivers or near fixed coastal installations. Or when installations are switched on during dive operations. A permit-to-work system must be used where this possibility is known to exist.

Although freshwater applications occur (their rarity may be a danger in itself), marine systems require larger amounts of power and, except for cathodic protection, alternatives are normally sought. In general, there should be no diving if there is a significant electrical field, and if one is suspected, suitable precautions must be taken; the use of metal dive-boats must be avoided.
Divers should maintain constant vigilance of unusual sensations when diving in unknown waters. Watch for unusual fish behaviour and be aware that electrical fields affect compasses, upsetting underwater navigation.

6.25.2 Use of electricity underwater in equipment and experiments.
Underwater electrical equipment introduces hazards to scientific and archaeological diving.
Water, particularly if it is saline, is a moderate conductor of electricity. There is, then, an apparent hazard to divers and submersible pilots who have to work with electrically controlled equipment. However, it can be safe to use electricity underwater.

The most obvious dangers from electricity underwater is electric shock from a malfunctioning or improperly grounded apparatus. When using any electrical gear underwater, therefore, it is imperative that the equipment be thoroughly tested before it is deployed, and then used only in the precise manner that it was designed for. Electric shock can come from either a generator or battery source; and it should be noted that a 48-volt battery for a DPV can often deliver a more serious shock than a 120 or 220 line voltage because of the higher amperage delivered by the batteries.

Units powered from surface or remote batteries.

If the casing of the electrical apparatus is metallic, it should be electrically continuous and must be adequately earthed (grounded) by a suitable electrode at the battery or generator end of the system. Conventional overcurrent protection, which must be supplemented by earth-leakage trips provides a similar safety factor to that of earthed (grounded) hand tools used outdoors on the surface. A system using an isolation transformer and amplified differential earth-leakage protection is preferred. A limit of 5 mA tripping current is suggested. If false tripping occurs at this level it indicates inadequate insulation in either the cable or apparatus. The possibility of using intrinsically safe supplies (i.e. those employing potentials below the limiting value) exists, but care must be taken to use design information obtained from a reputable source.

Units powered by self-contained batteries.

Self-powered units present an electrical and explosive hazard. Batteries should be connected just before use and disconnected as soon after use as possible.

If the case is either metallic and electrically continuous or insulating, then even in the event of implosion the risk of dangerous external fields is minimal. Care must be taken if attempts are made to salvage such items as it may take several hours for the batteries to discharge.

However the risk of explosion is considered to be the main hazard with self-powered units.

Many batteries (even when described as sealed) evolve hydrogen during charging and discharging. Unless nitrogen or oil immersion is used, all such units should be opened when on charge and after use in the water. H_2 plus O_2 is the explosive mixture resulting from an ingress of H_2 into an air-filled compartment. The opening of all underwater battery compartments must be carried out in the open air away from any burning material and very hot surfaces. Once air or inert gas flushing has been carried out, the battery holder can be reassembled but not sealed, and the small amounts of H_2 that may evolve after discharge should dissipate without danger as long as the batteries are in a well-ventilated place.

Additionally, protection against sparks may be obtained by using magnetically operated reed switches. As very considerable quantities of hydrogen can be evolved from a battery discharged to a level where the weakest cell is reversed biased, it is strongly recommended that a circuit be incorporated to isolate the batteries when their Electromotive Force (EMF) falls below a predetermined level.

There are other hazards with batteries.

Emission of toxic fumes is a problem associated with various batteries. Good ventilation is always sufficient to deal with this problem.

Fumes from overheated insulation may be a problem, but dangerous plastics that evolve poisonous or carcinogenic gases at high temperatures are now only commonly found on older insulation. Diving Officers/Chief Divers should inspect the wiring and the age of the equipment to assess the likelihood of this problem with their equipment.

All electrical equipment must be regularly inspected, and at the first sign of trouble must be subjected to replacement or very thorough service and further inspection.

A code of practice for use of electricity underwater has been published by Association of Offshore Diving Contractors (AODC).

6.26 THE USE OF RADIOISOTOPES UNDERWATER.

Biological experiments, water movement and chemistry studies, and possibly some geological experiments in which material is exposed to radioisotopes in relatively small, sealed containers underwater or as low-activity sediment tracers provide the few instances of use of radioisotopes underwater. Experiments where large amounts of radioisotopes are administered to open systems are not considered and would require special authorization should they be justified.

Study of radioisotopes including dangerous, high-level emitters such as radioactive strontium, caesium, and plutonium nuclear waste constitutes a special case. Underwater work involving these materials should only be carried out under the direct supervision of a panel of experts.

Any project must have the prior approval of the national controlling authority, usually your own laboratory radiation protection officer. The site or area where you propose to work and the isotopes to be used must be registered with the appropriate government and local authority.

Personnel must be designated radiation workers, or at least registered under a scheme approved by your laboratory; and they should all have prior experience of using the radioisotopes in question in the laboratory before using them underwater.

Amounts and kinds of radioisotopes used must be covered by a government Registration Certificate (where appropriate), and final disposal must be at a place and in the ways allowed by a Certificate of Authorization for the Disposal of Radioactive Waste.

There are strict laws governing transportation and packaging of radioisotopes while in transit. Make sure that you and your vehicle are insured while carrying and using radioisotopes.

6.26.1 Accidental spillage or loss of radioactive samples.

Consider the following points carefully:

i). Is there any possibility of spillage, either at the surface or underwater, from an unsealed isotope source due to equipment malfunction or breakage? Samples are most at risk when being handled at the air-water interface, especially on a rocky shore or in small boats in rough weather. If spillage occurs, is there any danger to public water or food supplies, or to the environment by localized concentration via the food chain?

ii). Can the containers with radioactive materials be readily relocated and recovered under all anticipated weather conditions, to prevent loss of radioisotopes on the seabed, or will they stay in place for later recovery without risk of displacement or washing ashore? They must be marked conspicuously in case this should happen.

iii). Are the containers so stowed during underwater transportation as to allow the diver to jettison them safely for later recovery should difficulties arise?

6.26.2 Protection of divers from radiation sources.

Experiments using beta-emitting isotopes such as carbon-14, calcium-45 and phosphorus-32 are relatively safe. There is little risk to the divers from the external radiation itself since water is a good absorber of beta-particles, although the stronger emitters such as P-32 may give a significant radiation dose if contained in a thin-walled, hand-held container. The sea also offers a vast dilution ratio should accidental spillage occur underwater. Amounts of radioisotopes should be kept to a minimum - not more than a few millicuries in any experiment - and special consideration should be given to work in freshwater environments in view of the possible subsequent uses of the water. For this reason use the isotope with the shortest half-life that is practicable.

As far as is understood no experience has yet been gained using gamma emitters in underwater experiments. However, if these are planned, it must be remembered that water is not a good absorber for gamma radiation, and further shielding such as lead will be required underwater as well as on land. Divers will also require waterproofed safety film badges for such work; these can readily be adapted from those used in the laboratory.

6.26.3 Disposal of waste.

Remember that a large amount of water may have to be transported back to the laboratory after the experiments, for authorised disposal. Therefore take sufficient strong, sealable, containers and conspicuously labelled packaging for this. The same applies to all solid waste and to other materials such as preserved experimental material and samples for analysis.

6.27 THE USE OF TELEVISION CAMERAS UNDERWATER.

Surface-controlled cameras can be very tiring to work with, owing to the weight and drag of the cable, and care must be taken to ensure that the cable neither entangles the diver, nor drags him into deeper water. Using handheld cameras can be very absorbing, and all too often routine diving safety checks become overlooked. The standby diver must be responsible for ensuring that this does not occur. The camera should not be so securely fastened to the diver that he cannot instantly jettison it in an emergency.

6.28 ACOUSTIC NOISE.

Most acoustic devices, echo-sounders, range-finders, beacons, etc. radiate so little power as to be harmless to divers working in their vicinity. There are systems, however, such as those used in geophysical research, long-range sonars, seismic exploration for oil and gas, and by the military, which radiate power at such an intensity as to be harmful to divers in the water. If there is any doubt about a system, the supervisor must take such steps as to ensure that the system cannot radiate power during a diving operation. The minimum step would be the use of a personally placed, and removed, "Do not operate" board on the system's main control switch, or a permit to work system with a positive lockout.

Certain fish farms are equipped with acoustic seal scarers which may cause discomfort and disorientation to the diver.

6.29 THE USE OF AIRLIFTS AND WATER DREDGES.

Divers needing to use any hazardous underwater equipment should be trained and competent to use it as a scientific or archaeological tool. Airlifts and water dredges vary in power and ease of use, and they both have their separate problems. Whenever these devices are used the diver must be in voice communication with the surface so that the water pump, or air compressor, can be controlled, and can also be switched off immediately in an emergency.

Airlifts

If air is injected into the lower end of a tube underwater, the bubbles expand and accelerate. This creates a negative pressure at the lower end which can be used to remove sediments. The power of this suction is mostly dependant on the length of the tube, its diameter, and the volume of injected air. Powerful airlifts can transport anything that will fit up the tube, including small boulders or diving equipment. All airlifts should have a suitable guard at the lower end to prevent oversize objects blocking the opening because, if this happens, air can rapidly replace all water in the tube and the whole system can suddenly become dangerously buoyant. The larger the volume of the tube, the greater the problem.

In addition to the guard, the supply of air must be easily and rapidly controllable by the diver as well as by the surface team. At the divers end a lever-operated ¼ turn lever valve should be used, with the ‘on’ in the horizontal position, and ‘off’ vertically down (this may require minor modifications of the handle). If there is a risk of sudden buoyancy, then a cord can be attached to the horizontal handle and secured to the seabed so that, should the airlift uncontrollably rise, the cord will automatically pull the handle to the closed position. If a semi-rigid extension hose is added at to the lower end of the airlift, safe arrangements must be made for the diver to be able to control the air supply and shut it off immediately in an emergency.

Particular care must be taken to ensure spare second stages and octopus rigs do not get sucked into the airlift. The suction can rapidly empty the cylinder and leave the diver without a reserve. Airlifting is best done using surface supplied diving equipment.

Because airlifts are normally operated in a near-vertical attitude, excavated debris discharged from the top can fall back on the operator if there is insufficient current to take it away. With particles smaller than sand, this may not be anything other than annoying. With larger and heavier objects it can be dangerous to the diver and so the discharge has to be managed. The discharge can be diverted by appropriate engineering, such as a chute supported by floats, but the simplest solution is to pull the airlift to an angle with a rope attached to a suitable place on the seabed. However as the angle increases, the airlift efficiency decreases.

Water dredges

If water is injected at pressure at one end of a near-horizontal tube, and a branch tube is taken off close to the point of injection, there will be a negative pressure within the branch. While this gives a suction less than a similar diameter an airlift, the costs are lower as the motive power can come from a simple fire pump rather than a more expensive, high-volume, low-pressure compressor.

The diver must be able to control the flow of injected water, but this can be done with almost any sort of appropriate valve. Although there is not a danger of a dangerous increase in buoyancy should the dredge become blocked, there is a different hazard with this equipment. The velocity of the injected water causes a jetting effect; the stronger the flow, the more powerful the reaction. There are two main ways of overcoming this problem, the dredge can either be tethered to the seabed, or the water leaving the exhaust end of the dredge can be baffled or diverted so that so that the energy is dissipated.

SECTION 7. BOATS AND BOATING SAFETY.

7.1 GENERAL.
Divers should be attended by a small standby boat, unless they are shore diving in clear, calm, water with a negligible current. The standby boat should, when possible, be fitted with two engines or an alternative method of propulsion, or operate in company with another boat. Propeller guards should be fitted if practical, unless the boat is at anchor. If anchored, this must be done in such a way as to be able to be instantly slipped. When operating in a current it may be prudent to trail a floating line, of at least 8 mm diameter, astern. This line should terminate in a float, so as to be visible to the divers, and act as a safety line should the divers be swept astern of the vessel. The boat must be easily entered from the water, (either by inherent design or a ladder), and have water-level handholds fitted. There must be built-in buoyancy in several independent sections.
A suitably qualified and experienced coxswain must be responsible for the standby boat, and will remain in the boat whilst acting in that capacity. He will ensure that, at least, the following equipment is carried, in suitable storage.
i) An anchor, fastened to a length of chain and an adequate length of rope, of at least 8 mm diameter. The rope must be securely fastened to a buoy in case emergency slipping is required.
ii) A VHF radio.
iii) A bailer.
iv) A drogue, (sea anchor).
v) In-date distress flares/rockets/smoke signals.
vi) Diver recall signals (if required).
vii) Engine spares as required - such as spark plugs, split pins, shear pins, propeller, starter cord, etc.
viii) Basic tools, as required.
ix) First-aid kit.
x) Fire extinguisher.
xi) Inflatable repair kit - if required.
xii) Foghorn, or other audible warning device.
xiii) Compass.
xiv) Chart, or relevant section.
xv) Radar reflector.
xvi) Oars/paddles.
xvii) An adequate supply of fuel, and oil, for the main and standby engines. Thought must be given to the fuel consumption of a planing-hulled vessel that is unable, for any reason, to reach planing speed. If the spare fuel is in jerricans, a funnel is essential.
xviii) An international code flag "A", and mast.
xix) Suitable navigation lights, if there is any possibility of the vessel being operated in conditions of low visibility, or at night.
xx) Spare rope/painters.

A standby boat should never operate alone more than three miles offshore, or in an exposed situation. In these cases it must be accompanied by a larger mother ship. The mother ship must be fitted with a method for rapidly, and safely, launching and recovering the standby boat, preferably when fully laden.
Certain workboats will have to comply with "The Safety of Small Workboats and Pilot Boats - A Code of Practice," produced by the MSA. (See section 7.6 for summarised details).

7.2 LAUNCHING AND RECOVERING.
Fifty percent of this is simply common sense, and the remaining fifty percent good seamanship.

Slipways - launching.
Consider the sea conditions and the tide direction. If necessary use a rope between the vehicle and the trailer. Watch for weed and/or slime with subsequent loss of traction and grip - for the vehicle, trailer and personnel.

Ensure the engine(s)/drive(s) are locked up, and the boat untied, bar the winch, bung in.
Reverse the boat into the water, the crewman holds the painter, disconnects the winch, and launches. The vehicle and trailer are parked above the high water mark, in a non-obstructive position, and ready for recovery.

The coxswain enters the boat, lowers (if required) the engines/drives and starts them, once they are warmed-up, and running smoothly, the crew boards.

Shore - launching.
As above, do not leave the vehicle with the engine running on a beach for more than a minute, watch for soft sand/old weed under the sand. Turn the boat bows to the waves if necessary. It may be worth swimming a kedge anchor out, prior to launching.

Recovery.
Remember that conditions may have changed since launching, swell always looks flat from the back. Come shallow with the engine locks off; if twin engines, only have one in gear. Motor in gently, on the back of one wave if required The crew goes overboard when shallow enough, to the seaward, he must be able to stand and control the vessel, as the coxswain stops and lifts the engines, the crew turns the vessel bows to the swell.

Always ensure that the boat is properly on the trailer before pulling it out of the water.

A trailer winch can be used to winch the trailer, as well as the boat.

It is possible to drive the boat onto a designed trailer, for very rapid recovery, but this takes an extremely well-drilled boat and shore crew.

7.3 TOWING LAWS.
Present UK law has evolved over many years, and, as a consequence, has developed into a veritable minefield. These notes are intended to give general guidance to the law, as it relates to the towing of boat trailers, by private cars or light commercial vehicles, at present.
Originally trailer regulations were all contained within the Motor Vehicle (Construction and Use) Regulations, then, in 1982, the Statutory Instrument 1189 was added, followed by the Motor Vehicle (Construction and Use) Amendment Number 41981, and then several EEC regulations. Added to this are the different interpretations placed upon the several parts of these by various regional police forces and various Traffic Commissioners.
There are however many, universally agreed items of legislation. The minimum penalty for an infringement of these regulations is three penalty points on your licence, and it is always the driver's fault.

Speed Limits.
Assuming the absence of any posted maximum speed limit signs, on a motorway or dual carriageway, 60 mph. On any other road, 50 mph. If there is not a black sign, with the white numerals "50" on the trailer's lighting board, then reduce these limits by 10 mph. A trailer must not be towed in the outside lane of a three-lane motorway.

Tow balls.
The European standard is 50 mm, not 2 inch.

Tyres.
These may be either crossply or radial, (regardless of what is on the towing vehicle), but not mixed, on the trailer. They must be suitable for the use to which the trailer is being put, and at the correct inflation pressure. There must be no cuts longer than 25 mm, or 10% of the tyre width (whichever is greater), or deep enough to reach the cords/ply. There must be neither bulges, nor visible cord/ply. The tread must be a minimum of 1.6 mm, throughout a continuous band measuring at least three quarters of the breadth of the tyre, the centre of this band being at the centre of the tread, and around the full circumference. All tyres must conform to European Standards, in which case the letter "E" is visible before the number.

Number Plates.
The trailer must be fitted with a registration number plate, the same number as the towing vehicle. If the vehicle was registered after 1/6/73, then the plate must be yellow reflective, with black numbers and letters. The size should be either 511 mm X 102 mm, or 284 mm X 200 mm. Plates must be labelled BSAU 1451967.

Mudguards.
Trailers must be fitted with mudguards, unless adequate protection is afforded by the body of the trailer. (Unfinished trailers on their way to a works for completion are exempt under the Community Directive 78/549).

Size Constraints.
A trailer and its load should not normally exceed 7 metres in length, and the trailer must not be more than 2.3 metres in width, although the load may be 2.9 metres.

Unbraked Trailers.
An unbraked trailer is legal, providing the gross (trailer plus load), designed, axle weight is less than 750 Kg, or the towing vehicle's kerbside weight is at least double the trailer's gross weight. The trailer must clearly be marked with its maximum gross weight, on the nearside, close to the tow bar.
Braked Trailers.
The trailer's gross weight must not exceed the vehicle's kerbside weight. Trailers must be fitted with a coupling and a correctly matched brake and linkage, which must have a minimum braking efficiency of 45%G. The fitted handbrake must be capable of holding the outfit on an 18% gradient. (1 in 6.25). An emergency braking device must be fitted, to allow application of the brakes if the trailer should break away from the towing vehicle. The device must apply and lock on the brakes, then detach from the vehicle. It must not attempt to connect the trailer to the vehicle. There are three general types of braked couplings.

i) The spring over - run coupling with mechanical brakes, that requires a catch to be manually operated before reversing.This is a very robust coupling which is only legal, for road use, on trailers manufactured before 1982. It is still widely used on off-road trailers, in non-EEC countries, and by the armed forces.
ii) The hydraulic over - run coupling with standard mechanical brakes. This style also requires a catch to be manually put over before reversing, and is only legal on trailers manufactured before the 1st April 1989.
iii) Auto reversing brakes and couplings must be fitted to all trailers manufactured after 1st April 1989. The reversed rotation of the road wheels operates a cam to lift the brakes clear of the drum. When the handbrake is applied, the spring energy store in the coupling pulls the cable further on, so as to over-ride the clearance on the cam.
If coupled air brakes are used, together with pin and eye fittings, then the gross train weight may be more than 3.5 tons but less than 7.5 tons.

Lighting.
i) A pair of brake lights must be fitted to all trailers, they must be between 350 mm and 1500 mm off the ground, and not less than 600 mm apart (400 mm if the trailer's overall width is less than 1300 mm). They must operate with the towing vehicles lights.
ii) A pair of tail lights, operating with the vehicle lights, must be fitted to all trailers. Their positioning is the same as the brake lights.
iii) A pair of amber direction indicators, flashing in unison with the vehicle's lights, between 60 and 120 times per minute, must be fitted, in the same positions as above.
iv) The number plate must be illuminated by an approved source.
v) Two, red, triangular reflectors must be fitted, at least 600 mm apart, (or 400 mm if the trailer is less than 1300 mm overall width). The base of them must be between 350 mm and 900 mm off the ground, and they must be at least 100 mm away from the stop, tail, and indicator lights.
vi)At least one, and not more than two, rear fog lights, must be fitted to all trailers manufactured after 1st October 1979, or first used after 1st April 1980, and wider than 1.3 m, They must operate independently of the rear brake lights, and need not be operational if the towing vehicle is not wired for rear fog lights.
vii) Side marker lights must be fitted if the trailer is wider than 2.1 m, or if the total combination, (vehicle, trailer, and load), exceeds 18.3 m, (unless the trailer is less than 1.6 m wide). One light must be on each side within 9.15 m of the front, spaced not more than 3.05 m apart, and one within 3 m of the rear of the load.
viii) A pair of front marker lights need to be fitted if the trailer is longer than 2.3 m, or wider than 1.6 m, or the combination is longer than 12.2 m, unless side markers are fitted.
ix) Amber side reflectors are required on all trailers longer than 5 metres. One must be not more than 500 mm from the rear, and another within the centre third of the trailer length.
x) Reversing lights are not compulsory, but if fitted, they must not dazzle, at eye level, at a reasonable distance, and there should be a pair.

Towing vehicle.
A minibus or crewbus cannot be used to tow a trailer unless there is a side door in the passenger compartment, or no passengers are being carried in the rear of the vehicle.

Transport of petrol.

No more than two, suitable, petrol containers may be carried inside a motor vehicle, or trailer. Each container can be of no more than 10 litres capacity, and must be clearly marked "Petroleum Spirit Highly Inflammable".

7.4 MAXIMUM OPERATING CONDITIONS.
Maximum operating conditions will depend upon the boat's size, type, and power. Care must be taken to ensure that the boat is not overloaded. The diving operation must be aborted, the divers recalled, and the boat returned to base, before any deteriorating conditions become dangerous. The recall decision may be made by either the Diving Supervisor or the Coxswain.
As a guide, 16 feet RNLI inflatables, with 40 H.P. engines, are not permitted to operate more than 5 miles offshore, or in a wind exceeding 27 knots. HMCG General Purpose inflatables are not permitted to operate in a sea state above a 3, and HMCG RHIBs do not operate in a sea state above a 4. None of these vessels puts out in visibility of less than two miles, unless equipped with electronic navigation equipment and radar.
These are the limits for emergency services, not routine operations.

7.5 DISTRESS.
VHF radios are an invaluable safety aid. All members of a diving team should possess an Operators Licence, and be fully conversant with the controls of the radio that is carried, especially those required for the transmission of "Mayday" and "Panpan" messages.
Always contact SAR units as soon as you feel that you may need them, it takes time to launch and travel. A missing diver will almost certainly be out of air before any assistance can reach you.
For any missing person, surface or sub-surface, put a buoyed shot in the last known location, and launch a buoyed drogue.

Man overboard.
If you see a person go overboard, immediately shout the fact to the coxswain, giving directions, and keep your eye on the casualty.

If you are coxswain, turn the propeller away from the casualty, then go short about to the recovery. Designate someone to watch the casualty.

Approach from down-wind/tide (whichever is having the greater effect). Do not ram the casualty. When alongside, lock the gears in neutral.

When in an unfamiliar vessel, always work out a method of recovering a person from the water, in both vertical and horizontal lifts, before you have to do it.

Helicopter rescue.
This will almost certainly be by one of the Sea - King variants.

i) The Royal Navy Sea - King. (Usually painted grey or grey and red).
These are usually found at Portland, Culdrose, and Prestwick. It has a radius of action of about 180 nautical miles, an endurance of about 4 hours, a transit speed of about 105 knots, and a search speed of about 90 knots. The survivor capacity is 13, and it may carry a diver.

ii) The Royal Air Force Sea - King. (Usually painted yellow).

There are two SAR dedicated squadrons, with flights based around the country. It has a radius of action of 250 miles, an endurance of 5.5 hours, a transit speed of 120 knots, and a search speed of 90 knots. The survivor capacity is 19 people.

iii) Bristows Coastguard Sea - King. (Usually painted red and white).
This is a civilian aircraft with more windows and larger floats. They are stationed at Stornoway, Solent, and Shetland. The radius of action is 200 miles, the endurance 4 hours, transit speed 110 knots, and search speed 90 knots. The survivor capacity is 19, (although a single lift of 31 has been undertaken at Shetland). Note that the barn door and winch, although still on the starboard side, are in front of the sponsons.

In general :-
Each of these aircraft weighs about 10.5 tons, it has a main rotor diameter of 62 feet, and an overall length of 73 feet. The downdraught to keep it airborne is of the order of 120 mph. So always ensure that all loose objects are tied down. Do not forget things like hats, outboard fuel tanks, park benches, unladen lightweight pick-up vehicles etc.
Keep all people in one place, preferably visible to the pilot, who sits on the starboard of the aircraft.

In the event of a Medevac, keep non-essential personnel as much out of the way as possible.

After establishing VHF contact, only use the radio to answer questions, and even then be as brief as possible.

Do not shine lights directly at the helicopter.

Do not fire flares once the helicopter has you visual. Although you may be asked to show smoke.

Never fasten the winch wire, or high wire, to anything.

Always allow the earth wire to (electrically) ground before touching anything hanging from the helicopter.

7.6 DEPARTMENT OF TRANSPORT, CODE OF PRACTICE.

A code of practice for small work boats - The Safety of Small Commercial Motor Vessels, a Code of Practice, The Department of Transport, Surveyor General's Organisation - is currently being prepared. When it is published a summary of the relevant portions will be printed.

SECTION 8. DECOMPRESSION PROCEDURES.

1. All dives involve decompression. In particular, a limiting no-stop dive ends with the divers just as close to excessive bubble formation as any decompression dive involving stops. Decompression procedures must be determined by reference to approved Decompression Tables.

2. The following established tables are currently approved for use by UK scientific and archaeological divers;

BSAC/RNPL, 1972
BSAC, 1988,1990
2806 (RN Table 11)
Bühlmann/SAA
US Navy, 1990
DCIEM

3. The table with which the personnel are most familiar should be employed. Differences between the established tables are not consistent across schedules (i.e. it is impossible to produce a ranked list of most to least conservative) and any such differences are likely to have fewer problems than the consequences of mistakes occasioned by the use of unfamiliar procedures.

4. Diving Officers/Chief Divers should ensure that their divers are trained in and use the most conservative decompression table for the type of diving they undertake (see section 10.9), in order to minimise any long term health risk.

5. When a diving team is comprised of personnel from institutions which have selected different Decompression Tables (see 4 above), Dive Supervisors should endeavour to 'pair' divers/tenders who are trained and experienced in the same decompression table; if this is impractical the most appropriate table for the task being carried out must be adopted by the pair (see also 7 below).

6. Divers must not switch between tables during a series of dives. A series of dives is taken to be a programme of repetitive dives whereby dives, other than the first, are started with a residual tissue load from previous dives.

7. Dive Supervisors must ensure that divers who are diving using unfamiliar procedures (e.g. 5 above) are fully conversant with the ascent rates, and stop procedures of the Table used, in particular the procedure to be adopted in the event of underwater separation.

8. Whichever table is used for decompression, the instructions should be rigidly adhered to *unless* there is, or potentially is, an injury or illness which it is considered takes precedence over the danger of suffering from decompression sickness. As the ascent rate is part of the decompression procedure any ascent in excess of the table's rate should instigate the missed stops procedure.

9. Diving Contractors, Diving Supervisors and Divers must endeavour to plan and conduct diving operations so as to minimise the risk of decompression sickness. The following provisions apply to all dives, whichever table or dive computer is used. Dive plans should aim to:

i) do the deepest dive first in a series, with the maximum depth of later dives becoming increasingly shallower.

ii) Divers must be desaturated of breathing gases between dive series, i.e. before beginning a new series of dives with a deeper dive. Desaturation times are given by some Decompression Tables, however if the Tables employed does not give desaturation times then a minimum period of 12 hours must elapse between the last dive of the first series and the first dive of the next, except if the last dive of the previous series was to a depth of 30m or more, in which case the minimum period is 16 hours.

iii) avoid more than 3 dives (ascents) per day (in any 24-hour period) from depths of 6m or greater.

iv) avoid more than one dive a day which includes an underwater decompression stop.

v) provide opportunity for the off-loading of gas from very slow tissues, i.e. Diving Contractors and Diving Supervisors must ensure that divers who carry out a programme of dives over a long period have a 24-hour continuous period free of diving. This break should be taken at least every seventh day, and if each day's diving involves a dive to 30m or more this 24-hour break should be taken at least every fourth day.

vi) avoid the need for divers to engage in strenuous post-dive activities.

Dive plans should avoid the need to:

i) make multiple ascents.
ii) make upward excursions, or conduct a dive with a saw-toothed profile.

If, during a dive, a diver experiences conditions which may be deemed provocative, e.g. hard work underwater, a saw tooth profile, then allowance should be made for this, i.e. by reducing the no-stop time (e.g. by 40% or by staying one level clear of the limiting line). These restrictions should also then be applied to subsequent dives in the series or, where the tables employed allow, switching to the next, more conservative, schedule within the chosen tables.

10. Planning Decompression Stops and multi-level dives. Dives involving underwater decompression stops must be carefully planned in advance. Dives involving surface decompression, with or without the use of oxygen, must be avoided. DWR only allows its use within strict limits imposed by the Diving Inspectorate.

11. For any dive with no planned in-water decompression stops and which is less than 10m, a two person, two compartment decompression chamber must be available within six hours travelling time and the dive plan should show how a casualty could be effectively transported. For any dive deeper than 10m or with planned decompression stops of up to 20 mins this chamber must be within two hours travelling time and advance written arrangements must have been made inbetween the Diving Contractor and the chamber operator. With planned decompression stops in excess of 20 minutes the chamber must be available on site, together with sufficient equipment and competent people to operate it.

12. It is widely excepted that the risk of both DCI and long term risk to health from micro-emboli are reduced by (i) carrying out only no-stop dives (that is those without the need for stage decompression, as opposed to the making of a safety stop), (ii) ascents complying with the tables ascent rate and including a safety stop and (iii) staying well within no-stop limits. All Diving Officers/Chief Divers should bear these points in mind when planning work programmes.
13. It is advisable to avoid excursion by flying, driving, or climbing, to more than 600 metres altitude within 24 hours of diving. The chief danger arises with flying after diving, where pressure drops will be rapid. Pressurised aircraft normally maintain a cabin pressure equivalent to 2000 - 8000 ft. If flying is essential the following table should be used.

	Time before flying at cabin altitude.	
Type of dive.	2000ft.	8000ft.
No stop, < 60mins under pressure in the last 24 hours.	2 hours	4 hours
All other air diving. < 4 hours under pressure.	12 hours	12 hours
Air and Nitrox saturation. > 4 hours under pressure.	24 hours	> 48 hours

14. Many decompression tables and dive computers supply corrections to be used when diving at altitude. If not, the following table may be consulted. It should, however, be used with caution for dives following a rapid excursion to altitude, as opposed to dives following at least 16 hours equilibration.

< 100 metres.	No adjustment.
100 - 300 metres.	Add 0.25 actual depth to obtain table depth.
300 - 2000 metres.	Add 0.33 actual depth to obtain table depth.
2000 - 3000 metres.	Add 0.5 actual depth to obtain table depth.

No table appears to exist for diving above 3000 metres. The Institute of Naval Medicine (INM) recommends the following conversion formula.

$$\text{Depth (Table)} = \frac{2 \times \text{Depth (Actual)}}{\text{Barometric pressure (bars)} + 1}$$

All dives at altitude should be no-stop dives.

15. There is a vast selection of dive computers available on the sports diving market, with more coming out all the time. Most of the principles of operation and mathematical models on which the programmes are based, remain commercial secrets. Although DWR does not allow their use for the calculation of decompression information they do, however, have many useful applications in scientific and archaeological diving, and it is suggested that the following guidelines be followed when using them.

i) The diver must be thoroughly conversant with the use, and particularly, the limitations of the instrument being used.

ii) The instrument must provide information on ascent rates.

iii) It should be capable of handling at least two or three dives in a twelve-hour period, and log such salient features so as to enable a written record of the dive to be made.

iv) For regular use, each organisation should choose and operate only one type of instrument.

v) While operating dives with computers, contemporaneous records of the operation must be kept, in the traditional, and legal, manner.

vi) At no time should a computer be the only source of decompression information in the water. Divers must always carry a set of tables,and back up instrumentation, in case of mechanical or electrical failure.

vii) A separate record of maximum depth and elapsed time must be kept, in case of post-dive complications.

viii) Many dive computers do not give the total decompression time required after a dive. The diver must ensure that there are sufficient air supplies available, in the water, at the correct depth, for any required stops.

ix) Dive computers should be kept separate from heavy diving equipment, in order to minimise the possibility of damage.

x) Each member of the team should be issued with a dive computer of the same type, and partners must not, under any circumstance, share an instrument.

xi) The computer must not be used to its limit, and special care taken to avoid saw-toothed profiles.

xii) The organisation must retain the ability to revert to the use of printed tables at any time.

xiii) All dive plans must comply with Section 8.9.

SECTION 9. SITUATIONS NOT COVERED BY THESE ADVICE NOTES.

Although these Advice notes, together with other published manuals, notes, and COPs, provides guidance to the statutory requirements placed upon divers by current legislation, and indicates safe diving practises in a variety of situations, it cannot, by the very definition of scientific and archaeological research diving, be all-encompassing. When a proposed diving operation involves conditions and/or circumstances not covered by this, or any complementary COP, the Chief Diver/Diving Officer should act as follows.

Study all the relevant Advice Notes and COPs for advice which infringes on any part of the proposed operation.

Draft a full set of instructions for the proposed operation. These instructions must include all new training procedures, equipment, safety procedures, and the exact routines to be followed during all stages of the operation, including potential faults, failures and accidents.

It may be helpful to refer this document to several Chief Divers at some of the establishments listed in Section 10.12, in case they have, or know of someone who has, undertaken a similar operation.

If the proposed operation is take place within UK territorial waters and involves a breach of DWR97, apply to the HSE for special exemptions, as explained in Section 1.

SECTION 10. APPENDICES.

10.1 ABBREVIATIONS USED IN TEXT.

ABLJ - Adjustable Buoyancy Life-Jacket.
ACoP - Approved Code of Practice.
AODC - The Association of Offshore Diving Contractors.
BC - Buoyancy compensator.
BR 2806 - The RN Diving Manual.
BSAC - The British Sub Aqua Club.
CIRIA - Construction Industry Research and Information Association.
CM - Centimetre.
CMAS - The World Underwater Federation.
COP - Code of Practice.
DCI - Decompression illness.
DCIEM - (Canadian) Defence and Civil Institute of Environmental Medicine.
DOW/DWR - Diving at Work Regulations 1997.
DPV - Diver propulsion vehicle.
DV - Demand valve.
EMF - Electro-motive force.
ERCA - Experience Route Competence Assessment.
FT - Foot.
GPS - Global positioning system.
HM - Her Majesty's.
HMCG - Her Majesty's Coastguard.
HP - Horse Power.
HR - Hour.
HSE - Health and Safety Executive.
IFA - Institute of Field Archaeologists.
INM - Institute of Naval Medicine.
IRPCS - International Regulations for Preventing Collisions at Sea, 1972.
M - Metre.
KG - Kilogram.
MINS - Minutes.
MM - Millimetre.
MOD - Ministry of Defence.
MPH - Miles per hour.
MRC - Medical Research Council.
NAS - Nautical Archaeological Society.
NERC - Natural Environment Council.
PADI - Professional Association of Diving Instructors.
RCV - Remote-controlled vehicle.
RHIB - Rigid-hulled inflatable boat.
RNLI - Royal National Lifeboat Institution.
RNPL - Royal Navy Physiological Laboratory.
ROV - Remote operated vehicle.
RN - Royal Navy.
SAA - The Sub Aqua Association.

SAR - Search and rescue.
SCOA - Self contained, open circuit, air mixture, diving apparatus.
SCUBA - Self contained underwater breathing apparatus.
SDDE - Surface demand diving equipment
SDSC - Scientific Diving Supervisory Committee.
SMB - Surface marker buoy.
SSAC - The Scottish Sub Aqua Club.
TUV - Towed underwater vehicle.
UA - Underwater Association.
UK - United Kingdom.
UNESCO - United Nations Educational, Scientific, and Cultural Organisation.
US - the United States (of America).
VHF - Very High Frequency, marine band radio.
WCoP - Working Code of Practice.

10.2 RELEVANT TEXT FROM THE SCIENTIFIC AND ARCHAEOLOGICAL APPROVED CODE OF PRACTICE.

It was intended to print the Scientific and Archaeological Code of Practice in this section to enable users of these advice notes to be able to refer to them - whether at work or not, or diving in the U.K. or not.
However, Crown Copyright prevents this and HMSO were not prepared to waive this copyright. Therefore, in accordance with SDSC's stated principle of allowing any potential user free access to any material relevant to their health and/or safety the following is the text of the ACoP, as prepared by the sub-committee responsible, and as finally approved by the HSE.
It must be stressed however that it is not the Diving at Work Regulations 1997, neither is it a finalised copy of the Scientific and Archaeological diving projects Approved Code of Practice - and users of these advice notes are strongly recommended to purchase a copy of both from HMSO.

Introduction

Explanation and intention of the code.
The code expands on the means of achieving the standards set by the Diving at Work Regulations (DWR). It deals selectively with only those regulations which need further explanation. The regulations themselves, which are printed separately to this code, need to be addressed fully.

The official status of the code.
Approved Codes of Practice (ACoPs) offer practical examples of good practice. They give advice on how to comply with the law by, for example, providing a guide to what is reasonably practicable. ACoPs have a special legal status. If employers are prosecuted for a breach of health and safety law, and it is proved that they have not followed the relevant provisions of the Approved Code, a court can find them at fault unless they can show that they have complied with the intention of the law in some other way.

Guidance is to help people understand the law, comply with the law, and to give technical advice. Further practical advice to the Scientific and Archaeological ACoP may be obtained from the Scientific Diving Supervisory Committee (SDSC) advice notes to the Scientific and Archaeological ACoP.
Following guidance is not compulsory and employers are free to take other action. But if they do follow guidance they will normally be doing enough to comply with the law.

Regulations are law, approved by Parliament, usually made under the Health and Safety at Work Act following specific proposals from the Health and Safety Commission. Regulations set out specific action which must be taken. Modern goal-setting regulations set out what must be achieved but not how it must be done. Old style prescriptive regulations spelt out, often in some detail, what must be done.

The legal basis of the diving regulations is the Health and Safety at Work Act. The Act sets out the general duties which employers have towards employees and members of the public, and employees have to themselves and to each other.
Duties under the Health and Safety at Work Act are qualified by the principle of "so far as is reasonably practicable", which means that the degree of risk in a particular job needs to be balanced against the time, trouble, cost and physical difficulty of taking measures to avoid or reduce the risk.

Who wrote this ACoP and how it was agreed.
The authors were a sub-committee of the Scientific Diving Supervisory Committee (SDSC) comprising of Mr.M.Dean, Archaeological Diving Unit, Mr.R.Forbes, Heriot Watt University, Mr.P.J.Lonsdale, University Marine Biological Station Millport, Dr.M.Sayer, Dunstaffnage Marine Laboratory, and Dr.M.White, British Antarctic Survey. The ACoP text was arrived at following extensive industry consultation.

Updating arrangements.
The HSE will undertake an annual review of all of the ACoPs, and will issue reapproval(s) as necessary.

Scope and areas covered by this code.
The Scientific and Archaeological Approved Code of Practice applies to scientific, archaeological and related diving projects.
Scientific diving projects include all diving projects undertaken in support of scientific research or educational instruction.
Archaeological diving projects do not include projects involving the recovery of items for salvage and subsequent sale or personal use.
DWR apply if any member of the diving team is paid or otherwise rewarded beyond the level of direct actual expense incurred. It will also apply where the primary intention of the diving operation is to collect objects, samples, or information for later conversion into reward to a level beyond that of the actual expense incurred during and for the diving operation.
The DWR do not apply if the reward is limited to reimbursement of actual food, accommodation, travel, or other incidental expenses directly related to the diving operation.

The other diving ACoPs cover media diving projects, recreational diving projects,commercial diving projects offshore and commercial diving projects inshore/inland. There is also an intention to produce ACoPs for the military, the police, and shellfish diving.

Sources of information.
The SDSC advice notes to the Scientific and Archaeological ACoP.
The UNESCO/CMAS Scientific Diving Code of Practice.
CMAS diving qualifications.
DWR 97.
Scientific and archaeological diving projects approved code of practice.

Definitions in Regulations.

2(1) diver means a person at work who dives

2(2) a person "dives if he/she enters water, a chamber or any other environment in which he/she is subject to pressure greater than 300 millibars above atmospheric pressure and who in order to survive in such an environment breathes in air or other breathing mixture at a pressure greater than atmospheric pressure

2(1) diving project means any activity in which at least one person takes part or will take part as a diver and extends from the time when that person, or the first such person, commences to prepare to dive until that person, or the last such person, has left the water, chamber or other environment and is no longer subject to pressure greater than atmospheric pressure

2(1) the 1995 order means the Health and Safety at Work etc. Act 1974 (Application outside Great Britain) Order 1995 (b)

3(2) These Regulations shall apply to and in relation to the premises and activities outside Great Britain to which sections 1 to 59 and 80 to 82 of the Health and Safety at Work etc. Act 1974 apply by virtue of the 1995 order as they apply within Great Britain

3(1) These Regulations shall apply to and in relation to any diving project apart from the following:- **3(1)(a)** the care or treatment of patients in a hospital or other medical establishment or in transit to such place where the means of transit is provided by or in respect of the hospital or other medical establishment; **3(1)(b)** activities in which areas or rooms are kept at a pressure higher than atmospheric in order to conduct some experiment or process in a sterile environment; **3(1)(c)** operations in which members of the armed forces of the Crown or of a visiting force are engaged in warfare or training for warfare; (**2(1) visiting force** has the same meaning as it does for the purposes of any provision of Part I of the Visiting Forces Act 1952); **3(1)(d)** activities to which the Work in Compressed Air Special Regulations 1958 apply

Clients

4 Every person who to any extent is responsible for, has control over or is engaged in a diving project shall take such measures as it is reasonable for a person in his position to take to ensure that these Regulations are complied with

It is the client's responsibility to ensure that the Diving Contractor is competent to undertake the duties.

Contractors

4(1) For every diving project there shall be one person and one person only who is the Diving Contractor
4(2) The Diving Contractor shall be the person who **4(2)(a)** employs the diver or divers engaged in the diving project or **4(2)(b)** dives in the diving project as a self-employed person or such person as that employer or self-employed person shall (or where there is more than one person such person as those persons shall jointly) appoint in writing before the commencement of the diving project to act as Diving Contractor

The Diving Contractor is an appropriate and competent person within the organisation.. This person is required to be appointed in writing by a person within the organisation who has the relevant authority to make such an appointment.

In the event of a diving project involving personnel from more than one such registered body, then the Diving Contractors will have to appoint one of their number to act as the sole Diving Contractor. This appointment needs to be in writing and be made before the commencement of the diving project.

In exceptional circumstances a Diving Contractor may only be responsible for part of the diving project, for example, when the project is especially long term or geographically far-ranging. In such cases the appointment of the Diving Contractor will need to specify the period for which he/she is acting.

6(1) The Diving Contractor shall ensure, so far as is reasonably practicable, that the diving project is conducted in a manner which protects the health and safety of all persons taking part in that project.
5(3) Each Diving Contractor shall: **5(3)(d)** ensure, so far as reasonably practicable, that any person taking part in the diving project complies with the requirements and prohibitions imposed on him/her by or under the relevant statutory provisions and observes the provisions of the dive plan;

It is the responsibility of the Diving Contractor to ensure sufficient suitably qualified personnel are available with such suitable equipment as may be required for the duration of the diving project so as to enable all aspects of the project to be undertaken in an acceptably safe manner.

A risk assessment is required to be undertaken for each project and there needs to be written evidence that this has been carried out.

Such personnel and equipment shall include all safety back up systems envisaged as required in the project's risk assessment.

The Diving Contractor is also responsible for ensuring that a suitably qualified Supervisor is appointed, in writing, for all parts of the diving project, and that the Supervisor is capable of constant direct supervision of the part of the diving project for which he/she is responsible.

Where the diving operation is of such a size that the Supervisor cannot supply this direct supervision, then further Supervisors are required to be appointed by the Diving Contractor.

In such cases the Diving Contractor needs to clearly define, in writing, the particular area of the operation for which each Supervisor is responsible.

For all diving operations, suitable provision needs to be made to ensure the availability of a recompression facility. When diving operations which do not involve planned decompression stops or depths in excess of 30 metres take place in U.K. Territorial waters, prior contact with H.M.Coastguard, by the Supervisor, to ascertain that a diving emergency could be handled to an acceptable standard shall be deemed to be sufficient.

When diving operations involving in-water decompression stops or depths in excess of 30 metres are planned, the Supervisor is required to make prior direct contact with a recompression facility, and the chamber operator informed of the details of the intended diving operation. The chamber operator also needs to be supplied with a method of communicating with the Supervisor for the duration of the diving operation so as to be able to inform him/her if the facility becomes unavailable.

If the use of any type of hyperbaric transportation chamber is planned in the event of an emergency, the Supervisor will need to, before the start of the diving operation, ensure that transfer is possible between the transportation and the main chamber, without a decrease in internal pressure.

In assessing both hyperbaric and normobaric transfers to recompression facilities, the Supervisor needs to ensure that there is a sufficient supply of oxygen available for the planned duration of the transfer.

Dive Planning and Risk Assessment.

6(2) No person shall act as a Diving Contractor unless, before the commencement of the diving project, he/she **6(2)a** prepares a dive plan in respect of that project
8(1) The dive plan shall be based on an assessment of the risks to the health and safety of any person taking part in the diving project and shall consist of all such information and instructions as are necessary to give advice to and to regulate the behaviour of those so taking part.

Each Diving Contractor shall issue all divers and Supervisors with a generic set of diving regulations, such as the SDSC advice notes to the Scientific and Archaeological ACoP, together with relevant in-house rules.

These rules and regulations will need to cover all of the normal risks involved with diving and procedures to mitigate their effect, and are required to include advice on: sea conditions, underwater visibility, pollution, depth, temperature, access to and from the shore/boat/platform etc., gas mixture, experience and number of personnel, location and proximity to emergency facilities, including recompression chambers and medical expertise.

All diving operations shall have a site and date specific risk assessment undertaken. This assessment is required to be appended to the diving operations log-book together with any additional safety procedures required.

6(3) Each Diving Contractor shall: **6(3)(a)** ensure that there are sufficient people with suitable competence to carry out safely and without risk to health both the diving project and any action which may be necessary in the event of a reasonably foreseeable emergency connected with the diving project;

The minimum diving team size will be three for SCUBA operations and four for surface supplied operations.

At least two of the team, including the Supervisor, shall have a current HSE- recognised first aid certificate.

All of the divers need to be trained in artificial resuscitation and oxygen administration to a standard approved by the DSAAC, with re-fresher training at intervals not exceeding three years.

In remote locations the Supervisor or other member of the surface team will need to be an HSE- approved Diver Medic.

As the Supervisor has to retain direct control of the diving operation sufficient suitably competent extra personnel may be required to operate plant and equipment and to provide safety support. Such operatives need to be in direct and effective communication with the Supervisor.

Diving Equipment.

6(3) Each Diving Contractor shall: **6(3)(b)** ensure that suitable and sufficient plant is available whenever needed to carry out safely and without risk to health both the diving project and any action which may be necessary in the event of a reasonably foreseeable emergency connected with the diving project;

Each diver requires to be supplied with breathing gas which is to a DSAAC- recognised standard, and which is adequate in volume and rate of supply for the specific diving operation, and shall have a separate supply immediately available for emergency use.

The Supervisor will need to be capable of calling the divers to the surface in an emergency, and each in-water diving team will always have a means of summoning assistance.

For each dive site there needs to be a suitable system for the emergency recovery of a casualty from the water, and suitable procedures organised for the emergency transportation of the casualty to a specialist treatment centre.

There shall also be a means of summoning further emergency assistance that does not require the Supervisor, diver medic, any life support technician, or other essential personnel leaving the immediate dive site.

In addition to such plant and equipment required for each diver and the diving project there ought to be, in the immediate vicinity of each dive site, an adequately stocked first aid box including an emergency oxygen administration set.

Suitable thermal, environmental and safety protection equipment is required to be available at all times for all personnel involved in the diving project.

When diving in polluted waters suitable disinfection procedures will need to be in place before the start of any diving operation.

6(3) Each Diving Contractor shall: **6(3)(c)** ensure that the plant is maintained in a safe working condition;

All plant and equipment needs to be checked by a competent person in a practical period immediately before use or deployment, and this check entered in the diving operations log book.

All major or safety items of plant and equipment owned by, or rented or leased to, the Diving Contractor, shall have a maintenance record showing that it has been checked by a competent person within a period not exceeding six months before use. (Or more frequently if required by European legislation or manufacturers recommendations).

This record shall identify the item of equipment, show the date of checking, the signature of the competent person, any limitations as to use, and any repairs or modifications carried out.

Sufficient and appropriate plant and equipment will need to be available for the number of divers involved in the operation. Where breathing and similar equipment is likely to be shared, appropriate disinfection procedures will need to be instituted.

Supervisors

9(1) There shall be a Supervisor exercising direct personal control over every diving project or part of a diving project.
9(2) A Supervisor shall be appointed to supervise only such part of a diving project as can safely be supervised by one person.
11 A Supervisor may give such reasonable directions to any person taking part in the diving operation in respect of which the Supervisor is appointed as are necessary to comply with regulation 10.

A Supervisor shall be appointed, in writing, by the Diving Contractor or the Diving Contractor's appointed deputy, for all parts of a diving project. The name of the person appointed is required to be entered in the Diving Operations log book.

If a diving operation is taking place over such an area or time scale that one Supervisor cannot be in full, direct, control then further Supervisors need to be appointed for specific areas of the operation. Such written appointments will clearly define the times and areas of control.

The Supervisor shall have immediate over-riding control of all safety aspects of the portion of the diving operation for which he/she is appointed apart from the legislative requirements of the Master of a Ship or Vessel.

During the period specified in the appointment the Supervisor may neither leave the dive site nor dive without formally handing the supervision over to another Supervisor. Such a handover will be entered in the Diving Operations log book.

Whilst the Supervisor does not need to have direct physical control over all items of plant, machinery, and control systems involved in the diving operation, he/she does need to have direct and clear audio and/or visual control of the operatives of such equipment.

Before the start of the part of the diving operation for which he/she is responsible the Supervisor will need to decide upon a common system of signals to be used between all personnel involved in the operation, and ensure that everyone is familiar with this system.

9(2) No person shall be appointed, or shall act, as a Supervisor unless he/she has suitable qualifications and is suitably competent to perform the functions of Supervisor in respect of the diving operation which he/she is appointed to supervise.

Whilst the Supervisor need not be an in-date diver, he/she shall be adequately trained or experienced in the operational and safety techniques which are to be used in the portion of the diving operation for which he/she is responsible.

The Supervisor shall have a current, HSE- recognised, first aid certificate together with DSAAC- approved training in therapeutic oxygen administration.

It is the responsibility of the Supervisor to ensure that the diving regulations are complied with and relevant logs maintained.

10(1) The Supervisor shall:-
10(1)(a) ensure that the diving operation, in respect of which he/she is appointed to carry out, so far as is reasonably practical -
(i) is without risk to the health and safety of all those taking part in that operation and of other persons who may be affected thereby;

The Supervisor needs to establish that all relevant parties are made aware that a diving operation is in progress, and all the necessary permits and permissions have been obtained.

He/she will have to assess the competencies, abilities and fitness of all the personnel involved in the diving operation and ensure that they are capable of safely carrying out the tasks required of them. This includes a realistic assessment of his/her own fitness and capabilities.

If a task requires the use of any specialised equipment the Supervisor needs to ensure that all the personnel involved in it's use are aware of any particular hazards and risks associated with the equipment as well as the general risk assessments of the operation.

It is the responsibility of the Supervisor to ensure that all equipment used in the diving operation is safe and suitable for use.

The Supervisor's responsibilities to the divers in a diving operation continue until such time as any decompression in a chamber, including therapeutic decompression, is completed, and/or it may reasonably be assumed that no member of the diving team is likely to suffer from decompression illness as a result of the diving operation.

All decompression schedules used in the diving operation are required to be approved and enforced by the Supervisor.

<u>Divers</u>

Diver training and competencies.

13(1) No person shall dive in a diving project unless he/she :-
13(1)(a) is competent to carry out safely and without risk to health any activity he/she may reasonably expect to carry out while taking part in the diving project;
13(1)(b) has an approved diving qualification which is valid for any activity he/she may reasonably expect to carry out while taking part in the diving project;

All members of the minimum diving team shall be qualified to at least CMAS 3* level, or other such standard listed on the current list of approved diving standards issued by the HSE..

Any diver not qualified to this standard may dive with the minimum diving team but as a trainee. In such a case the Supervisor will need to take such additional precautions as are necessary to protect the health and safety of this extra person.

When any equipment other than self-contained, open circuit, air diving equipment is used, the diver, stand-by diver and Supervisor shall have proof of training in its use approved by the DSAAC.

The diver and standby diver shall thoroughly familiarise themselves with the operation and position of all items of the others' equipment before the operation commences.
This safety check routine also needs to include any trainee(s) diving with the team.

All divers need to be trained in the use of, and familiar with, any specialised items of equipment that they will be using.

14(1) The Executive may approve in writing such training or qualifications as it considers suitable for the purpose of ensuring adequate competence of divers.

A minimum adequate level of competence is CMAS 3* or equivalent.

17(1) Any certificate of training, issued, or having effect as if issued, under the 1981 Regulations shall have effect, subject to any conditions or limitations contained therein, as if it were an approved diving qualification for the purposes of these Regulations.

HSE to explain the transitional arrangements for diver training.

First-aid training and competencies.

All divers in a diving project shall have proof of competence in resuscitation and oxygen administration approved by the DSAAC.

The Supervisor will need to have either a current HSE- approved first aid certificate or HSE- approved Diver Medic certificate.

Medical Checks.

13(1) No person shall dive in a diving project unless he/she - **13(1)(b)** knows of nothing which makes him unfit to dive (including any illness or medical condition which makes him unfit to dive);

Each diver shall inform the Supervisor immediately if there is any transitory medical condition which prevents them from diving safely or rendering assistance to another member of the diving team.

12(1) No person shall dive in a diving project unless he/she - **12(1)(b)** has a valid certificate of medical fitness to dive.

Every diver, or person who is likely to be subject to hyperbaric conditions as routine, rather than emergency, procedures shall be in possession of a valid certificate of medical fitness to dive.

15(1) The certificate of medical fitness to dive is a certificate from an approved doctor that the person issuing the certificate considers the person named in the certificate to be fit to dive.

For SCUBA diving on air to a maximum of thirty metres with planned decompression stops of less than five minutes and for divers who are not at work this certificate may be issued by a medical doctor to the standards defined by the diver certificates being utilised.
The certificate is valid for one year.

For diving at work the certificate can only be issued by an HSE- approved diving medical practitioner, and is valid for one year.

15(6) "approved doctor" means a medical practitioner who is, or who falls within a class of medical practitioners which is, for the time being approved in writing by the Executive for the purposes of this regulation; and any such approval may be given generally or restricted to any category of diver or dive.

HSE to explain the transitional arrangements for medicals.

<u>Annexes</u>

Major legislation which covers all industries

1. Health and Safety at Work Act 1974.
2. Management of Health and Safety at Work Regulations 1992.
3. Workplace (Health, Safety and Welfare) Regulations 1992.
4. Health and Safety (Display Screen Equipment) Regulations 1992.
5. Personal Protective Equipment Regulations 1992.
6. Provision and Use of Work Equipment Regulations 1992.
7. Manual Handling Operations Regulations 1992.
8. Health and Safety First Aid Regulations 1981.
9. The Health and Safety Information for Employees Regulations 1989.
10. Employers' Liability (Compulsory Insurance) Regulations 1969.
11. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985.
12. Noise at Work Regulations 1989.
13. Electricity at Work Regulations 1989.
14. Control of Substances Hazardous to Health Regulations 1994.
15. Chemicals (Hazard Information and Packaging for Supply) Regulations 1994.
16. Construction (Design and Management) Regulations 1994.

The Diving at Work Regulations 199-

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10.3 CMAS DIVING QUALIFICATION EQUIVALENTS.

The following list is intended to be a guide to Diving Officers/Chief Divers, it is not a list of CMAS approval.

All standards in italics are currently on the HSE list of approved diving qualifications suitable for diving under the Scientific and Archaeological ACoP.
Any visiting diver with qualifications (and hence medical certificate) which are not on the approved list, but are of equivalent competency should apply to the HSE policy division at Rose Court for a certificate of exemption. If granted, this exemption will be for a specific person during a specific diving operation, diving project, or period of time. It will not be a blanket exemption.

Country.
Organisation.
Diving grade.

International.
C.M.A.S.
3 diver or above, this includes any of the following that clearly display the CMAS 3* brevet on the certification document.*

Argentina.
3* - NQS Advanced Diver.
4* - NQS Advanced Divemaster.
Federacion Argentina de Activdades Subacuaticas.
3* - Buceador 3 Estrellas.

Australia.
Australian Underwater Federation.
2* - NQS Scuba Diver.
Federation of Austrailian Underwater Instructors.
1* - Snorkel Diver.
2* - Scuba Diver.
3* - Master Diver.

Austria.
Tauchsportverband Osterreichs.
1* - Grundstufe/ 1 Stern.
2* - 2 Stern.
3* - 3 Stern.

Belgium.
Federation Belge de Recherches et d'Activites Sous Marine.
1* - Brevet Elementaire.
2* - Brevet Moyen.
3* - Brevet Superieur.

Brazil.
Confederacao Brasileira de Pesca e Desportos Subacuaticos.
1* - Plongeur 1 Etoile.
2* - Plongeur 2 Etoiles.
3* - Plongeur 3 Etoiles.

Bulgaria.
Federation Bulgare des Sports Sous Marine.
1* - Scaphandrier Plongeur Autonome.

Canada.
A.C.U.C.
3* - Diver Level 3.
Federation Quebecoise des Activites Subaquaticus.
3* - Plongeur 3 Etoiles.

Colombia.
Federacion Columbiana de Actividades Subacuaticas.
1* - Buzo Deportivo 1 Estrella.
2* - Buzo Deportivo 2 Estellas.
3* - Buzo Deportivo 3 Estrellas.

Cuba.
Federacion Cubana de Actividades Subacuaticas.
1* - Buzo 1 Estrella.
2* - Buzo 2 Estrellas.
3* - Buzo 3 Estrellas.

Cyprus.
Cyprus Subaqua Club Andreas Kariolou.
3* - 1st Grade Diver.
Cyprus Federation of Underwater Activities.
1* - 3rd Grade Diver.
2* - 2nd Grade Diver.
3* - 1st Grade Diver.

Czechoslovakia.
Svaz Potapecu Ceskoslovenska.
1* - Insigne de Bronze.
2* - Insigne d'Argent.
3* - Insigne d'Or.

Denmark.
Dansk Sportdykker Forbund.
1* - 1 Star Diver.
2* - Plongeur Sportif Nordique.
3* - Plongeur de lere Classe.

Egypt.
Egyptian Underwater Sports Federation.
1* - 1 Star Diver.
2* - 2 Star Diver.
3* - 3Star Diver.

European Economic Community.
3 - European Scientific Diver.*

3 - Advanced European Scientific Diver.*
Technical Diving International (Europe) Ltd.
*3**
Finland.
Suomen Urheilusukeltajain Liitto Ry.
1* - 1 Star Diver.
2* - Plongeur Sportif Nordique.
3* - Plongeur de lere Classe.

France.
Federation Francaise d'Etudes et de Sports Sous Marine.
1* - Brevet Elementaire.
2* - 1er Echelon.
3* - 2eme Echelon.
4* - Plongeur Autonome.

Germany.
Verband Deutscher Sporttaucher.
1* - Brevet Sporttauchen.
2* - Brevet Bronze.
3* - Brevet Silver.
4* - Brevet Gold.
Verband Deutscher Tauchleher.
3* - 2 Star Diver.

Greece.
Federation Hellenique de la Peche Sportive et des Activites Subaquatiques.
1* - Plongeur Autonome 1 Etoile.
2* - Plongeur Autonome 2 Etoiles.
3* - Plongeur Autonome 3 Etoiles.

Hong Kong.
Hong Kong Underwater Federation.
1* - 3rd Class Diver (Pool).
2* - 3rd Class Diver.
3* - 2nd Class Diver.
4* - 1st Class Diver.

Indonesia.
Indonesian Subaquatic Sport Association.
1* - Scuba Diver III.
2* - Scuba Diver II.
3* - Master Scuba Diver.

Ireland.
Irish Underwater Council.
1* - Trainee Diver.
2* - Club Diver.
3* - Leading Diver.

Israel.
Federation for Underwater Activities in Israel.

2* - 2 Star Diver.
3* - 3 Star Diver.

Italy.
Federazione Italiana Della Pesca Sportiva e Attivita Subacquee.
1* - Plongeur 1er Degre.
2* - Plongeur 2eme Degre.
3* - Plongeur 3eme Degre.

Japan.
Federation Japonaise des Activites Subaquatiques.
1* - 1 Star Diver.
2* - 2 Star Diver.
3* - 3 Star Diver.

Korea, Republic of.
Korea Underwater Association.
1* - Scuba Diver.
2* - Advanced Scuba Diver.
3* - Divemaster.

Liechtenstein.
Liechtensteiner Tauchsport Verband.
1* - Brevet 1 Etoile.
2* - Brevet 2 Etoiles.

Luxembourg.
Federation Luxembourgeoise des Activites Subaquatiques.
1* - Plongeur 1er Degre.
2* - Plongeur 2eme Degre.
3* - Plongeur 3eme Degre.

Malta.
Federation of Underwater Activities in Malta.
1* - Elementary Grade.
2* - Intermediate Grade.
3* - Advanced Grade.

Mauritius.
The Mauritius Underwater Group.
1* - Novice Diver.
2* - Sport Diver/Dive Leader.
3* - Advanced Diver.
4* - 1st Class Diver.

Mexico.
Federacion Mexicana de Actividades Subacuaticas.
1* - Buceador Juvenil.
2* - Buceador.
3* - Buceador de Primera.

Monaco.

Club de Chasse et d'Exploration Sous Marine.
1* - Plongeur 1 Etoile.
2* - Plongeur 2 Etoiles.
3* - Plongeur 3 Etoiles.

Netherlands.
Nederlandse Onderwatersport Bond.
1* - 1 Star Diver.
2* - 2 Star Diver.
3* - 3 Star Diver.

New Zealand.
New Zealand Underwater Association.
3* - Coach Diver.
CMAS Dive Club.
1* - Dive Club 1 Star Diver.
2* - Dive Club 2 Star Diver.
3* - Dive Club 3 Star Diver.

Norway.
Norges Dykkeforbund.
1* - 1 Star Diver.
2* - Plongeur Sportif Nordique.
3* - Plongeur de lere Classe.

Poland.
Polskie Towarzystwo Krajoznawcze Zarzad Glowny Komisja Dzialalnosci Podwodne.
1* - Brevet Inferieur.
2* - Brevet Moyen.
3* - Brevet Superieur.

Portugal.
Federecion Portuguesa de Actividades Subacuaticas.
1* - Plongeur Niveau 1.
2* - Plongeur Niveau 2.
3* - Plongeur Niveau 3.

San Marino.
Federazione Sammarinese Attivita Subacquee.
1* - Sommozzatore I Grado.
2* - Sommozzatore II Grado.
3* - Sommazzatore III Grado.

Senegal.
Federation Senegalaise des Activites Subaquatiques.
1* - Brevet Elementaire Senegalais.
2* - Brevet 1er Echelon Senegalaise.
3* - Brevet 2eme Echelon Senegalais.

Singapore.
Singapore Underwater Federation.
1* - Openwater Diver.

2* - Advanced Openwater Diver.
3* - Divemaster.

South Africa.
South African Underwater Union.
2* - 3rd Class Diver.
3* - 2nd Class Diver.
4* - 1st Class Diver.

Spain.
Federacion Espanola de Actividades Subacuaticas.
2* - Buceador Deportivo de 2 Clase.
3* - Buceador Deportivo de 1 Clase.

Sweden.
Svenska Sportdykarforbundet.
1* - 1 Star Diver.
2* - Plongeur Sportif Nordique.
3* - Plongeur de Lere Classe.

Switzerland.
Federation Suisse des Sports Subaquatiques.
1* - Brevet Elementaire.
2* - Brevet 1er Echelon.
3* - Brevet 2eme Echelon.

Tunisia.
Yachting Club de Tabarka.
3* - 2eme Echelon.
Federation Tunisienne des Sports Nautiques.
1* - Brevet de Plongeur 1er Degre.
2* - Brevet de Plongeur 2eme Degre.
3* - Brevet de Plongeur 3eme Degre.

United Kingdom.
British Sub Aqua Club.
1* - Snorkel Diver.
2* - 3rd Class Diver.
3 - 2nd Class Diver.*
2* - Sports Diver/Dive Leader.
3 - Advanced Diver.*
4 - 1st Class Diver.*
Sub Aqua Association.
1* - Elementary Diver.
2* - Club Diver/Dive Leader.
3 - Dive Supervisor/ Dive Master.*
Scottish Sub Aqua Club.
2* - 3rd Class Open Water Diver.
3 - 2nd Class Master Diver.*
4 - 1st Class Premier Diver.*
American Nitrox Divers International UK Ltd.
*3**

International Association of Nitrox and Technical Divers UK.
*3**
National Association of Underwater Instructors UK.
*3**
SCUBA Schools International GB Ltd.
*3**
United States of America.
National Young Mens Christian Association Scuba Program.
1* - Bronze Star Diver.
2* - Silver Star Diver.
3* - Gold Star Diver.
National Association of Underwater Instructors.
2* - Openwater Diver, Level II.
3* - Advanced Diver, Level IV.
Professional Association of Diving Instructors.
1* - Open Water Diver.
2* - Advanced Open Water Diver with Rescue Diver.
3 - Divemaster.*

Venezuela.
Federacion Venezolana de Actividades Submarinas.
2* - Buceador Basico.
3* - Buceador Avanzado.

Yugoslavia.
Savez za Povodne Aktivnosti i Sportski Ribolov na Moru SFR Jugoslavije.
1* - Plongeur 1 Etoile.
2* - Plongeur 2 Etoiles.
3* - Plongeur 3 Etoiles.

Zimbabwe.
Zimbabwe Underwater Divers Association.
2* - 3 Star Diver.
3* - 2 Star Diver.

The following commercial standards are currently on the HSE list of approved diving qualifications suitable for diving under the Scientific and Archaeological ACoP.

Australia.
Diver Accreditation Scheme Part 1 - SCUBA to 30m.
Diver Accreditation Scheme Part 2 to 30m.
Diver Accreditation Scheme Part 2 - Restricted - to 30m.
Diver Accreditation Scheme Part 3.
Diver Accreditation Scheme Part 3 Restricted
Diver Accreditation Scheme Part 3 Restricted + HSE Surface Supplied Diving (Top up).
Diver Accreditation Scheme Part 4.

Belgium.
Operateur Van Onderwaterwerken.
Operateur de Travaux Subaquatiques.

Canada.
Category 1 Diver.
Category 2 Diver.
Category 3 Diver.
Bell Diver.
Surface Supplied Mixed Gas Diver to 70m.
Unrestricted Surface Supplied Diver to 50m.
Restricted Surface Supply Diver to 30m
Unrestricted SCUBA Diver to 40m.
Restricted SCUBA Diver to 20m.

Denmark.
Air Diving Qualification.

Holland.
Part 1 Surface Dependant Diver.
Part 2 Bell Diver.
Category A (SCUBA).

France.
Class 1 Mention A.
Class 2 Mention A.
Class 3 Mention A.
Class 1 Mention B.
Class 2 Mention B.
Class 3 Mention B.

Norway.
Bell Diver.
Surface Orientated Diver.

South Africa.
Class 1 Diver.
Class 2 Diver - SCUBA and SSE to 50m.
Class 3 Diver - SCUBA and SSE to 50m.
Class 4 Diver - SCUBA to 50m.

United Kingdom.
HSE Closed Bell Diving.
HSE Surface Supplied Diving.
HSE SCUBA Diving.
HSE Surface Supplied Diving + HSE Surface Supplied Diving (Top-up).
HSE Part I.
HSE Transitional Part I (issued between 1st July 1981 - 3rd December 1981)
HSE Part II.
HSE Part II (Restricted)(Air range only).
HSE Transitional Part II (issued between 1st July 1981 and 3rd December 1981).
HSE Part III.
HSE Part III (Restricted - Tank).HSE Part III + HSE Surface Supplied (Top-up).
HSE Part IV.

HSE Part IV (Restricted - Tank).
TSA or MSA Bell Diving (issued between August 1975 and June 1981).
TSA or MSC Basic Air Diving (issued between August 1975 and June 1981).

Until 31st March 1999 there is a transitional system for archaeologists who were working under the general exemption DOW/1/81 to apply for a certificate by virtue of experience. Please apply to HSE policy section for futher details.

10.4 MATTERS TO BE ENTERED IN THE DIVING PROJECT PLAN.

For each Diving Project a Project Plan must be completed before the start of the project. This Project Plan is the primary risk assessment for the whole of the project.

Following on from this, a site and date specific risk assessment (refer to Section 10.5 for an example) may also have to be undertaken, for each Diving Operation, to cover ephemeral risks and hazards.

Hard copies of the Diving Project Plan, the Diving Project Risk Assessment, and the Diving Operation(s) Risk Assessment(s), if any, must be kept for at least two years after the completion of the Project/Operation.

The Project Plan must include at least the following information:-

(a) The Diving Contractor.

(b) The number of Supervisors required.

(c) The number of Divers required.

(d) The number of other personnel required and their duties.

(e) The equipment required.

(f) Any special competencies required from any personnel.

(g) The general risk assessment, including :-

Sea conditions anticipated,

underwater visibility,

pollution,

depth,

temperature,

access,

breathing gas, and whether SCOA or SDDE, and why,

in-water and surface communications requirements,

emergency procedures such as recompression chamber access, medical expertise, medical equipment, casualty evacuation plan, etc.

<u>10.5 EXAMPLE OF RISK ASSESSMENT FORM.</u>

SUMMARY OF RISK ASSESSMENT.

Site/Location.

Operations covered by this assessment.

Date of assessment.

Date reassessment due.

Assessor, (print name).

Signature.

Overall assessment of the risk of injury prior to remedial action:

Insignificant/Low/Med/High.

Priority for remedial action:

Nil/Low/Med/High.

Remedial action to be taken.

Date when remedial action completed.

Overall assessment of the risk of injury post remedial action:

Insignificant/Low/Med/High.

ASSESSMENT. (Assume no controls are in place).

Q1. Do the operations involve a significant risk of injury?

YES/NO.

If "No", complete assessment summary.
If "Yes", go to question 2.

Q2. Can the operations be avoided/mechanised/automated at a reasonable cost?

YES/NO.

If "No", go to question 3.
If "Yes", proceed, then check that the result is satisfactory.

Q3. Complete the following detailed assessment for all identified hazards, using the following parameters:-

Persons at risk - **E**mployees, **P**ublic, **V**isitors, **C**ontractors, **Y**oung persons.

Worst case outcome - **F**atality, **S**evere injury, **M**inor injury, **N**o injury, **E**quipment or environmental damage.

Likelihood - **L**ikely or frequently, **P**robable, **M**ay occur, **R**emote **I**nsignificant.

Hazard.	Persons at risk	Worst case outcome	Likeli-hood	Risk Acceptable/not
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

If the risk is not acceptable consider current controls on the following table.

This table must be completed for each hazard identified as having an unacceptable level of risk.

Hazard No.

Existing controls.
Existing information (including signs).
Existing training.
Best Practice.
Risk acceptable/not.

If the risk is still perceived as unacceptable then remedial action must be taken, and recorded on the assessment summary.

10.6 MATTERS TO BE ENTERED IN THE DIVING OPERATIONS LOG.

The following matter shall be entered in the diving operations log in respect of each diving operation:

(a) the name of the diving contractor;

(b) the dates on which and the period during which the diving operation was carried on;

(c) the name or other designation of the craft or work site in connection with which the diving operation was carried on and the location of that craft or work site;

(d) the name of the diving supervisor and the period for which he is acting in that capacity in respect of that diving operation;

(e) the names of the other persons engaged in the diving operation including those operating any diving plant or equipment and their respective duties;

(f) the arrangements for emergency support;

(g) the requirements for first aid personnel and equipment;

(h) the procedures followed in the course of the diving operation including details of the decompression schedule used;

(i) the maximum depth reached in the course of the operation for each diver;

(j) for each diver, in respect of each dive he makes, the time he leaves the surface, his bottom time (that is the period from the time he leaves the surface until he starts to ascend) and the time he reaches the surface;

(k) the type of breathing apparatus and mixture used;

(l) the nature of the diving operation;

(m) any decompression sickness, other illness, discomfort or injury suffered by any of the divers;

(n) particulars of any emergency which occurred during the diving operation and any action taken;

(o) confirmation that all equipment used has been checked immediately prior to the dive and conforms with the maintenance schedule;

(p) any defects that are discovered in any plant or equipment used in the diving operations;

(q) particulars of any environmental factors affecting the diving operation;

(r) any other factors relevant to the safety or health of the persons engaged in the operation.

This applies to all diving operations including work in surface compression chambers for which equivalent records of exposure to pressure need to be kept. A hard copy of the log must be kept for at least two years following the date on the log.

DIVING OPERATIONS LOG.

Contractor	**Date**	**Site**

I appoint ________________________ as diving from _________to____________
________________________ supervisor(s) _________ ____________
________________________ _________ ____________
signed. _________________(Contractor)

Emergency support arrangements	**Non divers in operation. Name and Duty**	**Equip. defects**	**Emergencies and action taken**
Nature of operation		**Diver problems injuries etc.**	**Deco. schedule**
Weather/Sea	**Forecast/tide**	**Vessel**	

First aid personnel and equipment requirements	**Specific health and safety factors**
Breathing apparatus and mix used, reason for choice.	**Notes**

Diver	**Leave surface**	**Reach surface**	**Bottom time**	**Max depth**	**Equipment checked**

Supervisors Signature.

10.7 MATTERS TO BE ENTERED IN THE DIVER'S LOG.

The following matters shall be entered in the diver's log in respect of each diving operation in which he takes part:

(a) the name and address of the diving contractor;

(b) the date;

(c) the name or other designation and the location of the work site or craft from which the diving operation was carried on;

(d) the name of the diving supervisor;

(e) the maximum depth reached on each occasion;

(f) the time he left the surface, his bottom time and the time he reached the surface on each occasion;

(g) where the dive includes time spent in a compression chamber, details of any time spent outside the chamber at a different pressure;

(h) the type of breathing apparatus and mixture used;

(i) any work done by him on each occasion and the equipment (including tools) used by him in that work;

(j) any decompression schedules followed by him on each occasion;

(k) any decompression sickness or other illness, discomfort or injury suffered by him;

(l) any other factor relevant to his safety or health.

A diver's log with photograph and medical certificate is required by everyone exposed to pressure for the purpose of diving operations, including associated use in surface compression chambers but excluding those who may have to enter a chamber in an emergency. A hard copy of the log must be retained for at least two years following the date of the last entry in it.

PERSONAL DIVE LOG.

<table>
<tr><td>Contractor</td><td colspan="2">Date</td><td colspan="2">Site</td></tr>
<tr><td colspan="5">Supervisor From To
_______________ _____ _____
_______________ _____ _____
_______________ _____ _____</td></tr>
<tr><td>Vessel</td><td colspan="4">Breathing apparatus and mix used</td></tr>
<tr><td colspan="2">Decompression schedule</td><td colspan="3">Problems, injuries, etc.</td></tr>
<tr><td colspan="2">Nature of operation</td><td colspan="3">Tasks and equipment used</td></tr>
<tr><td>Dive partner(s)</td><td>Leave surface</td><td>Reach surface</td><td>Bottom time</td><td>Maximum depth</td></tr>
<tr><td colspan="5">Notes (including relevant personal health and safety factors)

Supervisor,s signature.</td></tr>
</table>

10.8 EQUIVALENT WIND-CHILL TEMPERATURE CHART.

Wind MPH	5	10	15	20	25	30	35	40
Temperature, degrees Centigrade.								
+4	+2	-1	-4	-7	-9	-12	-12	-12
+2	-1	-7	-9	-12	-12	-15	-15	-17
-1	-4	-9	-12	-15	-17	-17	-21	-21
-4	-7	-12	-17	-17	-21	-23	-23	-26
-7	-9	-15	-21	-23	-26	-29	-29	-29
-9	-12	-17	-23	-26	-29	**-32**	**-34**	**-34**
-12	-15	-23	-29	**-32**	**-34**	**-34**	**-37**	**-37**
-15	-17	-26	**-32**	**-34**	**-37**	**-40**	**-40**	**-43**
-17	-19	-24	**-34**	**-37**	**-43**	**-46**	**-46**	**-48**
-21	-23	**-32**	**-40**	**-43**	**-46**	**-48**	**-51**	**-51**
-23	-26	**-37**	**-43**	**-46**	**-51**	**-54**	**-54**	**-57**
-26	-29	**-40**	**-46**	**-51**	**-54**	**-57**	**-60**	**-60**
-29	**-32**	**-43**	**-51**	**-54**	**-60**	**-62**	**-62**	**-65**
-32	**-34**	**-46**	**-54**	**-60**	**-62**	**-65**	**-68**	**-71**

Bold type indicates the greatest danger, when flesh may freeze within one minute.
It should be noted that the greatest increases in wind-chill occur at the lower wind speeds, and even on days warmer than 4^{o}C wind-chill can reduce the relative temperature to below freezing.

10.9 CHOICE OF DECOMPRESSION TABLES.

Employers have a statutory duty to make a provision in their diving rules concerning the decompression tables their employees are to use. Some, non-NERC, institutions within the UK scientific and archaeological diving community have issued their own diving rules, some of which specify tables while others lay down guidelines for the selection of appropriate procedures. Thus the SDSC established a working party to review the selection and recommendation of decompression tables.
Given that the various tables available have both positive and negative points it is felt that the simple recommendation of a single table is inappropriate. Rather, this review sets out to determine procedures which might be employed to (i) select Decompression Tables appropriate to scientific and archaeological diving in the UK, (ii) make recommendations/prioritize those tables with respect to minimizing both the short-term and long-term health risk of their use and (iii) to produce appropriate 'rules' for dealing with visiting scientists using other tables.

After due review of the nine commonly employed decompression tables a list of six approved tables has been produced. The excluded Tables were rejected on the grounds of (i) having been superseded (original US Navy Table), (ii) insufficient data/familiarity by the review team (French) and (iii) concerns about suitability/safety (PADI).

Of the six approved tables we consider the production of a simple ranking to be inappropriate, as the 'risk' of 'within table' decompression sickness is not distributed evenly across schedules. We have therefore concluded that each institution's Chief Diver/Diving Officer should select a decompression table for adoption for that institution, based on the pros and cons of the various tables and the types of diving undertaken from that establishment. Some pros and cons of each table are set out in the Appendix.

The need for appropriate, rigorous training, practice and application of the procedures associated with the selected table can not be over-stressed. Many of the decompression incidents recorded by sports divers as 'within table' can be traced to a misuse of the procedures required to meet the inherent assumptions of the tables being used.

Rules are set out for the matching of divers using different, but approved, procedures. However, we believe that these should only be applied to groups of scientists visiting or working alongside a host institution. In the case of single scientists, staying a length of time, it would probably be more practical to provide appropriate training in the use of the host institution's selected table.

The authors believe that the following observations will assist Chief Divers/Diving Officers in the selection of appropriate decompression tables which best meet the needs of their establishment.

2806 (RN Table 11)

1. The best tried-and-tested table (long term).
2. Uses well-tried algorithms.
3. The most conservative at depth.
4. Very simple table layout.
5. Based on one dive a day.

Designed for young-fit and dive-fit individuals.
Not readily available to the public.

SAA/Bühlmann

1. Readily available.
2. Uses well-tried algorithms.
3. Based on three ascents a day.
4. The waterproof slate is the complete table.
5. Very clear instructions.
6. The required precautionary halt ensures a reasonable diving technique.

7. The dive planner on the back is not relevant to scientific or archaeological diving.
8. Relatively new in the UK.

BSAC/RNPL (1972)

1. Uses well-tried algorithms.
2. Maximum of two ascents a day from greater than 9 metres.
3. Heavy penalty on second dive.
4. Allows unlimited no-stop diving at less than 9 metres.
5. Complete table fits on a waterproof slate.
6. Easy to use.
7. No longer readily available, although still in widespread use.
8. Many divers trained on this table.
9. Coarse altitude diving penalty system.

BSAC'88

1. No restriction on number of ascents.
2. Can plan dives using a multi-level dive planning procedure.
3. Generally more conservative than BSAC/RNPL.
4. Based on the same algorithms as the BSAC/RNPL.
5. Full procedure for accounting for pressure changes, i.e. moving to and diving at altitude.
6. Easy to use.
7. Only a sub-set of the tables can be carried on a waterproof slate.
8. Requires considerable discipline in diving procedures, e.g. 2-speed ascent rate.
9. Tables allow poor dive practices, i.e shallower dive first.
10. Need for considerable training in 'sensible' dive practices.
11. All BSAC branches should now be teaching these tables and associated procedures, hence their use will become increasingly common amongst sport divers and amateurs.

DCIEM

1. Designed for hard work in cold water.
2. A modern table which took account of, and was modified in accordance with, the problems encountered with other tables.
3. Extensive theoretical testing involved during the development.
4. Designed for repetitive diving.
5. Very conservative especially for long and/or deep exposures.
6. Low predicted incidence of decompression sickness.
7. Generally accepted by diving physiologists as a very safe table.
8. Rapid ascent rate - 18 +/- 3 m per minute.
9. Long in-water decompression is necessary resulting in longer dive times - reduce amount of time available for work and a greater air requirement.
10. Complex calculations are required for repeat diving - more training will be necessary to avoid mistakes.

US NAVY (Comments refer to old version as 1990 version were not available at the time of writing).

1. A long-established table - many dives completed successfully.
2. Used extensively abroad - considerable experience in their use will be available.
3. Designed for repetitive diving.
4. Allows longer exposures with reduced in-water decompression - maximise time available for underwater work.
5. Designed for military diving with associated backup - higher levels of risk are acceptable.
6. High rate of ascent - 18 m per minute.
7. Higher probability of DCI than DCIEM and RNPL. For countries with comprehensive-incident reporting procedures, US Navy tables have a higher incidence of DCS than other tables.
8. Design of the table facilitates repetitive diving over extended time periods.

9. Complex calculations are required for repetitive diving - more training is required to avoid mistakes.
10. Tables allow poor dive practices, i.e. shallow dive followed by a deeper.

10.10 LIST OF EMERGENCY DECOMPRESSION CHAMBERS (AS OF 30/09/96).

CHAMBERS UNDER MINISTRY OF DEFENCE CONTROL

ENGLAND

DERA Hyperbaric Facility, Royal Hospital Haslar, Haslar Road, HAMPSHIRE, PO12 2AA	9 bar	Portsmouth(01705)582617 Mobile 0831 573724 24 hour emergency no.for civilians 0831 151523 & (01705)335888
Southern Diving Unit 1 (Plymouth), Diving Centre, HM Naval Base, Devonport, Plymouth, Devon, PL2 2BG	7 bar	Working Hours-Plymouth (01752)555386 Out of hours via Navy ops (01752)557550 Civilians if referred by NHS Doctor. Emergencies only
Southern Diving Unit 2 (Portsmouth), Reclaim Building, Horsea Island, Cosham, Portsmouth, Hants, PO6 4TT	7 bar	Working Hours-Portsmouth (01705)224094 Out of hours via Navy ops (01752)557550 Civilians if referred by NHS Doctor. Emergencies only

SCOTLAND

Clyde Submarine Base Northern Diving Group HM Naval Base Faslane Dumbartonshire G84 8HL	14 man 7 Bar	Helensburgh (01436)674321 X3206 Ops room X3309 or X6361 or (01436)810974 Outside working hours (01436)886834 Civilians only if indemnity form is signed.
Clyde Marine Services Base Great Harbour Greenock RENFREWSHIRE PA15 2AR	8 bar	Greenock (01475) 787912 Ext 230/279 (08.00 - 16.30)

CHAMBERS UNDER CIVILIAN CONTROL

ENGLAND

Royal Victoria Infirmary Queen Victoria Road	4 bar	0191 222 7191 or 0191 222 6000

Newcastle upon Tyne NE1 4LP		Mr.J.Pooley\Mr.John Cook (No air call) Emergency no.(0191)232 5131
Northumbria Police Diving Marine School Viking Park Blackett Street JARROW	6 bar	0191 510 2020 X65331 or X65316. Limited availability to civilians. Emergency no. 01661 872555
Hyperbaric Treatment and Training Services BUPA Murrayfield Hospital Holmwood Drive Thingwell Wirral	8 bar	0151 648 8000 Operations manager Mr.Dave Alcock
Nortwest Diving Ltd. Northside Westfloat Docks Road Birkenhead L41 1DF	6 bar 2.7 bar	(0151)653 8894 F.McNally
Lancashire and Cumbria Underwater Search Unit Lancashire Constabulary HQ Hutton Lancashire PR4 5SB	6.5 bar	(01772)618442 mobile (24 hr) 0831 340817 or (01772)618256 X2442 or 2438 and ask for the Preston Duty Officer
Stoney Cove Marine Trials Sapcote Stoney Stanton Leicester LEICESTERSHIRE LE9 4DW	6 bar	Mr D Crouch, 01455 273089 If no reply to above no. contact Hinkley Police 01455 637811 or 842778
Site Shift Manager British Nuclear Fuels Sellafield Seascale Cumbria	10 bar	(01946) 771462 or (01946) 771448
Port of London Authority Diving Service Denton Wharf Mark Lane Gravesend KENT DA12 2QB	8 bar	Emergency no.01474 560311 (01474) 562497 Port Control London, Duty Port Controller.

Diving Diseases Research Centre Hyperbaric Medical Centre Tamar Science Park Derriford Road Plymouth PL6 8BQ	1X6 bar 2X26 bar	(01752)209999 office hours or 24 hour (state diving emergency) 01752 261910
Atlantic Enterprise 7 Parkstone Road Poole Dorset BH15 2NN	6 bar	(01202)678278 office hours. (01459)134665 supervisors pager-24 hrs.
Diver Training College Malt Kiln Lane Appleton Roebuck York YO5 7DT	2X6 bar	(01904)744424 office hours, Mr.Steve Fila mobile 0860 847247 Emergency no.s (01904) 744301 or 744426

SCOTLAND

Aberdeen Royal Hospitals Trust Hyperbaric Medicine Unit Royal Infirmary Forester Hill ABERDEEN AB9 2ZD	31 bar	01224 681818 Emergency Hyperbaric Doctor
The Underwater Centre Ltd Fort William INVERNESSHIRE PH33 6LZ	3X5 bar	(01397) 703786 contact diving supervisor. At other times via Fort William Police (01397) 702361
Dunstaffnage Marine Research Laboratory Dunbeg Argyll PA34 LAD	6 bar	01631 562244 Office Hours Other times via Oban Coastguard 0631 563720
Eastness Marine Diving Services Eastness Pier Preston Crescent Inverkeithing Fife KY11 1DS	10 bar	(01383) 411011 Emergency no.(01383) 417084
University Marine Biological		01475 530581/2

Station	6 bar	or via Clyde Coastguard
Millport		
ISLE OF CUMBRAE		
KA28 0EG		
Wolfson Hyperbaric Medical Unit		(01382)660111 X2080
Ninewells Medical School	3 bar	or direct line (01382)
Dundee		632080 Dr.P.James
Tayside		
DD1 9SY		
C&R Diving Ltd.	6 bar	(01806)242755 or 588328
Sella Ness Ind.Est.		Mobile 0378 984538
Graven		
Moss Bank		
Shetland Islands		
ZE2 9QR		
Kishorn Diving & Salvage	10 bar	Oban Coastguard
Achintraid		or Ian Beaton (01520)
Kishorn		733212
Strathcarron		
Rosshire		
IV54 8SA		

IRELAND

Craigavon Area Hospital	5 bar	Portadown(01762)334444
68 Lurgan Rd		or emergency no.336711
Craigavon		
County Armagh		
Northern Ireland		
BT63 5QQ		
Galway Regional Hospital	8 Bar	Galway(00353)91524222
Recompression Team		X4331
Duty Anaesthetic Registrar		
Galway		
Ireland		

CHANNEL ISLANDS

St.Johns Ambulance & Rescue Service		Guernsey(01481)725211
Rohais	5 bar	Ask for the Duty Officer St Peter Port
Guernsey		
Jersey Hyperbaric Treatment	6 bar	Dr.Stanley Hamilton
Centre		Work (01534)873633
Albert Pier		Home (01534 862876

The Harbour
Jersey
JE2 3NE

ISLE OF MAN

Hyperbaric Dept Fire Headquarters Peel Road Douglas	2X5 bar	(01624)626394 Dr.David Douglas

SINGLE COMPARTMENT HYPERBARIC CHAMBERS

Hyperbaric Unit Whipps Cross Hospital Intensive Care Unit Whipps Cross Road Leystone LONDON E11 1NR	3 bar	(0181)5395522 X5150 Chamber no.(01831)5356665
Peterborough District Hospital Intensive Care Unit Thorpe Road Peterborough CAMBRIDGESHIRE PE3 6DA	3 bar	(01733)874000 X4529 Duty Anaesthetic Registrar
North Manchester General Hospital Delaunays Road Manchester M8 5RB	3 bar	(0161)7202538 Dr Dunbar
Glan Clwyd Hospital Bodelwyddan Clwyd NORTH WALES	2 bar	01745 583910 X4334

10.11 FIRST AID KIT CONTENTS.

The size and contents of the first aid kit must allow for :-

The number of persons involved in the diving operation;

The location of the dive site;

The anticipated time for further assistance to arrive;

Any special hazards identified by the risk assessment;

The medical competencies of the on site personnel:

The first aid kit may be an appropriate place to keep a method of summoning further assistance.

As a guide, for a small group working in a non-remote location with no particular hazards envisaged the first aid kit should contain at least:-

A mask and bag manual resuscitator, with oxygen feed;

3 guerdal airways (1 each size);

Medical oxygen regulator;

Sufficient medical oxygen to last until the casualty reaches a place of treatment or further supplies can be obtained;

Oxygen bottle key (if required);

4 aluminium foil blankets;

A windproof body bag;

3 large sterile unmedicated dressings;

3 medium sterile unmedicated dressings;

4 triangular bandages;

6 safety pins;

A selection of adhesive dressings;

A pair of sharp/blunt shears;

10.12 NATIONAL ORGANISATIONS RELEVANT TO SCIENTIFIC AND ARCHAEOLOGICAL DIVING.

Association of British Diving Schools, Fort Bovisand Underwater Centre, Plymouth, PL9 0AB.
Association of Offshore Diving Contractors, 177a High Street., Beckenham, Kent, BR31 1AH.
British Cave Diving Group, Withey House, Withey Close West, Bristol.
British Geological Survey, Murchison House, West Mains Rd., Edinburgh, EH9 3LA.
British Hyperbaric Association, Dr.J.A.S.Ross, Dept. of Environmental and Occupational Medicine, Medical School, Foresterhill, Aberdeen. AB9 2ZD.
British Museum (Natural History), Cromwell Rd., London SW7 5BD.

British Society for Underwater Photographers, c/o Fleur Fillingham, 60, St.Helens Gardens, London, W10 6LH.
British Standards Institution, British Standards House, 2, Park St., London, W1.
British Sub Aqua Club, Telford's Quay, Ellesmere Port, South Wirral, Cheshire, L65 4FY.
CMAS, Scientific Committee, 47, Rue de Commerce, Paris 75015.
Construction Industry Research and Information Association, 6, Storey's Gate, London SW1P 3AU.
Employment Medical Advisory Service, HSE Medical Division, Baynard House, 1, Chepstow Place, London, W2.
Health and Safety Executive (Diving Inspectorate), Rose Court, 2 Southwark Bridge, London SE1 9HS.
Health and Safety Executive (Diving NIG - Contractors Registration Unit), 39 Baddow Road, Chelmsford, Essex. CM2 0HL.
Health and Safety Executive (Library and Information Service), Broad Lane, Sheffield, S3 7HQ.
Inspection for Diving Equipment, Servicing and Testing. 23, Hillcrest Rd, Orpington, Kent, BR6 9AN.
Institute of Field Archaeologists.
Institue of Naval Medicine, Fort Rd., Alverstoke, Gosport, Hants., PO12 2UJ.
Institute of Oceanographic Sciences, Southampton Oceanography Centre, Empress Dock, European Way, Southampton, SO14 3ZH.
Marine Accident Investigation Branch, 5/7, Brunswick Place, Southhampton, Hants., SO1 2AN.
Medical Research Council, Decompression Sickness Panel, 20, Park Crescent, London, W1.
MOD(Navy), Hydrographic Dept., Creechbarrow Rd., Taunton, Somerset, TA1 2DN.
Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, SN2 1EU.
Nautical Archaeological Society,
Radiocommunications Agency, (Ship Radio Licensing Section), Radiocommunications Agency, Room 613, Waterloo Bridge House, Waterloo Rd., London, SE1 8UA.
Royal Geographical Society, Kensington Gore, London, SW7 2AR.
Scientific Diving Supervisory Committee, R.B.Pope, Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, SN2 1EU.
Scottish Sub Aqua Club, The Cockburn Centre, 40, Bogmoor Pl., Glasgow, G51 4TQ.
Society for Underwater Technology, 76, Mark Lane, London, EC3R 7JN.
Sub Aqua Association, Bryslan House, Upper St., Fleet, Hampshire, GU13 9PE.

10.13 ACCIDENT/INCIDENT REPORT FORM.

IN CONFIDENCE.

Please fill in as much of the form as possible, continue on separate sheets if required. Return to P.J.Lonsdale, University Marine Biological Station Millport, Isle of Cumbrae, Scotland, KA28 OEG. Tel. 01475 530581, fax 01475 530704.

This report form is for the SDSC data base, and is not intended to replace the normal reporting procedures (if any) required by RIDDOR.

RIDDOR 1995 has slightly altered the reporting arrangements for diving. Under it the reporting of dangerous occurrences in respect of diving will cover any of the following incidents.

The failure or the endangering of any lifting equipment associated with the diving operation, or life support equipment, including control panels, hoses and breathing apparatus which puts a diver at risk. The expression "at risk" is qualified by the potential for a fatality, major injury or reportable disease. So this includes any incident where the breathing apparatus malfunctions whether there was the potential for harm or not.

Any damage to, or endangering of, the dive platform, or any failure of the dive platform to remain on station, which puts a diver at risk. In this respect the dive boat is classed as the platform.

The trapping of a diver.

Any explosion in the vicinity of a diver.

Any uncontrolled ascent or any omitted decompression which puts the diver at risk.

Although there are only three reportable occupational diseases (DCI, barotrauma resulting in lung or other organ damage, and dysbaric osteonecrosis) the list of major injuries requiring to be reported is somewhat larger, and includes :-

any fracture, other than to the fingers, thumbs or toes;
any amputation;
dislocation of the hip, knee, or spine;
loss of sight (whether temporary or permanent);
a chemical or hot metal burn to the eye, or any penetrating injury to the eye;
any injury leading to hypothermia, heat induced illness or unconsciousness or requiring resuscitation or admittance to hospital for more than 24 hours;
any loss of consciousness caused by asphyxia or by exposure to a harmful substance by inhalation, ingestion or through the skin;
any other loss of consciousness;
any acute illness which requires medical treatment where there is a reason to believe that this resulted from exposure to a biological agent or its toxins or infected material;
any other acute illness requiring medical treatment.

Date/time group of incident.

Location.

Name of Casualty. **Sex.**
Date of Birth.

Address.

Telephone number.

Any previous known, relevant, physical ailments, disabilities, or impairments.

Details of any medications or drugs taken (prescribed or not), in the last 48 hours.

Number of years diving.

Number of dives.

Date of last medical. Commercial/sport.

Name of Informant.

Address.

Telephone number.

Name of Contractor.

Address.

Telephone number.

Name of Supervisor/Marshall.

Address.

Telephone number.

Did the incident cause any injury to the casualty? If so, describe the injury/injuries signs and symptoms, in chronological order (24 hour clock), as far as possible.

What first-aid treatment was undertaken ?

Type of Diving. Self-Contained/Surface Demand/Other (specify).

Breathing Mixture.

Qualifications of diving team. Casualty.

Supervisor.

Standby diver 1.

Standby Diver 2.

Dive Details for the last 48 hours. (Time of leaving surface, time leaving bottom, time of arrival at surface, maximum depth, details of any safety or decompression stops, dive profile).

Tables\type of computer used.

Purpose of dive.

Dive partner record at time of incident.
In water alone/diving with one buddy/ diving with more than one buddy/roped diver to surface operations/surface marker buoy used/ buddy line used, diver to diver/distance to nearest standby diver..........

Vessel involved ? If so, give details.

Coastguard contacted ? If so, state station/unit.

Any other emergency services contacted ? If so, which?

Environmental Conditions.

Water: Visibility.

Temperature.

Tide.

Current.

Swell.

Surface: Wind.

Weather.

Temperature.

Visibility.

Details of casualty's diving equipment, condition pre and post dive, and whether recovered with the casualty.

Detailed description of incident/accident.

10.14

DRAFT STANDARDS
for
EUROPEAN SCIENTIFIC DIVERS
and
ADVANCED EUROPEAN SCIENTIFIC DIVERS

The following standards were reached, following much preparatory work by Marco Weydert (DG XII D/3), by the participants on the course/seminar for the Instructors of European Scientific Divers held at Cavo, Isola d'Elba, Italy over the period 1st - 11th May 1997 (supported by the grant MAS3-CT96-6351 from the European Commission); primarily by the following members of the specially convened workshop:

Phil Lonsdale, (Chairperson), University Marine Biological Station Millport, Scotland.
Juha Flinkman, (Vice Chairperson), University of Helsinki, Finland.

Jaoa Feotoria, University of Algarve, Portugal.
Inez Flameling, Netherlands Institute of Ecology.
Jo Hammelin, Centre d'Oceanologie de Marseille, France.
John Heine, American Academy of Underwater Sciences, USA.
Peter Konig, Federal Maritime and Hydrographic Agency of Germany.
Brian Munday, University College Galway, Ireland.
George Petihakis, Institute of Marine Biology of Crete.
Hanne Skjaeggestad, University Marine Laboratory, Northern Ireland.
Mats Walday, Norwegian Institute of Water Research.
Vidar Wennevik, Institute of Marine Research, Norway.

PREAMBLE.

The goals of the European Standards for Scientific Diving are:-

a) to assure the mobility of fully trained scientific divers,
b) to allow member states (and others) to assess the training level of a migrant,
c) to enable specialist courses and optional training, above the minimum, to be developed on a European basis so as to provide a more effective use of self contained underwater breathing apparatus (SCUBA) diving techniques in science.

There are two different levels of standard, both of which are professional.

a) the European Scientific Diver. (ESD).
b) the Advanced European Scientific Diver. (AESD).

Both of these standards represent a minimum agreed training and attestation of competence which promote scientists to move freely throughout the countries of the European Economic Area (EEA) in order to co-operate on and participate in sub-aquatic research projects involving diving using SCUBA. The equivalence is issued following certification by authorised national agencies. Depth and breathing gas limitations may apply. All member countries of the EEA are expected to recognise one or both of these training levels (application of directive EEC 92/51). The ESD qualification exceeds the minimum standards for the P** training level, and the AESD qualification exceeds the minimum standards for the P*** training level.

The standards do not include any regulations such as insurance, medical examinations, employment rules, safety rules, diving limits, rules for recognition of national scientific diving schools, etc. These are covered by national law and European Directives.

Neither do the standards take account of any speciality requirements by employers. They simply define the minimum basic training of a scientific diver as needed for mobility and as a basic training level on which the employer can build further training modules.

National laws and regulations may regulate training but the minimum standards must be maintained.

Scientific diving training for these standards can be given either one or a combination of more than one of the following:

a) a taught course;

b) a supervised programme of continuous training and assessment carried out in a nationally recognised institution;

c) recreational diving activities under the auspices of a a nationally recognised diving organisation:

In all of these cases, all dives must be logged and certified in the candidate's personal log. Any scientific dives must be further certified by the diving officer or director (or appointed deputy) of the scientific research institute for which they were undertaken.

A minimum of 18 years of age is required.

Both the ESD and AESD certificates will be issued to members of the permanent staff, contract staff, research students, technicians, and trainees or students of nationally recognised research institutions *such as:*

- *Universities;*
- *University departments;*
- *University field centres and stations;*
- *Technical colleges;*
- *Government research Laboratories;*
- *State research laboratories;*
- *Regional research laboratories;*
- *Local research laboratories;*
- *Engineering research institutions;*
- *Multi-national and European research laboratories;*
- *Hospitals;*
- *Medical research institutions;*
- *Diving physiological and ergonomic research institutions;*
- *National and Regional museums;*
- *Charitable or non-profit research foundations:*

MAINTENANCE OF QUALIFICATIONS.

1. A scientific diver who satisfies these requirements will gain either an ESD or an AESD certificate that is valid for five years.
2. This certificate must then be renewed every five years by making an application to the issuing authority.
3. Holders of these certificates must comply with all national and local rules concerning third party insurance, medical fitness, safety at work and scientific diving activities when diving in a host member country when they are engaged in scientific diving activities. The certificate only indicates the training level,and not the current level of diving competence.

CROSS-OVERS.

Cross-overs from non European to European standard may be organised by the European Scientific Diving Supervisory Committee (ESDSC) if the standards are met.

TRANSITION RULE.

Already fully certified scientific divers (on a national basis), or scientific divers having more than two years of professional experience with a minimum of 30 scientific dives, and a total of more than 100 dives may receive the ESD certificate if applied for by 1.1.99, under the condition that they have obtained P** level or higher by 1.1.97.

Already fully certified scientific divers (on a national basis), or scientific divers having more than two years of professional experience with a minimum of 50 scientific dives, to include at least 20 dives leading the diving team, and a total of more than 100 dives may receive the AESD certificate if applied for by 1.1.99, under the condition that they have obtained P*** level or higher by 1.1.97.

THE EUROPEAN SCIENTIFIC DIVER.

A European Scientific Diver is a diver capable of acting as a member of a scientific diving team. He/she may attain this level by either a course or by in-field training and experience under suitable supervision or by a combination of these two methods.

The ESD must :-

- show proof of basic theoretical knowledge and a basic understanding of:

1. diving physics and physiology, the causes and effects of diving related illnesses and disorders and their management.
2. the specific problems associated with diving to and beyond 20m, calculations of air requirements, correct use of decompression tables.
3. equipment, including personal dive computers and guidelines as to their safe use.
4. emergency procedures and diving casualty management.
5. principles of dive planning.
6. legal aspects and responsibilities relevant to scientific diving in Europe and elsewhere.

- be fully competent with/in:

1. diving first aid, including cardio-pulmonary resuscitation (CPR) and oxygen administration to diving casualties.
2. SCUBA rescue techniques and management of casualties.
3. the use and user maintenance of appropriate SCUBA diving equipment.

- be fully competent with:

1. search methods.
2. survey methods, both surface and sub-surface, capable of accurately locating and marking objects and sites.
3. the basic use of airbags and airlifts for controlled lifts, excavations and sampling.
4. basic rigging and rope work, including the construction and deployment of transacts and search grids.
5. underwater navigation methods using suitable techniques.
6. recording techniques.
7. acting as surface tender for a roped diver.
8. sampling techniques appropriate to the scientific discipline being pursued.

-show proof of having undertaken 70 open water dives, to include a minimum of:

1. 20 dives with a scientific task of work, such as listed above.
2. 10 dives between 15m and 24m.
3. 5 dives greater than 25m.
4. 12 dives in the last 12 months, including at least 6 with a scientific task of work.

All evidence must be recorded in nationally acceptable logs, countersigned by suitably qualified persons.

None of the above precludes the possible requirement for a practical or theoretical demonstration of any or all of the points shown.

THE ADVANCED EUROPEAN SCIENTIFIC DIVER.

An Advanced European Scientific Diver is a diver capable of organising a scientific diving team. He/she may attain this level by either a course or by in-field training and experience under suitable supervision or by a combination of these two methods.

The AESD must :-

- show proof of theoretical knowledge and a comprehensive understanding of:

1. diving physics and physiology, the causes and effects of diving related illnesses and disorders and their management.
2. the specific problems associated with diving to and beyond 30m, calculations of air requirements, correct use of decompression tables.
3. equipment, including personal dive computers and guidelines as to their safe use.
4. emergency procedures and diving casualty management.
5. the principles and practice of dive planning and the uselection and assessment of divers.
6. legal aspects and responsibilities relevant to scientific diving in Europe and elsewhere.
7. dive project planning.

- be fully competent with/in:

1. diving first aid, including CPR and oxygen administration to diving casualties.
2. SCUBA rescue techniques and management of casualties.
3. the use and user maintenance of appropriate SCUBA diving equipment, including dry suits and full face masks.
4. basic small boat handling, and electronic navigation.
5. supervision of diving operations.

- be fully competent with:

1. search methods, such as those utilizing free swimming and towed divers together with remote methods suitable for a various range of surface and sub-surface situations.
2. survey methods, both surface and sub-surface, capable of accurately locating and marking objects and sites.
3. the basic use of airbags and airlifts for controlled lifts, excavations and sampling.
4. basic rigging and rope work, including the construction and deployment of transacts and search grids.
5. underwater navigation methods using suitable techniques.

6. recording techniques.
7. roped/tethered diver techniques and various types of underwater communication systems such as those utilising visual, aural, physical and electronic methods.
8. sampling techniques appropriate to the scientific discipline being pursued.

-show proof of having undertaken 100 open water dives, to include a minimum of:

1. 50 dives with a scientific task of work, such as listed above.
2. 10 dives between 20m and 29m.
3. 10 dives between 29m and the national limit.
4. 12 dives in the last 12 months, including at least 6 with a scientific task of work.
5. 20 dives in adverse conditions, such as currents, cold water, or moving water.
6. 20 dives as an in-water dive leader.

All evidence must be recorded in nationally acceptable logs, countersigned by suitably qualified persons.

None of the above precludes the possible requirement for a practical or theoretical demonstration of any or all of the points shown.

THIS TABLE IS FOR COMPARISON ONLY, AND IS NOT PART OF THE STANDARDS.

THE EUROPEAN SCIENTIFIC DIVER.	**THE ADVANCED EUROPEAN SCIENTIFIC DIVER.**
An ESD is a diver capable of ***acting as a member of*** a scientific diving team. He/she may attain this level by either a course or by in-field training and experience under suitable supervision or by a combination of these two methods.	An AESD is a diver capable of ***organising*** a scientific diving team. He/she may attain this level by either a course or by in-field training and experience under suitable supervision or by a combination of these two methods.

- show proof of ***basic*** theoretical knowledge and a ***basic*** understanding of: 1. diving physics and physiology, the causes and effects of diving related illnesses and disorders and their management. 2. the specific problems associated with diving to and beyond ***20m***, calculations of air requirements, correct use of decompression tables. 3. equipment, including personal dive computers and guidelines as to their safe use. 4. emergency procedures and diving casualty management. 5. principles of dive planning. 6. legal aspects and responsibilities relevant to scientific diving in Europe and elsewhere.	- show proof of theoretical knowledge and a ***comprehensive*** understanding of: 1. diving physics and physiology, the causes and effects of diving related illnesses and disorders and their management. 2. the specific problems associated with diving to and beyond ***30m***, calculations of air requirements, correct use of decompression tables. 3. equipment, including personal dive computers and guidelines as to their safe use. 4. emergency procedures and diving casualty management. 5. the principles ***and practice*** of dive planning ***and the selection and assessment of divers.*** 6. legal aspects and responsibilities relevant to scientific diving in Europe and elsewhere. ***7. dive project planning.***
- be fully competent with/in: 1. diving first aid, including CPR and oxygen administration to diving casualties. 2. SCUBA rescue techniques and management of casualties. 3.the use and user maintenance of appropriate SCUBA diving equipment.	- be fully competent with/in: 1. diving first aid, including CPR and oxygen administration to diving casualties. 2. SCUBA rescue techniques and management of casualties. 3.the use and user maintenance of appropriate SCUBA diving equipment, ***including dry suits and full face masks.*** ***4. basic small boat handling, and electronic navigation.*** ***5. supervision of diving operations.***

- be fully competent with: 1. search methods. 2. survey methods, both surface and sub-surface, capable of accurately locating and marking objects and sites. 3. the basic use of airbags and airlifts for controlled lifts, excavations and sampling. 4. basic rigging and rope work, including the construction and deployment of transacts and search grids. 5. underwater navigation methods using suitable techniques. 6. recording techniques. 7. ***acting as surface tender for a roped diver.*** 8. sampling techniques appropriate to the scientific discipline being pursued.	- be fully competent with: 1. search methods, ***such as those utilizing free swimming and towed divers together with remote methods suitable for a various range of surface and sub-surface situations.*** 2. survey methods, both surface and sub-surface, capable of accurately locating and marking objects and sites. 3. the basic use of airbags and airlifts for controlled lifts, excavations and sampling. 4. basic rigging and rope work, including the construction and deployment of transacts and search grids. 5. underwater navigation methods using suitable techniques. 6. recording techniques. 7. ***roped/tethered diver techniques and various types of underwater communication systems such as those utilising visual, aural, physical and electronic methods.*** 8. sampling techniques appropriate to the scientific discipline being pursued.
-show proof of having undertaken ***70*** open water dives, to include at least: 1. ***20*** dives with a scientific task of work, such as listed above. 2. 10 dives between ***15m and 24m***. 3. ***5*** dives ***greater than 25m.*** 4. 12 dives in the last 12 months, including at least 6 with a scientific task of work.	-show proof of having undertaken ***100*** open water dives, to include at least: 1. ***50*** dives with a scientific task of work, such as listed above. 2. 10 dives between ***20m and 29m.*** 3. ***10*** dives ***between 29m and the national limit.*** 4. 12 dives in the last 12 months, including at least 6 with a scientific task of work. ***5. 20 dives in adverse conditions, such as currents, cold water, or moving water.*** ***6. 20 dives as an in-water dive leader.***

10.15 REGISTER OF ADVICE NOTE HOLDERS AND AMENDMENT SHEET.

Amendments to the Advice Notes will be sent to registered holders. Please send your name, address, and day-time phone number to the editor - P.J.Lonsdale. University Marine Biological Station Millport, Isle of Cumbrae, Scotland. KA28 0EG. It is anticipated that amendments will be undertaken annually. The following table is to enable holders to ensure that their copy is up-to-date.

AMENDMENT NUMBER	DATE	SECTION NUMBER