IMCA International Code of Practice for Offshore Diving

The International Marine Contractors Association

www.imca-int.com

IMCA D 014 Rev. 1
October 2007

The International Marine Contractors Association (IMCA) is the international trade association representing offshore, marine and underwater engineering companies.

IMCA promotes improvements in quality, health, safety, environmental and technical standards through the publication of information notes, codes of practice and by other appropriate means.

Members are self-regulating through the adoption of IMCA guidelines as appropriate. They commit to act as responsible members by following relevant guidelines and being willing to be audited against compliance with them by their clients.

There are two core activities that relate to all members:

- Safety, Environment & Legislation
- Training, Certification & Personnel Competence

The Association is organised through four distinct divisions, each covering a specific area of members' interests: Diving, Marine, Offshore Survey, Remote Systems & ROV.

There are also four regional sections which facilitate work on issues affecting members in their local geographic area – Americas Deepwater, Asia-Pacific, Europe & Africa and Middle East & India.

IMCA D 014 Rev. 1

The text of the code of practice has been updated, mainly to reflect the contents of and to reference current IMCA guidance documents which are either new or have been updated since the publication of the original document in 1998. The text has more references to risk assessment and documentation requirements.

In the references in this code of practice only the numbers and titles of IMCA guidance notes are referred to. No mention is made about the latest revision number, since IMCA guidance notes may be updated from time to time. To ensure the latest revisions are used, you should check the IMCA website (www.imca-int.com/publications). The latest revisions are available on the IMCA members website and printed copies of the documents can be obtained from IMCA.

Any person with suggested improvements to this code of practice is invited to forward these, in writing, to IMCA (imca@imca-int.com).

www.imca-int.com/diving

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Introduction

1.1 General

The offshore commercial diving industry, while providing services to the oil and gas industry and alternative energy resources, can be the subject of various regulations, standards, codes and guidelines imposed by national governments of a particular area, the clients who wish the work to be carried out, the insurers of the diving contractor or other outside organisations, societies, advisory committees and associations.

While offshore diving in some areas is heavily regulated, there are other areas where there may be little or no outside control of diving activities. In such areas the diving contractors themselves are left to establish their own internal controls by means of their company manuals and procedures.

In the absence of local regulations there can be instances where some clients attempt to impose the regulatory standards of another area. This can cause confusion as many national regulations are based on local environmental and social conditions which simply may not apply in other parts of the world.

The document is intended to assist among others:

- personnel involved in diving operations;
- clients' staff involved in the preparation of bid documents and contracts;
- client and diving contractor representatives;
- vessel owners and marine crews involved with diving operations;
- installation and rig managers using divers;
- all personnel involved in operational management;
- all personnel involved in quality assurance and health, safety and environment.

IMCA has included recommendations in areas where there is a difficult balance between commercial considerations and safety implications. It is recognised, however, that safety must never be compromised for any reason. In particular, there is a need for clients and contractors to recognise and accept the importance of providing:

- sufficient and appropriately qualified and competent personnel to conduct operations safely at all times;
- safe, fit-for-purpose and properly maintained equipment;
- adequate time for routine preventative maintenance.

In order to provide a 'level playing field' for diving contractors, this code of practice seeks to lay down minimum requirements which all IMCA members world-wide should comply with (see also section 1.4).

1.2 Status of the Code

This code offers examples of good practice. It gives advice on ways in which diving operations can be carried out safely and efficiently.

The code has no direct legal status but many courts, in the absence of specific local regulations, would accept that a company carrying out diving operations in line with the recommendations of this code was using safe and accepted practices.

1.3 Work Covered by the Code

This code is intended to provide advice and guidance in respect of all diving operations carried out anywhere in the world being:

- outside the territorial waters of a country (normally 12 miles or 19.25 kilometres from shore);
- inside territorial waters where offshore diving, normally in support of the oil and gas industry, is being carried out. Specifically excluded are diving operations being conducted in support of civil, inland, inshore or harbour works or in any case where operations are not conducted from an offshore structure, vessel or floating structure normally associated with offshore oil and gas industry activities.

1.4 National Regulations, Standards, Codes and Guidelines

A number of countries in the world have national regulations and/or standards which apply to offshore diving operations taking place within waters controlled by that country and from vessels and floating structures registered in that country (flag state). In case the national regulations and/or standards are more stringent than this code they must take precedence over this code and the contents of this code should only be used where they do not conflict with the relevant national regulations/standards.

There are also international regulations, codes and standards (such as those of the International Maritime Organization (IMO)) which apply to offshore diving operations that diving contractors need to be aware of.

1.5 Diving Contractor Manuals and Procedures

All companies carrying out diving operations covered by this code need to prepare amongst others (see also section 7, 8 and 9):

- diving, emergency and maintenance manuals and procedures;
- safety/risk management manuals including management of change;
- quality assurance manuals;
- diving project plans;
- work procedures and plans;
- risk assessments for mobilisations/demobilisations, the work to be undertaken and for any foreseeable emergencies.

This code is not meant to be a substitute for company manuals and procedures.

1.6 Updating Arrangements

This code is a dynamic document and the advice given in it will change with developments in the industry. It is intended that this code shall be periodically reviewed and any necessary changes or improvements made.

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Glossary of Terms

A number of specialised terms are used in this document. It is assumed that readers are familiar with most of them. However, a number of them, although in use for many years, could be misunderstood. These terms are defined below to ensure that readers understand what is meant by them in this document.

ALST	Assistant life support technician
Certification	A document that confirms that a particular test or examination has been carried out or witnessed at an identified time on a specific piece of equipment or system by a competent person
Classification	A diving system built in accordance with a classification society's own rules, can, at the owner's request, be assigned a class
Company medical adviser	A nominated diving medical specialist appointed by a diving contractor to provide specialist advice
Competent	Having sufficient training or experience (or a combination of both) to be capable of carrying out a task safely and efficiently
DCI	Decompression illness
Deck decompression chamber (DDC)	A pressure vessel for human occupancy which does not go under water and may be used as a living chamber during saturation diving, diver decompression or treatment of decompression illness. Also called compression chamber, recompression chamber, deck chamber or surface compression chamber
Dive plan	A plan prepared for each dive or series of dives to brief the diver(s) about the work to be undertaken including the necessary safety precautions to be taken
Diving project plan	Documents and information available on-site at a diving project and should include mobilisation and demobilisation plans, the diving technique/procedures to be used, step-by-step diver work procedures, identification of hazards and control and contingency procedures for any foreseeable emergency
Diving system	The whole plant and equipment for the conduct of diving operations
Diving bell	A pressure vessel for human occupancy which is used to transport divers under pressure either to or from the underwater work site. Also called closed diving bell or submersible decompression chamber

Diving medical specialist	A doctor who is competent to manage the treatment of diving accidents, including, where appropriate, mixed gas and saturation diving accidents. Such a doctor will have undergone specialised training and have demonstrated experience in this field
DMAC	Diving Medical Advisory Committee
DP	See *Dynamic Positioning*
DPO	DP operator. This is an individual who operates the dynamic positioning system
DSV	A diving support vessel (DSV) whose primary role is the support of diving operations
Dynamic positioning (DP)	A system that automatically controls a vessel's position and heading by means of thrusters. A typical DP system consists of a control system (including power management and position control), reference systems (such as position, heading and environmental references) and power systems (including power generation, distribution and consumption)
Fixed diving system	A diving system installed permanently on a vessel or fixed/floating structure
FMEA	Failure modes and effect analysis. This is a methodology used to identify potential failure modes, determine their effects and identify actions to mitigate the failures
Habitat	An underwater structure inside which divers can carry out dry welding and which is fitted out with life support facilities
HAZID	Hazard identification
HAZOP	Hazard and operability study
HES	Hyperbaric evacuation system
HIRA	Hazard identification and risk assessment
HRC	Hyperbaric rescue chamber
HRV	Hyperbaric rescue vessel (hyperbaric lifeboat)
JSA	Job safety analysis. Also called SJA (safe job analysis), JHA (job hazard analysis), TRA (task risk assessment)
Lift Bag	A bag which is filled with air or gas to provide uplift to an underwater object. Often used for lifting purposes by divers
Lock-off time	The time at which a diving bell under pressure is disconnected from the compression chamber(s) on deck
Lock-on time	The time at which a diving bell under pressure is reconnected to the compression chamber(s) on deck
LSP	Life support package. A portable package with gas and facilities for life support and/or decompression of saturation divers in an emergency
LSS	Life support supervisor
LST	Life support technician
MOC	Management of change. This is a process that needs to take place to revise an existing approved design/fabrication or work/installation procedure
Medical examiner of divers	A doctor who is trained and competent to perform the annual assessment of fitness to dive for divers. Medical examiners of divers may not possess knowledge of the treatment of diving accidents
NDT	Non-destructive testing

Risk assessment	The process by which every perceived risk is evaluated and assessed. As part of the process control measures to be established to prevent harm before an operation commences should be identified. The findings and actions will be documented. A risk assessment is part of the risk management process
ROV	Remotely operated vehicle
Standby diver	A diver other than the working diver(s) who is dressed and with equipment immediately available to provide assistance to the working diver(s) in an emergency
SWL	Safe working load
Toolbox talk	A meeting held at the start of each shift or prior to any high-risk operation, where the diving supervisor and/or the diving supervisor's delegate and shift personnel discuss the forthcoming tasks or jobs and the potential risks and necessary precautions to be taken
Wet bell	A basket with a closed top section which is capable of containing a dry gaseous atmosphere to provide a refuge for the divers. It is not a pressure vessel. A supply of spare gas will be carried on the wet bell. Also called an open bottom bell

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Duties, Roles and Responsibilities

3.1 Diving Contractor

On any diving project there needs to be one company in overall control of the diving operations. This will normally be the company who employs the divers. If there is more than one company employing divers then there will need to be a written agreement as to which of these companies is in overall control.

The company in control is called the diving contractor. The name of the diving contractor should be clearly displayed and all personnel, clients and others involved in the diving operation should be aware who the diving contractor is.

The diving contractor will need to define a management structure in writing. This should include arrangements for a clear handover of supervisory responsibilities at appropriate stages in the operation, again recorded in writing.

The diving contractor's responsibilities are to provide a safe system of work to carry out the diving activity. This includes the following:

- A diving project plan;
- An overall quality management system which includes a safety management system;
- Appropriate insurance policies;
- Risk assessments for mobilisation/demobilisation, the operation of the equipment and work tasks to be undertaken and the contingency/ emergency plans;
- A management of change procedure;
- A safe and suitable place from which operations are to be carried out;
- Suitable plant and equipment supplied, audited and certified in accordance with the relevant IMCA DESIGN documents, other Diving, Remote Systems & ROV and Marine Division guidance notes and IMO documents, including equipment supplied by diving personnel;
- Plant and equipment correctly and properly maintained;
- A suitable plan which includes emergency and contingency plans;
- Sufficient personnel of the required grades in the diving team;
- Personnel holding valid medical and training certificates and qualified and competent in accordance with the IMCA Training, Certification & Personnel Competence tables;
- Suitable site-specific safety and familiarisation training provided to all members of the dive team;

- Adequate arrangements to ensure that the supervisor and dive team are fully briefed on the project and aware of the content of the diving project plan and the dive plan;
- Project records kept of all relevant details of the project, including all dives;
- A procedure for near-miss and incidents/accidents reporting, investigation and follow-up;
- Adequate arrangements for first aid and medical treatment of personnel;
- Clear reporting and responsibility structure laid out in writing;
- Diving supervisors and life support supervisors appointed in writing and the extent of their control documented;
- The latest approved version of the diving contractor documents and plans at the work site and being used;
- All relevant regulations/standards complied with.

The level of detail or involvement required of the diving contractor, and information on how to meet the responsibilities, are given in the relevant sections of this code. The guidelines and standards referred to in this code may be updated from time to time and the diving contractor should make sure the latest version of the guidelines and standards are being used.

3.2 Clients and Others

The actions of others can have a bearing on the safety of the diving operation even though they are not members of the team. These others include:

i) the client who has placed a contract with a diving contractor for a project. The client will usually be the operator or owner of a proposed or existing installation or pipeline where diving work is going to take place, or a contractor acting on behalf of the operator or owner. If the operator or owner appoints an on-site representative then such a person should have the necessary experience and knowledge to be competent for this task;

ii) the main contractor carrying out work for the client and overseeing the work of the diving contractor according to the contract. If the main contractor appoints an on-site representative then such a person should have the necessary experience and knowledge to be competent for this task. *Ref. IMCA TCPC 12/04*;

iii) the installation or offshore manager who is responsible for the area inside which diving work is to take place;

iv) the master of a vessel (or floating structure) from which diving work is to take place who controls the vessel and who has overall responsibility for the safety of the vessel and all personnel on it;

v) the DP operator (DPO) who is the responsible person on the DP control panel on a DP vessel/floating structure or the duty officer on an anchored DSV or floating structure. The DPO or duty officer will need to inform the diving supervisor of any possible change in position-keeping ability as soon as it is known.

These organisations or personnel will need to consider carefully the actions required of them. Their duties should include:

- agreeing to provide facilities and extend all reasonable support to the diving supervisor or contractor in the event of an emergency. Details of the matters agreed should form part of the planning for the project;
- considering whether any underwater or above-water items of plant or equipment under their control may cause a hazard to the diving team. Such items include:
  - vessel/floating structure propellers and anchor wires
  - underwater obstructions
  - pipeline systems under pressure test or with a pressure lower than the pressure at the diver work location
  - subsea facilities
  - water intakes or discharge points causing suction or turbulence
  - gas flare mechanisms that may activate without warning
  - equipment liable to start operating automatically
  - appropriate isolations and barriers (mechanical, electrical, optical, hydraulic, instrumentation isolations and barriers)

The diving contractor will need to be informed of the location and exact operational details of such items in writing and in sufficient time to account for them in the risk assessments;

- ensuring that sufficient time and facilities are made available to the diving contractor at the commencement of the project in order to carry out all necessary site-specific safety and familiarisation training;
- ensuring that other activities in the vicinity do not affect the safety of the diving operation. They may, for example, need to arrange for the suspension of supply boat unloading, overhead scaffolding work, etc.;
- ensuring that a formal control system, for example, a permit-to-work system, exists between the diving team, the installation manager and/or the master;
- providing the diving contractor with details of any possible substance likely to be encountered by the diving team that would be a hazard to their health, e.g. drill cuttings on the seabed. They will also need to provide relevant risk assessments for these substances. This information should be provided in writing and in sufficient time to allow the diving contractor to carry out the relevant risk assessments;
- providing the diving contractor with information about any impressed current system on the work site or in the vicinity and details of the system. This information should be provided in writing and in sufficient time to allow the diving contractor to carry out the relevant risk assessments;
- keeping the diving supervisor informed of any changes that may affect the diving operation, e.g. vessel movements, deteriorating weather etc.

3.3 Offshore Manager

Where the diving contractor has provided an offshore manager, then the offshore manager is the diving contractor's representative at the work site and is generally appointed on larger projects. Offshore managers have overall responsibility for the project execution and their responsibilities and tasks include:

- ensuring that activities are carried out in accordance with the requirements in the diving project plan and the applicable laws and regulations;
- ensuring that personnel are competent, qualified and familiar with the work procedures, safety precautions to be taken, laws and regulations and IMCA guidance and information notes.

The offshore manager will normally be the primary contact point offshore with the client. The offshore manager may or may not have a diving background.

3.4 Diving Superintendent

A diving superintendent should be appointed on projects requiring more than one supervisor (*Ref. AODC 048*). If an offshore manager has not been appointed then the diving superintendent is the diving contractor's representative at the work site. Diving superintendents are responsible for and competent (*Ref. IMCA C 003*) to manage the overall diving operation and their responsibilities, tasks and duties should include:

- ensuring the activities are carried out in accordance with the requirements in the diving project plan and the applicable laws and regulations;
- ensuring the personnel are competent and qualified and familiar with the work procedures, safety precautions to be taken, laws and regulations and IMCA guidance and information notes.

If qualified and holding a letter of appointment the diving superintendent can act as a diving supervisor.

3.5 Diving Supervisor

Supervisors are appointed by the diving contractor in writing and are responsible for the operation that they have been appointed to supervise. Unless an offshore manager or diving superintendent has been provided by the diving contractor then the diving supervisor is the diving contractor's representative at the work site. A diving supervisor should only hand over control to another supervisor appointed in writing by the diving contractor. Such a handover will need to be entered in the relevant operations logbook.

Supervisors can only supervise as much of a diving operation as they can personally control, both during routine operations and if an emergency should occur.

The supervisor with responsibility for the operation is the only person who can order the start of a dive, subject to appropriate work permits etc. Other relevant parties, such as a diving superintendent, offshore manager, ship's master, client representative or the installation manager, can, however, tell the supervisor to terminate a dive for safety or operational reasons.

There will be times, for example during operations from a DP vessel, when the supervisor will need to liaise closely with other personnel, such as the vessel master or the DP operator. In such circumstances, the supervisor must recognise that the vessel master has responsibility for the overall safety of the vessel and its occupants.

The supervisor is entitled to give direct orders in relation to health and safety to any person taking part in, or who has any influence over, the diving operation. These orders take precedence over any company hierarchy. These orders could include instructing unnecessary personnel to leave a control area, instructing personnel to operate equipment, etc.

To ensure that the diving operation is carried out safely, supervisors will need to ensure that they consider a number of points. For example:

- They should satisfy themselves that they are competent to carry out this work and that they understand their own areas and levels of responsibility and who is responsible for any other relevant areas. Such responsibilities should be contained in the relevant documentation. They should also ensure that they are in possession of a letter from the diving contractor appointing them as a diving supervisor;
- They will need to satisfy themselves that the personnel they are to supervise are competent to carry out the work required of them. They should also check, as far as they are reasonably able, that these personnel are fit and in possession of a valid medical certificate of fitness;
- They will need to check that the equipment they propose to use for any particular operation is adequate, safe, properly certified and maintained. They can do this by confirming that the equipment meets the requirements set down in this code. They should ensure that the equipment is adequately checked by themselves or another competent person prior to its use. Such checks should be documented, for example, on a pre-prepared checklist, and recorded in the operations log for the project;
- They will need to ensure that all possible foreseeable hazards have been evaluated and are fully understood by all relevant parties and that, if required, training is given. In addition, prior to commencement of a project an on-site job safety analysis (JSA) needs to be carried out. If the situation has changed, further risk assessment and management of change will need to be undertaken. They will need to ensure that the operation they are being asked to supervise complies with the requirements of this code. Detailed advice on how they can ensure this is given in various sections of this code;
- They will need to establish that all involved parties are aware that a diving operation is going to start or continue. They will also need to obtain any necessary permission before starting or continuing the operation, normally via a permit-to-work system;
- The supervisor will need to have clear audible and, if possible, visual communications with any personnel under their supervision. For example, a supervisor will be able to control the raising and lowering of a diving bell adequately if there is a direct audio link with the winch operator, even though the winch may be physically located where the supervisor cannot see it or have ready access to it (*Ref. IMCA D 023, IMCA D 024, IMCA D 037*);
- The supervisor also needs to have clear communication with other personnel on the diving location such as marine crew, DP operators, crane drivers and ROV personnel (see also section 7.5);
- During saturation or bell diving operations, supervisors will need to be able to see the divers inside the bell or compression chamber. This will normally be achieved on the surface by means of direct viewing through the view ports or by means of cameras, but when the bell is under water this will need to be by means of a camera;
- The supervisor will need to have direct communications with any diver in the water at all times, even if another person needs to talk to, or listen to, the diver (*Ref. AODC 31*);
- Ensuring that proper records of the diving operations are maintained.

3.6 Divers

Divers are responsible for undertaking duties as required by the diving supervisor. Divers should:

- inform the diving supervisor if there is any medical or other reason why they cannot dive;
- ensure that their personal diving equipment is working correctly and is suitable for the planned dive;
- ensure that they fully understand the dive plan and is competent to carry out the planned task;
- know the routine and emergency procedures;
- report any medical problems or symptoms that they experience during or after the dive;
- report any equipment faults, other potential hazards, near misses or accidents;
- check and put away personal diving equipment after use;
- keep their logbooks up to date and presenting it for signing by the diving supervisor after each dive.

3.7 Other Diving and Support Personnel

It is the responsibility of the diving contractor that all categories of personnel used during diving operations (*Ref. IMCA C 003*) including, but not limited to ROV personnel, rigging crew, inspection controllers and surveyors have been issued with clearly defined and documented roles and responsibilities.

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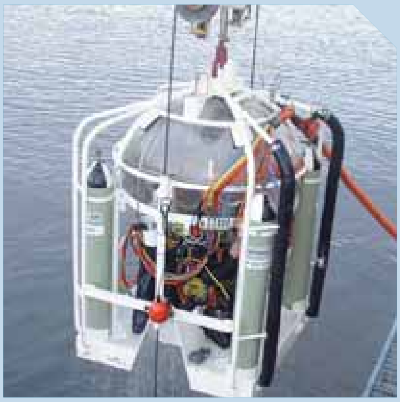

Equipment

4.1 Equipment Location and Operational Integrity

The choice of equipment location will be determined by the type of installation (a fixed structure may differ from a vessel or floating structure), the detail of the type of diving equipment involved, the integrity of any handling system with respect to lifting points or load bearing welds, and structures etc. In this respect it should be ensured that in-date test certificates for all equipment are available where required.

In some applications the diving system may be required to operate in a hazardous area (e.g. an area in which there is the possibility of danger of fire or explosion from the ignition of gas, vapour or volatile liquid). All diving equipment used in such an area must comply with the safety regulations for that area.

Diving supervisors should also comply with any specific site requirements and where required obtain an appropriate permit-to-work before conducting diving operations.

Equipment location is often dependent on available deck space. However, if it is possible then placing the diving deployment system close to a ship's centre of gravity will minimise motion.

A deck layout or plan should be prepared prior to mobilisation in order that a suitable equipment location and the service connections required are clear to all parties.

Before welding any part of the diving system to a vessel or fixed/ floating structure, the position of fuel tanks and any other possible problem should be ascertained.

4.2 Suitability

The diving contractor will need to be satisfied that the equipment provided for the diving project is suitable for the use to which it will be put, in all foreseeable circumstances on that project. Suitability can be assessed by the evaluation of a competent person, classification society, clear instructions or statements from the manufacturer or supplier and physical testing. New, or innovative, equipment will need to be considered carefully, but should not be discounted because it has not been used before.

4.3 Certification

The standards and codes used to examine, test and certify plant and equipment, and the requirements of those who are competent to carry out such examinations, tests and certification, have been established (*Ref. IMCA D 018, IMCA D 004, IMCA Guidance for Hyperbaric Evacuation Systems* (under development), *IMO Code of Safety for*

Diving Systems 1995 Resolution A.831(19) and *IMO Guidelines and Specifications for Hyperbaric Evacuation Systems Resolution A.692(17)*).

All equipment and plant supplied for use in a diving operation will need to comply with at least these standards. Suitable certificates (or copies) should be provided at the worksite for checking (see also section 4.14.3).

In addition to the equipment and plant certification mentioned above, portable diving systems and fixed diving systems should as a minimum conform to this code, applicable national regulations/ standards and flag state requirements.

Fixed diving systems are normally classified by a classification society.

A fixed diving system, as defined in the IMO code of practice, may also be certified and issued with a diving system safety certificate (*Ref. IMO Code of Safety for Diving Systems 1995 Resolution A.831(19)*).

4.4 Self Auditing/HAZOP/FMEA

Diving contractors should have a process in place for self-auditing their diving systems and equipment, during mobilisation and on an annual basis, in accordance with IMCA guidelines (*Ref. IMCA D 023, IMCA D 024, IMCA D 037, IMCA D 040*). DP systems, vessels and ROVs need also to be audited in accordance with IMCA guidelines.

Furthermore, a systematic assessment of the diving system and its sub-systems should be carried out. This assessment may take the form of a HAZOP. Additionally an FMEA may be used to provide a systematic assessment for the identification of potential failure modes, to determine their effects and to identify actions to mitigate the failures.

(*Ref. IMCA D 039, IMO Code of Safety for Diving Systems 1995, Resolution A.831(19)*).

4.5 Power and Emergency Power Supply

The power source for the diving system may be independent of the surface platform or vessel's power supply. If this is by a separate generator, the positioning of this should be governed by the following factors: vibration, noise, exhaust, weather, length of cable required, possible shutdown phases, fire protection and ventilation.

In addition to the main power source there needs to be an alternative power supply for safe termination of the diving operation and to ensure that life support for divers under pressure can be maintained (*Ref. IMCA D 023, IMCA D 024, IMCA D 037, IMO Code of Safety for Diving Systems 1995, Resolution A.831(19)*).

4.6 Gases

Gases stored in cylinders at high pressure are potentially hazardous. The dive project plan needs to specify that the gas storage areas need to be adequately protected by, for example, the provision of suitable fire extinguishing systems and physical guards against dropped objects. All gases used offshore will need to be handled with appropriate care.

4.6.1 Storage Cylinders

Gas cylinders will need to be suitable in design, fit for purpose and safe for use. Each cylinder should be tested and have appropriate certification issued by a competent person. Cylinders used for diving within the scope of this code may be subjected to special conditions, such as use in salt water, and will therefore need special care (*Ref. AODC 037, AODC 064, IMCA D 018*).

Gas storage in confined spaces requires continuous atmosphere monitoring systems.

Any relief valves or bursting discs should be piped to dump overboard and not in to the enclosed space (*Ref. IMCA D 024*).

4.6.2 Marking and Colour Coding of Gas Storage

Fatal accidents have occurred because of wrong gases or gas mixtures being used in a diving project. The diving contractor will need to ensure that all gas storage units comply with a recognised and agreed standard of colour coding and marking of gas storage cylinders, quads and banks. Where appropriate, pipework will also need to be colour coded. All gases should be analysed before use in any case. (Ref. AODC 16, IMO Code of Safety for Diving Systems 1995, Resolution A.831(19)).

4.6.3 Divers' Breathing and Reserve Gas Supply

The correct use of breathing gases for divers and the continuity of their supply are vital to divers' safety and health. Total or partial loss or interruption of a diver's breathing gas supply can be fatal. Equipment will therefore be needed to supply every diver, including the standby diver, with breathing gas of the correct composition, suitable volume, temperature and flow for all foreseeable situations, including emergencies. In particular, the supply will need to be arranged so that no other diver (including the standby) is deprived of breathing gas if another diver's umbilical is cut or ruptured (*Ref. AODC 28, IMCA D 023, IMCA D 024, IMCA D 037, IMCA D 040*).

Each diver in the water will need to carry a reserve supply of breathing gas that can be quickly switched into the breathing circuit in an emergency. This should have sufficient capacity to allow the diver to reach a place of safety (*Ref. IMCA D 023, IMCA D 024, IMCA D 037, IMCA D 040*).

An in-line oxygen analyser with an audible/visual hi-lo alarm will need to be fitted to the diver's gas supply line in the dive control area. The sampling should be from downstream of the final supply valve to the diver. This will prevent the diver being supplied with the wrong percentage of oxygen even if the breathing medium is compressed air. In addition, a carbon dioxide analyser will need to be fitted in all saturation operations using gas reclaim equipment.

Sufficient analysers for continuous monitoring of the reclaim, bell, DDC and divers supply, without having to cross connect between two analysers, need to be installed (*Ref. IMCA D 023, IMCA D 024, IMCA D 037*).

4.6.4 Emergency Breathing Gas Cylinders for Diving Basket/Wet Bell

When a diving basket or wet bell is used by surface-supplied divers, emergency breathing gas cylinders will need to be supplied in the basket or fitted to the wet bell in a standard, agreed layout. This enables the divers to access the cylinders rapidly in an emergency (*Ref. AODC 039, IMCA D 023, IMCA D 037*).

4.6.5 Oxygen

Pressurised oxygen can fuel a serious fire or cause an explosion, but can be used safely if stored and handled correctly. Any gas mixture containing more than 25% oxygen by volume will need to be handled like pure oxygen. It should not be stored in a confined space or below decks but out in the open, although protected as detailed in section 4.6.

Any materials used in plant which is intended to carry oxygen will need to be compatible with oxygen at working pressure and flow rate and cleaned of hydrocarbons and debris to avoid explosions. Formal cleaning procedures for such equipment will need to be provided by the diving contractor, together with documentary evidence that such procedures have been followed (*Ref. IMCA D 031*).

4.7 Communications

All divers in the water will need a communication system that enables direct, two way, voice contact with the supervisor on the surface. Speech processing equipment will be needed for divers who are breathing gas mixtures containing helium, which distorts speech.

All such communications will need to be recorded, and the recording kept for minimum 24 hours before being erased (*Ref. IMCA D 023, IMCA D 024, IMCA D 037*). If an incident occurs during the dive, or becomes apparent after the dive the communication record will need to be retained until the investigation has been completed.

4.8 Closed Diving Bells

4.8.1 Breathing Mixture Supply

The diving bell will need to be fitted with suitable protective devices that will prevent uncontrolled loss of the atmosphere inside the diving bell if any or all of the components in the main umbilical are ruptured (*Ref. AODC 009, IMCA D 024*).

4.8.2 Emergency Recovery

The dive project plan needs to include the equipment, personnel and procedures needed to enable the diving bell to be rescued if the bell is accidentally severed from its lifting wires and supply umbilical (*Ref. AODC 019*).

The bell will need to be equipped with a relocation device using the internationally recognised frequency to enable rapid location if the bell is lost. It should also be fitted with the internationally agreed common manifold block for attachment of an emergency umbilical. (*Ref. AODC 019, AODC 012*).

The bell will need to be capable of sustaining the lives of trapped divers for at least 24 hours (*Ref. AODC 019, AODC 026*).

The bell will need an alternative method of recovery to the surface if the main lifting gear fails. This is normally by means of the guide wires and their lifting equipment (*Ref. IMCA D 024, AODC 019*).

If release weights are employed, the weights will need to be designed so that the divers inside the bell can shed them. This design will need to ensure that the weights cannot be released accidentally (*Ref. AODC 061, IMCA D 024*).

The bell will need to be fitted with a stand off frame such that the divers can freely exit and re-enter the bell if it is resting on the seabed.

4.8.3 Surface Diver Deployment

During closed bell operations, a diver will need to be on the surface with equipment suitable to assist in an emergency within the surface diving range (see 5.2.3). The equipment should meet the minimum requirements for surface diving equipment as laid out in IMCA D 023 (*Ref. IMCA D 024*).

The methods of recovery need to be risk assessed to establish the most suitable method, equipment and resources required.

Where the diving takes place from a DP vessel or anchored vessel / floating structure where there are obstructions at the diving site and / or the freeboard is more than 2 metres, then a single basket should be provided to deploy the surface standby diver.

4.8.4 Equipment Level

Closed diving bells used for saturation or bounce diving will need a minimum level of equipment and facilities.

Divers will need to be able to enter and leave the bell without difficulty. Lifting equipment will need to be fitted to enable a person in the bell to lift an unconscious or injured diver into the bell in an emergency. Divers will also need to be able to transfer under pressure from the bell to a surface compression chamber and vice versa.

The bell will need doors that open from either side and that act as pressure seals.

Valves, gauges and other fittings (made of suitable materials) will be needed to indicate and control the pressure within the bell. The external pressure will also need to be indicated to both the divers in the bell and the diving supervisor.

Adequate equipment, including reserve facilities, will be needed to supply an appropriate breathing mixture to divers in, and working from, the bell.

Equipment will be needed to light and heat the bell.

Adequate first-aid equipment will be needed (*Ref. DMAC 15*).

Lifting gear will be needed to lower the bell to the depth of the diving project, maintain it at that depth, and raise it to the surface, without the occurrence of excessive lateral, vertical or rotational movement (Ref. IMCA D 024).

4.9 Emergency Markings on Hyperbaric Evacuation Systems

In an emergency, it is possible that personnel with no specialised diving knowledge will be the first to reach a hyperbaric evacuation system (HES). To ensure that rescuers provide suitable assistance and do not accidentally compromise the safety of the occupants, an IMO standard set of markings and instructions has been agreed (Ref. IMCA D 027). Such markings will need to be clearly visible when the system is afloat.

4.10 Electricity

Divers, and others in the dive team, are required to work with equipment carrying electric currents, which presents the risk of electric shock and burning. Procedures have been developed for the safe use of electricity under water, and any equipment used in a diving operation will need to comply with this guidance (*Ref. AODC 035*).

Recharging lead-acid batteries generates hydrogen that can provide an explosion hazard in confined spaces (*Ref. AODC 054, IMCA D 002*). Care will need to be taken to provide adequate ventilation.

4.11 Man-Riding Handling Systems

Particular safety standards will need to be applied when using lifting equipment to carry personnel because serious injury may result from falling. Such handling systems should be designed to be man-riding (*Ref. IMCA D 018, IMCA D 023, IMCA D 024, IMCA D 037*).

4.11.1 Winches

Both hydraulic and pneumatic winches will need suitable braking systems, providing primary and secondary protection. They are not to be fitted with a pawl and ratchet gear in which the pawl has to be disengaged before lowering (*Ref. IMCA D 018, IMCA D 023, IMCA D 024*).

4.11.2 Diving Baskets and Wet Bells

A basket or wet bell, used in support of surface-supplied diving, will need to be able to carry at least two divers in an uncramped position. It will need to be designed with a chain or gate at the entry and exit point to prevent the divers falling out, and with suitable hand holds for the divers. The design will also need to prevent spinning or tipping (*Ref. IMCA D 018, IMCA D 023, IMCA D 037*).

4.11.3 Lift Wires

Particular standards and testing criteria will need to be used for man-riding lift wires, including wires intended for secondary or back-up lifting. These wires will need to have an effective safety factor of 8:1, be non-rotating, and be as compact as possible to minimise the space requirements of their operating winches (*Ref. IMCA D 018, IMCA D 023, IMCA D 024, IMCA D 037*).

4.12 Medical/Equipment Locks and Diving Bell Trunks

The inadvertent release of any clamping mechanism holding together two pressurised units under internal pressure may cause fatal injury to personnel both inside and outside the units. All such clamps will need pressure indicators and interlocks to ensure that they cannot be released while under pressure (*Ref. IMCA D 023, IMCA D 024, IMCA D 037*). The pressure indicator and pressure/exhaust lines should have their own penetrators to avoid single point failure in case of blockage.

4.13 Therapeutic Recompression/Compression Chamber

No surface supplied diving operation within the scope of this code is to be carried out unless a two-compartment chamber is at the worksite to provide suitable therapeutic recompression treatment.

4.14 Maintenance of Diving Equipment

Diving plant and equipment is used under offshore conditions, including frequent immersion in salt water. It therefore requires regular inspection, maintenance and testing to ensure it is fit for use, e.g. that it is not damaged or suffering from deterioration.

4.14.1 Periodic Examination, Testing and Certification

Detailed guidance exists on the frequency and extent of inspection and testing required of all items of equipment used in a diving project, together with the levels of competence required of those carrying out the work (*Ref. IMCA D 018*).

4.14.2 Planned Maintenance System

The diving contractor will need to have an effective system for planned maintenance and spares control system for all plant and equipment (*Ref. IMCA D 018, IMCA D 004*).

Each equipment item will need to have its own identification number and a record needs to be kept which should describe the maintenance carried out, date and by whom.

4.14.3 Equipment and Certificate Register

An equipment register will need to be maintained at the worksite, with copies of all relevant certificates of examination and test. It will also need to contain information, such as design specifications and calculations of the equipment items such as, but not limited to, diver launch and recovery systems and winches, electrical systems, pressure vessels, plumbing, pipework and umbilicals. It will also need to contain details of any applicable design limitations, for example, maximum weather conditions for use, if applicable.

4.14.4 Cylinders Used Under Water

Divers' emergency gas supply cylinders (bail-out bottles) and cylinders used under water for back-up supplies on diving bells and baskets can suffer from accelerated corrosion. Particular care will need to be taken to ensure that they are regularly examined and maintained (*Ref. AODC 010, AODC 037, AODC 064, IMCA D 018*).

4.14.5 Closed Diving Bell, Wet Bell, Diving Basket and Clumpweight Lift Wires

Frequent immersion in salt water, shock loading from waves, passing over multiple sheaves, etc., can cause wear and deterioration to the lift wires of closed diving bells, wet bells and diving baskets as well as clumpweight wires if they are not properly maintained. Specialised advice on maintenance exists and will need to be followed to ensure that wires remain fit for purpose (*Ref. IMCA D 018, IMCA D 023, IMCA D 024, IMCA D 037*).

4.14.6 Lift Bags

Special requirements for the periodic examination, test and certification of lift bags have been established. Manufacturers' maintenance instructions and testing requirements will need to be followed (*Ref. IMCA D 016, IMCA D 018*).

4.15 Lifting Equipment Design, Periodic Test and Examination Requirements

All lifting equipment should be examined by a 'competent person' before the equipment is used for the first time, after installation at another site and after any major alteration or repair (*Ref. IMCA D 018*). Regular examination is also recommended. Any additional testing specified should be at the discretion of the competent person.

Any lifting wire should be provided with a test certificate confirming its safe working load (SWL). The SWL should never be exceeded during operations and should include the deployment device, the number of divers to be deployed (with all their equipment) and any components that hang from the lifting wire (including wire weight in air). The condition and integrity of the wire should be checked in accordance with the planned maintenance system (*Ref. IMCA D 018*, or more frequently as circumstances dictate).

The lifting and lowering winch should be rated by the manufacturer for a safe working load at least equal to the weight of the deployment device plus divers in air plus any additional components. An overload test of the winch's lifting and braking capacity should be undertaken after:

- all permanent deck fixings are in place;
- NDT on relevant welds has been completed.

All loose lifting gear, such as sheaves, rings, shackles and pins should have test certificates when supplied and be examined at six-monthly intervals thereafter in accordance with the PMS. The original manufacturers' test certificates should show the SWL and the results of proof load tests undertaken on the components to 2 x SWL to allow for possible dynamic loading factors during offshore use.

4.16 Chain Lever Hoists

Chain lever hoist are used extensively offshore during diving operations. However, there is a history of failure. Many of these units are not designed for subsea use and therefore are prone to corrosion and will require extensive maintenance and control of the time left submerged (*Ref. IMCA D 028*).

4.17 Vessel, Fixed Platform and Floating Structure Cranes

Any vessel, fixed platform and floating structure used for diving support should be inspected to ensure that the crane(s) used for underwater operations are fit for purpose (see also *Ref. IMCA D 035*).

Crane wires used underwater normally suffer damage from internal corrosion due to ingress of seawater and dynamic loadings in particular when loads are lowered/lifted through the splash zone.

5

Personnel

This section refers to the number of divers and support personnel, their grades, competence and qualifications, and their ability to run the planned dive safely, including carrying out contingency and emergency plans.

5.1 Qualifications and Competence

To work safely, efficiently and as a member of a team, personnel need to have a basic level of competence of the task they are being asked to carry out.

Competence is not the same as qualification. A person who has a particular qualification, such as a diver training certificate, should have a certain level of competence in that area but the diving contractor and the diving supervisor will need to satisfy themselves that the person has the detailed competence necessary to do the specific task required during the particular diving operation.

The different members of the diving team will require different levels and types of competence (*Ref. IMCA D 013, IMCA D 05/07, IMCA C 003*).

5.1.1 Tenders

Tenders are there to assist the divers. They should therefore be competent to provide the level of assistance that the diver expects and needs.

Competence is required of tenders in that:

- they should understand the diving techniques being used. This includes a detailed knowledge of the emergency and contingency plans to be used, including line communications and emergency communications;
- they will need to be fully familiar with all of the diver's personal equipment;
- they should understand the method of deployment being used and all of the actions expected of them in an emergency;
- they should understand the ways in which their actions can affect the diver.

Some tenders will be fully qualified, but less experienced divers. In such cases their competence will be able to be verified easily. In cases where the tender is not a diver, however, and may in fact be a member of the deck crew, then their competence will need to be established on the basis of previous experience supplemented, where appropriate, with any additional training which the diving contractor or supervisor feel is necessary (*Ref. IMCA C 003*).

5.1.2 Divers

Most divers will possess a formal training certificate showing that they have attended a recognised school or have been trained in some other way.

All divers at work should hold a diving qualification suitable for the work they intend to do. They will need to have the original certificate in their possession at the site of the diving project – copies should not be accepted.

Only two grades of diver are allowed to work within the scope of this code: surface-supplied divers and closed bell divers. IMCA produces an up-to-date list of diving and supervisor certificates that are IMCA-recognised (*Ref. IMCA D 05/07*).

Competence is required of a diver in several different areas simultaneously:

- The diver will need to be competent to use the diving techniques being employed. This includes the type of breathing gas, personal equipment and deployment equipment;
- They will need to be competent to work in the environmental conditions. This will include wave action, visibility and current effects;
- They will need to be competent to use any tools or equipment they need during the course of the dive;
- They will need to be competent to carry out the tasks required of them. This will normally require them to understand why they are doing certain things and how their actions may affect others

(*Ref. IMCA C 003*).

Even tasks which are apparently very simple, such as moving sandbags under water, require a degree of competence, both to ensure that the pile of sandbags created is correct from an engineering viewpoint and also to ensure that the diver lifts and handles the bags in such a way that they do not injure themselves.

Previous experience of a similar task is one demonstration of competence but care should be taken to ensure that a diver is not claiming or exaggerating experience in order to obtain work or appear knowledgeable to their superiors. If there is any doubt about the validity of experience then the individual should be questioned in detail to establish their exact level of knowledge.

Where a diver has not carried out a task before, or where a task may be new to every member of the diving team, competence can be gained by detailed review of drawings and specifications, the equipment to be operated under water, the area to be worked in and any other relevant factors.

The time required for this review, the depth of detail reviewed and the checks necessary to confirm competence, will depend on the complexity of the task involved and the hazards associated with the operation.

For instance, an experienced inspection diver asked to use a new measuring tool may well be competent to carry out this operation after a few minutes handling the tool on deck and reading an instruction manual. However, a team of divers which is required to install a complex new type of unit on the seabed may need not only instruction, but also actual trials under water in using the unit. The diving contractor will need to establish the level of competence required for a particular application.

5.1.3 Formally Trained Inexperienced Divers

Formally trained inexperienced divers need to gain competence in a work situation and it is correct to allow this provided it is recognised by the other members of the team that the individual is in the process of gaining experience and competence. In such cases it would be expected that the other team members and particularly the supervisor would pay particular attention to supporting the person gaining competence (*Ref. IMCA C 003*).

5.1.4 Deck Crew/Riggers

Divers rely heavily on the support given to them from the surface by the deck crew. The actions of the people on deck can have a major impact on the safety and efficiency of the work being carried out under water.

The deck crew will need to have competence in a number of areas:

- They will need to understand and be familiar with good rigging practice and seamanship. This will include relevant knots, slinging, correct use of shackles etc.;
- They will need to be familiar with safe working loads and safety factors;
- They should understand the task that the diver is being asked to carry out under water;
- They should understand the limitations of a diver in relation to the work they can carry out. For example they will need to understand that a diver cannot normally lift an item under water which it took two men to carry on deck;
- They should understand the various ways in which equipment can be prepared on deck to ease the task of the diver under water.

(*Ref. IMCA C 002* – rigger and rigger foreman competency).

There should be a toolbox talk prior to each job. During the toolbox talk the diving supervisor, or someone acting on behalf of the supervisor, should give an explanation to the deck crew about the work to be done and the safety precautions to be taken.

With a larger deck crew it will not be necessary for all members of the crew, some of which maybe divers, to have the same level of competence, provided they are closely overseen by a competent and experienced person, such as the rigger foreman.

5.1.5 Life Support Personnel

On projects involving saturation or closed bell diving techniques, specialised personnel will be used to look after stored high pressure gases and to carry out the operations on and around the deck compression chambers in which the divers are living. Such personnel are life support supervisors (LSS), life support technicians (LST), assistant life support technicians (ALST).

A certification scheme for life support technicians has been running for some years, administered by IMCA (*Ref. IMCA D 013*). All life support technicians need to hold a qualification as a life support technician and should be competent to carry out the tasks required (*Ref. IMCA C 003*).

5.1.6 Supervisors

There is only one person who can appoint a supervisor for a diving operation and that is the diving contractor. The supervisor should be appointed in writing. Under the IMCA Offshore Diving Supervisor and Life Support Technician Certification Scheme there are three types of supervisor (*Ref. IMCA D 013*).

5.1.6.1 Air Diving Supervisor

An air diving supervisor will need to have passed the relevant modules of the certification scheme (*Ref. IMCA D 013*) and be qualified and competent to supervise all surface diving operations including decompression in a deck chamber (*Ref. IMCA C 003*). Care will need to be taken that such an individual has the necessary competence if they are asked to supervise surface supplied mixed gas diving operations, since the examination and training for air diving supervisor does not include surface supplied mixed gas diving techniques.

5.1.6.2 Bell Diving Supervisor

A bell diving supervisor will need to have passed both air diving and bell diving modules of the certification scheme (*Ref. IMCA D 013*) and be qualified and competent to supervise all diving operations, including those in deck chambers (*Ref. IMCA C 003*).

5.1.6.3 Life Support Supervisor

A life support technician will need to have passed the life support technician module of the certification scheme (*Ref. IMCA D 013*) and, once having completed the requirements in IMCA C 003 and being considered competent by the diving contractor, will be qualified to supervise divers living in, or being compressed or decompressed in a deck chamber.

Supervisors do not normally need to be qualified in first aid, however the diving contractor should consider the role and requirements of the supervisor during a medical emergency.

If a diving operation is being planned, which does not fall clearly in to the areas normally undertaken by that diving contractor, then detailed consideration will need to be given to the most suitable qualification for the supervisors to be selected.

Clearly the issue of competence is more subjective and the diving contractor needs to consider the operations being planned and the competence of any individual being considered for appointment as a supervisor.

The possession of the necessary qualification does not in itself demonstrate competence for any specific operation.

The diving contractor will need to consider the details of the planned operation, such as the complexity of the part of the operation the person is going to supervise, the equipment and facilities which will be available to the supervisor, the risks which the supervisor and divers may be exposed to and the support which would be available to the supervisor in an emergency. After such consideration, a decision will need to be made whether one supervisor can be responsible for all that is intended or whether more supervision is required.

Relevant previous experience supervising similar operations should demonstrate a suitable level of competence. For this purpose the log book maintained by the supervisor can be consulted.

If relevant previous supervisory experience of similar operations cannot be demonstrated, due to unique features of the planned operation, or to the limited previous experience of the individual being considered, then the diving contractor should assess the relevant information available, consider the possible risks involved and make a decision as to the competence of the individual concerned.

It is possible that in the future, particularly on very large operations, a diving contractor may wish to appoint individuals as supervisors for parts of the operation, which do not fall neatly in to the categories identified above. In such a case, the diving contractor will need to consider the most suitable qualifications available and in particular establish the competence of the individual for that position.

5.2 Numbers of Personnel/Team Size

5.2.1 General

The diving contractor will need to specify the size of team based on the details of the project and the risk assessment. For safe operation, this may need to include additional deck support personnel and other management or technical support personnel, such as project engineers or maintenance technicians (*Ref. AODC 048*).

The diving contractor will need to provide a sufficient number of competent and qualified personnel to operate and maintain all the equipment and to provide support functions to the diving team, rather than relying on personnel provided by others for assistance (e.g. clients, ship crews, etc.).

If personnel who are not employed by the diving contractor are to be used in the diving team for any reason, such as technicians, they will need to be carefully considered for competence and suitability before being included (*Ref. IMCA C 003*). Such personnel can create a hazard to themselves and others if they lack familiarity with the contractor's procedures, rules and equipment.

There will be exceptions to this requirement, for example, when a diving system is installed long term on a DSV and there are suitable technicians employed by the vessel owner. In such circumstances, these personnel, whose principal duties may be associated with the diving or ship's equipment, may form part of the diving team. Such an arrangement will need to be confirmed in writing, together with the responsibilities of these individuals.

To allow a diving operation to be conducted safely and effectively a number of eventualities should be considered when deciding team size and make up including the following:

- type of task;
- type of equipment (air, saturation etc.);
- deployment method;
- location;
- water depth;
- operational period (e.g. 12 or 24 hours per day);
- handling of any foreseeable emergency situations.

The overriding factor must always be the safety of personnel during operation and maintenance. It is the absolute responsibility of the diving contractor to provide a well-balanced, competent team of sufficient numbers to ensure safety at all times.

When a dive is taking place, a diving supervisor (or a life support supervisor for chamber operations only during closed bell/ saturation diving) will need to be in control of the operation at all times. For larger projects, more than one supervisor may be needed on duty and a diving superintendent to be in charge of the overall diving operation (see also 3.4).

Each supervisor will only be able to provide adequate supervision of a defined area of operations, including dealing with foreseeable contingencies or emergencies.

5.2.2 Tenders

For umbilicals that are tended from the surface, at least one tender is required for each diver in the water. For umbilicals tended from a bell or basket, one tender is required for every two divers in the water.

5.2.3 Standby Diver

5.2.3.1 Surface Supplied Diving

A standby diver will need to be in immediate readiness to provide any necessary assistance to the diver, whenever a diver is in the water. The standby diver will need to be dressed to enter the water, but need not wear a mask or helmet. This equipment will, however, need to be immediately to hand.

There will need to be one standby diver for every two divers in the water. The standby diver will remain on the surface and should have a dedicated tender.

5.2.3.2 Closed Bell Diving

When using a closed bell, the standby diver will remain inside the bell. Another diver will need to be on the surface with equipment suitable for intervention within the surface diving range (see also 4.8.2).

This diver need not be dressed for diving provided the equipment is available, and may undertake other duties within the dive team while the bell is under water.

5.2.4 Life Support Personnel

The controls of a deck decompression chamber (DDC) used for surface supplied diving can be operated by any trained and competent person under supervision. All divers and qualified life support technicians (LSTs) are trained to operate a DDC.

Competent and qualified personnel providing life support will be needed to look after divers living in saturation. When divers are in saturation, normally two life support personnel of which one would be life support supervisor will need to be on duty at all times, although one may be absent for short periods such as toilet and refreshment breaks. In the absence of the LSS the bell diving supervisor is qualified to supervise the LST.

5.2.5 Team Sizes

5.2.5.1 General

It should be understood that the great variance in the types of tasks for which divers are employed, together with advances in technology, make it hard for this document to offer anything more than general advice. Furthermore, it is not the aim of this document to remove the responsibility for safe operations from the contractor. Actual team sizes will need to be decided after completion of a risk assessment.

Individuals in a diving team will often carry out more than one duty, provided they are qualified and competent to do so and that their different duties do not interfere with each other. Overlapping functions will need to be clearly identified in procedures.

Trainees will often form part of the team but will not normally be allowed to take over the functions of the person training them unless that person remains in control, is present to oversee their actions, and the handover does not affect the safety of the operation.

With regard to safe working practices, a single person should not work alone and this should be taken in consideration when establishing the minimum team size when undertaking work in the following hazardous activities such as:

- high voltage;
- heavy lifts;
- high pressure machinery;
- potential fire hazards – welding, burning, epoxy fumes, etc.

5.2.5.2 Minimum Team Size for Surface Supplied Diving

The absolute minimum required to conduct a safe surface-supplied air dive within the scope of this code is five – supervisor, working diver, standby diver, tender for working diver, tender for standby diver. Additional personnel may be needed to operate or maintain specialised equipment, such as winches, and to assist in an emergency.

The absolute minimum number of personnel required to carry out an offshore surface supplied mixed gas dive is six. This is made up of one supervisor and five personnel who are qualified to dive (*Ref. IMCA D 030*).

5.2.5.3 Minimum Team Size for Closed Bell Diving

An absolute minimum closed bell project requires two operations – one when the divers are in the bell or in the water under the control of a diving supervisor, and a second under a life support supervisor when the divers are in the saturation chambers. The absolute minimum team will be seven – diving supervisor, life support supervisor, life support technician, two divers inside the bell, one diver on the surface, and a tender for the surface diver. Additional personnel will be needed to operate winches and the umbilical, maintain specialised equipment and to assist in an emergency.

5.3 Working Periods

It is recognised that long hours are sometimes required, but such circumstances should be exceptional and never planned. It should be remembered that accidents are more likely when personnel work long hours because their concentration and efficiency deteriorate and their safety awareness is reduced.

Work should be planned so that each person is normally asked to work for a maximum of 12 continuous hours, and is then given a 12-hour unbroken rest period between shifts.

Members of the diving team will not be asked to work for more than 12 hours without having at least eight hours of unbroken rest during the previous 24 hours. Similarly, the longest period a person will be asked to work, and only in exceptional circumstances, will be 16 hours before being given eight hours of unbroken rest. This may be, for example, where a diving team has been on standby, but not diving, for a number of hours before diving is needed. In such cases, extreme care will need to be taken and allowance will need to be made for the effects of fatigue.

In saturation diving, the divers will not be asked to undertake a bell run exceeding eight hours from seal to seal. They will then need to be allowed at least 12 hours of unbroken rest.

Extended work periods offshore without a break can reduce safety awareness. Work will therefore need to be planned so that personnel do not work offshore for long periods without being allowed time onshore. These times may need to vary to suit operational needs or exceptional circumstances, but personnel should be given a reasonable onshore break related to the period spent offshore.

No person will be expected to work a 12-hour shift without a meal break taken away from their place of work. Personnel also need toilet and refreshment breaks during their shifts.

To allow for these breaks, the diving contractor will need to ensure that the planned work either has natural breaks (for example, during periods of strong tide) or that qualified and experienced personnel are available to act as relief during breaks. This is particularly important in relation to supervisors whose responsibilities are often onerous and stressful. Any such handovers of responsibility should be recorded in writing in the operations log.

5.4 Training

It is necessary that diving contractors ensure that their personnel receive safety and technical training in order to allow them to work safely and in line with any relevant legislation, or to meet specific contractual conditions or requirements.

5.4.1 Safety Training

Safety training should include the following:

- courses on survival, first aid and fire fighting;
- an installation- or vessel-specific safety induction course on the hazards to be found at work and while responding to emergencies;
- further task-specific safety training outlining any special hazards associated with the tasks being worked on;
- refresher training at regular intervals.

5.5 Language and Communications

In an emergency, personnel tend to revert to their own language. If team members do not speak the same language this can cause an obvious hazard. The diving project plan should state the language to be used during the project and all team members will need to be able to speak to each other fluently and clearly at all times, particularly during emergencies.

This is applicable to all lines of communications including, for example, diving operations, vessel/DP operations, crane operations and communications with third parties.

6

Medical

6.1 Medical Equipment

A minimum amount of medical equipment will need to be at a diving site to provide first aid and medical treatment for the dive team. First aid kits should be held in the diving bell, chambers and hyperbaric rescue facility. In addition specialised medical equipment needs to be held at the dive site. The minimum amount will depend on the type of diving, but a standard list has been agreed (*Ref. DMAC 15*).

Diving medical specialists will then know what equipment and supplies are available when giving advice to a worksite. Particular problems exist if a diver becomes seriously ill or is injured while under pressure. Medical care in such circumstances may be difficult and the diving contractor, in conjunction with its medical adviser, will need to prepare contingency plans for such situations. Recommendations are available concerning the specialised equipment and facilities needed (*Ref. DMAC 28*).

Medical equipment needs to be stored in a locked container, appropriately labelled and regularly inspected and maintained by a designated suitably qualified person, normally the diver medic.

The location of first-aid equipment will need to be identified by the international sign of a white cross on a green background.

6.2 Suitable Doctors

The physiology of diving and the problems encountered by an ill or injured diver are not subjects which most doctors understand in detail. For this reason it is necessary that any doctor who is involved in any way with examining divers or giving medical advice in relation to divers has sufficient knowledge and experience to do so (*Ref. DMAC 17*).

The medical examiner of divers who certifies their fitness to dive needs to have an understanding of the working environment of the diver, which is normally gained by undertaking an appropriate training course (*Ref. DMAC 17*). Such a doctor, however, may be unable to give the necessary advice in relation to treatment of decompression sickness or other diving related injury.

Some doctors, as a result of training and/or experience have the necessary knowledge to advise on suitable treatment of diving related injury. They are usually described as diving medical specialists.

6.3 First-Aid/Diver Medic Training and Competencies

Diving physiology and medicine forms an integral part of all diver training courses.

This qualification expires after a period of time. For diving within the scope of this code, divers will need to refresh their qualification at appropriate intervals. Divers with diving first-aid certificates may choose to complete a general first-aid course rather than a diving-specific course.

In addition, one member of the dive team who is not diving (other than the supervisor) will need to be trained to a higher standard of first aid known as 'diver medic'. In practice, this means that at least two team members, who do not dive together, are trained as diver medics. This level of training will also require refresher training at regular three-year intervals (*Ref. DMAC 11, IMCA D 020*).

For saturation diving, the diver medic may be a team member on the surface, but needs to be qualified to go under pressure in an emergency.

6.4 Medical Checks

All divers at work must have a valid certificate of medical fitness to dive issued by a suitable doctor. The certificate of medical fitness to dive must be renewed prior to expiring if a diver wishes to continue diving at work. If the examination is carried out during the last 30 days of the validity of the preceding medical then the start date of the new certificate will be the expiry date of the old certificate.

The certificate of medical fitness to dive is a statement of the diver's fitness to perform work under water and is valid for as long as the doctor certifies, up to a maximum of 12 months.

The medical examination looks at the diver's overall fitness for purpose. It includes the main systems of the body - cardio-vascular system, respiratory system, central nervous system - and ears, nose and throat, capacity for exercise, vision and dentition.

6.4.1 Responsibility of the Diver

Divers who consider themselves unfit for any reason, e.g. fatigue, minor injury, recent medical treatment, etc., will need to inform their supervisor. Even a minor illness, such as the common cold or a dental problem, can have serious effects on a diver under pressure and should be reported to the supervisor before the start of a dive. Supervisors should seek guidance from their company or its medical adviser if there is doubt about a diver's fitness.

Divers who have suffered an incident of decompression illness will need to record details of the treatment they received in their logbooks. They will need to show this to the supervisor responsible for the first dive after the treatment in order that a check can be made of their fitness to return to diving (*Ref. DMAC 13*).

6.4.2 Responsibility of the Supervisor

Before saturation exposure, the supervisor will need to ensure that the divers have had a medical examination within the previous 24 hours. This will confirm, as far as reasonably practicable, their fitness to enter saturation. The medical examination will be carried out by a nurse or a diver medic. The content of the examination and the format of the written record will be decided by the diving contractor and will be specified in the contractor's diving manuals.

Before any dive not involving saturation, the supervisor will need to ask the divers to confirm that they are fit to dive and will record this in the diving records.

6.5 Liaison with a Suitable Doctor

The diving project plan and risk assessment will need to consider the situation where a diver is injured but a doctor is not available at the worksite. In such a circumstance, arrangements will be needed to allow personnel at the site to communicate over radio or telephone links with a diving medical specialist. It is the responsibility of the diving contractor to make such arrangements, before any diving operation commences, with a suitably qualified and experienced doctor such that medical advice and treatment is available at any time to the diving personnel offshore.

Such an arrangement is normally the subject of a 'standby' agreement with a doctor experienced in diving medicine and means that an emergency contact is available at all times for medical advice. This arrangement should be documented with the necessary details readily available offshore.

Part of the planning will need to be the pre-agreement of a suitable method for recording and transferring medical information from worksite to doctor (*Ref. DMAC 01*). All risk assessments and diving project plans will need to account for the fact that a seriously ill or injured diver in saturation cannot be treated as if the diver was at atmospheric pressure (*Ref. DMAC 28*).

If the required treatment cannot be administered by the personnel at the worksite, then trained medical staff and specialised equipment will need to be transported to the casualty. Treatment will be given to the injured diver inside the saturation chamber. The diver will not be decompressed or transferred to any other location until in a stable condition.

To enter a chamber a suitable diving qualification is not required by medical staff, they should however be examined and certified fit before entering the chamber (*Ref. DMAC 17*).

It is not normal acceptable practice to have someone in a compartment on their own during blow-down into saturation. This includes medical specialists in emergency situations.

6.6 Medical and Physiological Considerations

6.6.1 Diver Monitoring

For safety reasons, the diving project plan will need to specify that supervisors need to be able to monitor divers' breathing patterns and receive verbal reports from the divers of their condition. There is no requirement to monitor the temperature, heart rate or other physiological parameters of the diver because this information will not assist the supervisors' assessment of safety (*Ref. DMAC 02*).

6.6.2 Seismic Operations, Sonar Transmissions and Piling Operations

There are inherent problems for divers who are close to seismic operations, sonar transmissions or piling operations (*Ref. DMAC 06, DMAC 12*). If there is any possibility of these activities being undertaken in the vicinity of a diving project, the diving project plan will need to include parameters for the safety of the diver.

6.6.3 Decompression Illness After Diving

Divers are at risk of decompression illness (DCI) after diving. It is difficult to treat decompression illness if recompression facilities are not immediately available. The diving project plan will therefore need to specify that divers remain close to suitable recompression facilities for a set time following a dive (*Ref. DMAC 22*).

6.6.4 Flying After Diving

The diving project plan will need to state that flying is avoided for a specified time (*Ref. DMAC 07*) following a dive because of the decrease in pressure on the diver's body caused by increased altitude.

6.6.5 Thermal Stress

The diving project plan will need to specify ways in which divers can be maintained in thermal balance because excessive heat or cold can affect their health, safety and efficiency. For example, divers may be provided with suitable passive or active heating, such as thermal undergarments and a well-fitting 'dry' diving suit, or a hot-water suit. Conversely in very warm waters nothing more than cotton overalls may be required.

For dives deeper than 150 metres, active gas heating, due to the high thermal conductivity of the oxygen and helium breathing mixture, should be available as an option for the divers.

6.6.6 Duration of Saturation Exposure

When planning a dive, consideration will need to be given to the previous saturation exposures of each diver and the time they have spent at atmospheric pressure since completing their last saturation dive.

Because of the effects of long periods under pressure on the diver's health, safety and efficiency the diving project plan should state that divers are not to be in saturation for more than a specified number of days (normally 28) including decompression and that they will need to be at atmospheric pressure for a specified period before starting another saturation (*Ref. DMAC 21*).

It is recognised that operational circumstances may require these artificial limits, particularly the time at atmospheric pressure, to be varied and this should be done in conjunction with the company medical adviser.

6.6.7 Divers Out of Closed Bells

Divers operating out of a closed bell over extended periods can suffer from dehydration. A diver spending over two hours out of a closed bell should be offered the opportunity to return to the bell and remove their breathing apparatus for a drink or other refreshments. While lack of food will not normally be a problem, a light snack when back at the bell can be helpful.

7

Work Planning

7.1 Diving Project Plan

Before any diving is carried out there should be a diving project plan in existence. The diving project plan should consist of documents such as:

- the risk management process for onshore planning and work preparations and at the worksite during execution, including HAZIDs/HIRA, JSA, toolbox talks, management of change and responsibilities of the relevant personnel;
- a management of change procedure;
- safety management interface documents (bridging documents) agreed with all parties concerned;
- adverse weather working policy;
- diving/operating/maintenance procedures;
- mobilisation/demobilisation plans;
- step-by-step work procedures;
- contractors manuals and documentation;
- code, standards and reference documents;
- communication and responsibility organigrams;
- accident/near-accident and incident notification, reporting and investigation procedures;
- deployment of divers and standby divers;
- equipment, tools and materials to be used and their deployment;
- equipment audit reports and certification;
- permits-to-work system;
- drilling mud and chemical risk assessments;
- lift plans;
- minimum gas/breathing mixture requirements;
- suitable emergency and contingency plans, including: lost bell recovery; rescue of divers from a habitat; and hyperbaric evacuation for surface orientated and saturation diving operations. These should be agreed by all relevant parties;
- any location-specific hazards identified by the client.

See also section 9 for more details about a number of the above mentioned documents.

All supervisors will need to be familiar with and have ready access to the diving project plan. In addition, the divers, project team and supporting personnel should also have access to this information.

7.2 Risk Management Process

The diving contractor should have a risk management process in place which addresses the project lifecycle and should include the following.

7.2.1 Onshore

- Risk identification meetings (HAZID or HIRA) prior commencement of the development of step by step work procedures;
- Final risk assessment (HAZID or HIRA) when the step by step work procedures have been finalised;
- Risk assessments of mobilisation/demobilisation plans and the contingency and emergency plans.

The risk identification and assessments (HAZIDs and HIRAs) will need to identify site-specific hazards, assess the risks and set out how these can be mitigated or controlled. The persons responsible for any actions will also need to be identified.

The meetings should be attended by experienced diving contractor engineering and offshore personnel as well as experienced client personnel.

7.2.2 Mobilisation

Mobilisation and familiarisation of the offshore personnel.

7.2.3 Offshore Operations

- A job safety analysis (JSA) should be completed prior to initiating the work. With the work procedures in place on the vessel/fixed/floating structure, all relevant persons responsible for the work should discuss the potential hazards and precautions to be taken. If the JSA reveals significant unanticipated safety risks then offshore acceptances should be withheld pending revision of the work procedure to address the safety concerns. Approval for the revision needs to be given by all parties concerned, onshore and offshore. Management of change procedures need to be followed (see 9.7, *Ref. IMCA S&L 001*);
- A toolbox meeting should be held at the start of each shift or prior to any high-risk operation, where the diving supervisor and/or the diving supervisor's delegate and shift personnel discuss the forthcoming tasks or job and the potential risks and necessary precautions to be taken;
- Dive plan. This should be used for each dive to brief the divers. It should contain the tasks to be carried out, hazards, risks and precautions to be taken.

7.3 Operational and Safety Aspects

7.3.1 SCUBA

Self-contained underwater breathing apparatus (SCUBA) has inherent limitations and is not a suitable technique for diving under the scope of this code (*Ref. IMCA D 033*).

7.3.2 Use of Compressed Air or Oxy-Nitrogen Mixtures

Divers breathing a mixture of oxygen and nitrogen under pressure, whether compressed natural air or an artificial mixture, are at risk of both oxygen toxicity and nitrogen narcosis as the depth increases. The diving procedures will therefore need to specify the maximum depth for the mixture being used.

Breathing mixtures other than oxygen and nitrogen (or air) will need to be used when diving takes place deeper than 50 metres of water.

When nitrox diving is carried out the partial pressure should not exceed 1.5 bar absolute.

7.3.3 Exposure Limits for Air and Oxy-Nitrogen Diving

Diving carries an inherent risk of decompression illness (DCI). In surface supplied diving the incidence of DCI drops if the length of time a diver spends at any particular depth is limited. Many diving contractors use an artificial limit on time at any depth, typically the US Navy 'O' repetitive group, to reduce the chances of DCI. Diving procedures should be based on these maximum time limits.

It should be remembered that any subsequent dive within 12 hours of surfacing (repetitive diving) may not be allowed by some decompression tables and will be restricted in others.

7.3.4 Surface Supplied Air Diving

During surface supplied diving divers need to be able to enter and leave the water safely and in a controlled manner.

On a vessel/floating structure, where the freeboard is less than 2 metres, a risk assessment should be carried out to establish if there are any obstructions that could be dangerous for diver(s) and standby diver(s) and to identify which diver/standby diver launch and recovery system should be used. In addition the environmental conditions at the worksite should also be taken in consideration.

i) When diving from an anchored vessel/floating structure where there are no hull obstructions near the diving site and the freeboard is less than 2 metres, then either one or other of the following options should be fitted:
   - a closed diving bell or wet bell or diving basket(s) and equipment for the deployment of a surface standby diver; or
   - a ladder which extends at least 2 metres below the surface in calm water. The ladder should have sufficient holds under and above water and on deck level to allow the diver to step easily onto the deck. In addition a dedicated arrangement e.g. a crane, A-frame or davit, certified for man riding, with sufficient reach should be present to recover an incapacitated diver from the water by, for example, their safety harness onto the deck.
   - The equipment used, including launch and recovery systems, should meet the minimum requirements for diving equipment as laid out in IMCA D 023.

ii) When diving from a DP vessel or an anchored vessel/floating structure where there are obstructions at the diving site and/or a freeboard of more than 2 metres then either or other of the following options should be fitted:
   - a closed or wet diving bell and equipment for the deployment of a surface standby diver; or
   - two diving baskets – one for the diver(s) and one for the standby diver.

   The equipment used, including launch and recovery systems, should meet the minimum requirements for diving equipment as laid out in IMCA D 023.

7.3.5 Surface Supplied Mixed Gas Diving

The diving contractor may wish to carry out work using surface supplied techniques but where the use of compressed air or oxy-nitrogen mixtures would not be appropriate. The normal solution is to use a mixture of helium and oxygen as the breathing gas. For such diving a properly equipped wet bell (*Ref. IMCA D 037*) should be used and the maximum depth should be limited to 75 metres of water. For depths between 50 and 75 m of water the bottom time should be limited to a maximum of 30 minutes (*Ref. IMCA D 030*).

The diving project plan for such work will need to consider all the relevant safety implications of using this technique instead of the use of a closed bell. In particular, divers and supervisors will need to be experienced in this type of diving.

7.3.6 Water Intakes and Discharges

Divers are vulnerable to suction or turbulence caused by water intakes and discharges as well as discharge products. The diving contractor will need to establish with the client whether there are any underwater obstructions or hazards in the vicinity of the proposed diving project. If there are any intakes or discharges, suitable measures will need to be taken to ensure that these cannot operate while divers are in the water unless the divers are protected with a suitable physical guard. Such measures will need to be part of a work control system, such as a permit-to-work system, and could include mechanical isolation (*Ref. AODC 055*).

7.3.7 Restricted Surface Visibility

Restricted surface visibility caused by, for example, driving rain or fog may affect the safety of the operation. The diving project plan will need to identify when operations will need to be suspended because of restricted visibility (*Ref. AODC 34*).

7.3.8 Underwater Currents

The diving project plan will need to consider the presence of currents and the limitations they impose on the diver's operational ability (*Ref. AODC 047*). While other parameters also need to be taken into account, tide meters provide accurate information on the current at different depths and can be used to assess the diving conditions.

7.3.9 Diving Near ROV operations

There are a number of safety considerations that need to be taken into account when divers are working with, or in the vicinity of, ROVs and guidance is available. These include entanglement of umbilicals, physical contact, electrical hazards, etc. The diving project plan will need to include mitigation of these hazards. For example, umbilicals could be restricted in length and electrical trip mechanisms could be employed. All ROV thrusters should be fitted with thruster guards (*Ref. AODC 035, AODC 032, IMCA R 004*).

7.3.10 Safe Use of Electricity

Divers often come into contact with equipment operated by or carrying electricity. Care will need to be taken, therefore, to ensure that the divers and other members of the dive team are protected from any hazards resulting from the use of electricity and particularly from any shock hazard (*Ref. AODC 035*).

Battery-operated equipment used inside compression chambers can also be a hazard and the diving project plan will need to include safe parameters for using such equipment (*Ref. IMCA D 041*).

7.3.11 High-Pressure Water Jetting

Even an apparently minor accident with this equipment has the potential to cause a serious internal injury to the diver. A work procedure that includes the use of such units will therefore also need to include safe operating procedures that will need to be followed. Such procedures can be found in industry guidance (*Ref. AODC 049, DMAC 03*).

7.3.12 Lift Bags

The use of lift bags under water can be hazardous. The diving project plan will need to include ways to prevent the uncontrolled ascent of a load. Good practice established by the industry should be followed (*Ref. IMCA D 016*).

7.3.13 Abrasive Cutting Discs

The diving project plan will need to address the risk of abrasive cutting discs breaking during use under water. In particular, the adhesive used in these discs tends to degrade in water. The plan will need to ensure that only dry discs not previously exposed to water are used, and that only enough discs for each dive are taken under water at any one time.

7.3.14 Oxy-Arc Cutting and Burning Operations

There are inherent hazards in the use of oxy-arc cutting and burning techniques under water, including explosions from trapped gases, trapping of divers by items after cutting, etc. Guidance on this subject exists. The diving project plan will need to include precise instructions regarding the operating procedures. Appropriate procedures will need to be employed (*Ref. AODC 035, IMCA D 003*).

7.3.15 Diving from Installations

A specific evacuation plan will need to be in place when surface orientated diving or saturation diving is carried out from fixed installations (*Ref. IMCA D 025*).

7.3.16 Diving from DP Vessels/Floating Structures

Diving from dynamically positioned vessels/floating structures can be hazardous to divers because of the presence of rotating propellers and thrusters. Practical steps have been established to reduce the risks arising from this hazard and these will need to be included in the diving project plan (*Ref. IMCA D 010*).

An ROV or some other way of carrying out the task should be used if the possibility of an umbilical or diver coming into contact with a thruster or propeller cannot be discounted.

The diving project plan will need to ensure that any diving support vessel/floating structure operating on dynamic positioning meets industry technical and operational standards (*Ref. IMCA M 103, 108 DPVOA, 127 DPVOA, IMCA M 117, IMCA M 178, 113 IMO*)

7.3.17 Quantity of Gas

The likely quantities of gases needed for diving operations, including therapeutic treatments and emergencies, will need to be calculated when planning a diving project. Allowances will also need to be made for leakage, wastage, contingencies, etc. (*Ref. AODC 014*). Diving will need to be stopped if the minimum quantity of gas acceptable for safety purposes falls below the agreed minimum specified in the diving project plan.

7.3.18 Levels of Oxygen in Helium

For safety reasons, pure helium should not be sent offshore except as a calibration gas or for a specific operational requirement. A small percentage of oxygen will need to be present in helium to be used within the scope of this code. The industry norm is 2% (*Ref. DMAC 05, AODC 038*).

When an oxygen-helium mixture is used as the reserve supply in a diver's bail-out bottle, it should contain a percentage of oxygen that allows it to be breathable over the largest possible depth range. Guidance on a suitable percentage exists (*Ref. DMAC 04*).

7.3.19 Contents of Gas Mixes

Gas cylinders containing breathing gases coming from suppliers should be colour coded in accordance with industry guidance (*Ref. AODC 016*) and will be accompanied by an analysis certificate. The diving project plan will need to make it clear that neither of these should be accepted as correct until a competent member of the dive team has analysed at least the oxygen content. This analysis will need to be repeated immediately before use of the gas.

7.3.20 Length of Divers' Umbilicals

The required length of divers' umbilicals in relation to the worksite will need to be included in the diving project plan, particularly where an emergency situation might require rapid location and recovery of a diver (*Ref. AODC 020*).

When a diving bell is being used from a dynamically positioned vessel/floating structure, the diving project plan in addition will need to consider the fouling and snagging hazards in relation to umbilical length (*Ref. IMCA D 010*).

7.3.21 Duration of Bell Runs and Lockouts

The diving project plan will need to limit bell runs to less than eight hours from 'lock-off' to 'lock-on' because of decreased safety and efficiency. The diving project plan will also need to ensure that each diver spends no more than six hours out of the bell.

The diving project plan will need to state that divers in saturation need to be given at least 12 continuous hours of rest in each 24-hour period.

7.3.22 Transfer Under Pressure

The transfer of divers or equipment into or out of the saturation chamber, or between chambers under pressure, introduces a particular hazard. The diving project plan will need to state that internal doors, i.e. those between the transfer chamber and the trunking to the diving bell and those separating living chambers within the chamber complex, are to be kept closed and sealed at all times except when divers are actually passing through them.

7.3.23 Underwater Obstructions

Diving operations can be complicated by the number of lines deployed during operations: DP taut wire, equipment guide lines, clump weights and wires, divers' bell umbilicals, swim lines, etc. This situation is however often simplified by the level of detailed planning involved in the operation, resulting in all involved parties having a clear understanding of responsibilities and expectations (*Ref. IMCA D 010*).

7.3.24 Over-Side Loads/Scaffolding and Working

Dropped loads and scaffolding pose a serious risk to divers. Therefore no over-side working should take place from structures, and no crane-lifts transferred over the side when diving is taking place, and while divers are in the water unless a safe horizontal separation between divers and the above activities is maintained.

The hazards of over-side loads/scaffolding need to be addressed during the onsite job safety analysis (*Ref. IMCA D 007*).

7.3.25 Effluent and Waste Dumping

When diving operations are taking place the dumping of industrial effluent in the vicinity should be avoided. Such activities could reduce the effectiveness of divers by obscuring their vision, could cause them skin infections, or could result in potentially harmful chemicals being carried back into a saturation diving bell or complex. Some industrial effluents may be considered harmless under normal conditions, but their toxic affect on the human body may change under pressure (*Ref. IMCA D 021*).

7.3.26 Diving Operations in the Vicinity of Pipelines

Divers should not be permitted to work on a pipeline system which is under test. When the line is suspected of being damaged or defective divers should not approach the line until its internal pressure has been reduced to a pressure which has been established as safe through a full engineering and hazard assessment (*Ref. IMCA D 006*).

7.3.27 Diving on Depressurised or Empty Pipelines/Hoses/Subsea Structures

When diving on depressurised or empty pipelines/hoses/subsea structures care needs to be taken to ensure that a diver will not get trapped and/or injured due to underpressure. A risk assessment needs to be carried out to establish the risks and precautions to be taken when work is planned to be carried out on depressurised or empty pipelines/hoses/subsea structures. When new lines/hoses need to be flooded, consideration should be given to undertaking any intervention using an ROV or another remote system. When divers are used for opening the flooding valve, as a minimum, a diffuser needs to be installed which will prevent a diver getting trapped or injured.

7.3.28 Diving on Wellheads and Subsea Facilities

Whenever divers are required to work on part of a subsea system the pressure should be reduced to ambient and adequate safety barriers put in place, such as double block and bleed, to isolate other parts of the system which still contain hydrocarbons or other fluids under pressure (*Ref. IMCA D 019, IMCA D 021*).

7.3.29 Impressed Current Systems

Impressed current systems may be installed to protect vessels, structures or pipelines against corrosion by means of electrically supplied anodes in the sea which protect the parent structure.

The client is obliged to provide the diving contractor with information whether such a system is installed. As part of the risk assessment, contractors carrying out diving in the vicinity of an impressed current system should follow the advice given in AODC 035. Depending on the voltage of the system and the proximity to the divers, the system may need to be switched off.

7.3.30 Diving Under Flares

It may be necessary to locate the diving vessel close to the flare of an installation for certain tasks. The heat and fallout could have an adverse affect on topside personnel and equipment in proximity to the flare. Should work be required under or in close proximity to the flare a study/review should be carried out to establish a safe location, given the output from the flare, wind speed and direction. This should be included in the work procedure.

7.3.31 Detection Equipment When Diving in Contaminated Waters

When diving in contaminated waters or waters which may become contaminated as result of underwater activities, the use of appropriate gas detection equipment should be considered to identify any contaminations entering the bell, which could affect the divers.

7.3.32 Mud/Cuttings from Drilling Operations

The client is obliged to provide the diving contractor with details of any possible substance likely to be encountered by the dive team that would be a hazard to their health, for example, drill cuttings on the seabed. This information must be provided in writing and in sufficient time to allow the diving contractor to carry out the relevant risk assessment and, if necessary, to take appropriate action such as the use of protective clothing (*Ref. IMCA D 021*).

7.3.33 Permits to Work

A 'permit to work' should be raised when divers have to work on installations, pipelines and subsea facilities. This is to ensure that any operation of plant or equipment that may put the diver at risk, for example, by creating suction at intakes close to the work-site, exposure to electrical current, release of pressure, ejection of effluent or a powerful flow of water, or any other harmful effect, is isolated or immobilised.

On a vessel/floating structure a 'permit to dive' system which identifies the controls and conditions should also be in place before diving operations are allowed to commence.

7.4 Environmental Considerations

The safe and efficient deployment and operation of divers is dependent upon suitable environmental conditions. For any given situation the combination of these conditions can be dramatically different and it is the responsibility of the diving supervisor to assess all available information before deciding to conduct, to continue or to finish diving operations. Each diving contractor should normally define clear environmental limits (adverse weather working policy). Diving supervisors should also ensure that they understand the implications of any other limitations which apply to vessels/fixed and floating structures and deployment systems.

At no time should a diving supervisor allow contractual pressure to compromise the safety of personnel during diving operations.

The following sub-sections are designed to highlight environmental aspects that affect diving operations. There is not, however, any substitute for practical experience.

7.4.1 Water Depth and Characteristics

Water characteristics may have a significant effect and the following factors should be taken into account when assessing the use of a diver on a given task.

7.4.1.1 Visibility

Poor visibility can alter the effectiveness of the operation. Diving operations near or on the bottom can stir up fine grained sediment which may reduce visibility, particularly in low or zero current situations.

7.4.1.2 Temperature

Extreme temperatures (both high and low) may affect the reliability of equipment and impose particular hazards on personnel.

7.4.1.3 Pollutants

The presence of man-made and natural petroleum products around oil fields can cloud optical lenses and may damage plastic materials. Equally, gas can affect visibility, block sound transmission and cause sudden loss of buoyancy. Special precautions should be taken to protect the divers if pollutants are present and prevent these pollutants from entering the diving bell, as well as protecting personnel who may handle the divers or their equipment during launch/recovery and during maintenance (*Ref. IMCA D 021*)

7.4.1.4 Water Movement

Divers are very sensitive to water movement and great care has to be taken in shallow water where surge of the water or the proximity of vessel/floating structure thrusters can have a major effect on the ability of a diver to remain in a particular position (*Ref. AODC 47*).

7.4.2 Currents

Currents can cause considerable problems in diving operations (*Ref. AODC 47*) but unfortunately it is often the case that very little quantitative data on particular current profiles is available.

Simulations and analysis can provide good indications of the effect of currents but often currents are not constant even close to the seabed. Currents vary with location and surface currents can be quickly affected by wind direction.

The use of a tide/current meter may provide information on the current strength and direction at any particular depth.

7.4.3 Sea State

The sea state can affect every stage of a diving operation.

Working from a support vessel/floating structure in rough seas requires careful consideration of safety before and during launch and recovery.

Rough seas also require a heightened awareness of the possibility of accidents during recovery, both to the surface crew and to the divers. It is important, particularly in adverse sea states, that all personnel involved with launch and recovery wear all necessary personal protective equipment and fully understand their own role as well as the role of others involved in the operation, such as the captain of the support vessel. Good communication is a vital factor in reducing the possibility of accidents.

In certain situations, purpose-built deployment systems, e.g. motion compensation systems, can either reduce or better accommodate the effect of wave action thereby enabling diving operations to be conducted in higher than normal sea state conditions while maintaining normal safety standards.

7.4.4 Weather

The cost and efficiency of operations can be adversely altered by the effects of weather. Local weather forecasts should be consulted before commencing any diving operation.

While divers under water may not be directly affected by the various effects of weather, these can have an effect on diving operations in a number of different ways:

- Wind speed and direction can make station-keeping difficult for the support vessel/floating structure;
- Rain and fog will cause a reduction in surface visibility, possibly creating a hazard for the support vessel/floating structure (*Ref. AODC 34*);
- Bad weather can make working on deck extremely hazardous for the diving crew, particularly with adverse combinations of wind, rain, snow, etc.;
- Hot weather can cause overheating. In particular umbilicals stored on deck are more susceptible to overheating by warm air or direct sunlight;
- Extreme heat, including direct sunlight, or cold can cause the temperature inside deck chambers to rise or fall to dangerous levels. In such conditions the internal temperature should be monitored and kept at a comfortable level;
- Extreme heat, including direct sunlight, or cold can adversely affect divers acting as standby divers who will be static but dressed in most of their diving equipment. Arrangements should be made to keep the standby diver sheltered, at a comfortable temperature and well hydrated;
- Electric storms or lightning may be a hazard to exposed personnel or equipment.

Operations should, therefore, be carefully monitored with regard to the safety of both personnel and equipment.

7.4.5 Ice

From time to time diving may have to take place in areas where floating ice and freezing temperatures may occur. Prior to commencement of the work it should be established whether the plant and equipment are suitable, designed and certified to work in these conditions. In addition there is a risk of weight increase due to ice build-up on the equipment such as the launching system and diving bell, which could result in overloading. Plans should be in place to deal with those situations. Risk assessments of the emergency and contingency plans, in particular hyperbaric evacuation, should take account of floating ice and ice built-up on equipment and precautions to be taken.

7.4.6 Hazardous Marine Life

In some parts of the world divers may come into contact with marine life which will pose a hazard. Prior to commencing diving operations it should therefore be established if there is any known local hazard of this type and this should be taken into account during the risk assessment.

If hazardous marine life is suspected then suitable emergency and contingency plans should be drawn up to deal with its effects.

7.4.7 Other Considerations

A diving supervisor should only allow a diving operation to begin after careful consideration of all possible environmental criteria, their interaction with each other, and other factors including the deployment equipment, the system's readiness, crew readiness and the nature and urgency of the tasks. This should form part of the risk assessment and JSA carried out for that operation.

7.5 Communications

Effective communications are essential to ensure that all personnel directly involved in operations are made fully aware of the work being undertaken and that during operations all parties are kept aware of the status of any unusual situation.

Communications between the diving team and any other relevant personnel (such as marine crew, DP operators, crane drivers) are important to safe and efficient operation (*Ref. IMCA M 175, IMCA M 103, IMCA D 023, IMCA D 024, IMCA D 037, IMCA D 040*).

On a DP diving support vessel/floating structure, in addition to the primary and secondary means of voice contact between the bridge and diving supervisor, there also needs to be a set of DP alarms in the diving control centre.

If there is an ROV operation taking place in the vicinity (*Ref. AODC 032*), established communications should always exist between:

- the diving supervisor and the ROV supervisor (when an ROV is used in a diving operation the diving supervisor has ultimate responsibility for the safety of the whole operation);
- the diver and the ROV operator (NB this is normally routed through the diving supervisor). If the ROV is used to watch the diver then back-up hand signals should be rehearsed.

Effective communications are vital to the safety and success of any operation. To ensure this the diving supervisor needs to be given access to the communications service of the vessel or fixed/floating structure on which operations are based, as and when required.

Communication systems encompass all available media and equipment: word of mouth, reports, telephone, telex, email, fax, radio, etc.

7.6 Diving from Vessels, Fixed Platforms or Floating Structures

7.6.1 General

Divers may work from a variety of locations ranging from very small boats to a large fixed installations or structures.

Vessels used to support diving operations may be purpose-built or modified, or they may be vessels of opportunity. Whichever type is to be used it should hold a certificate of class awarded by a recognised classification society and meet IMCA, IMO and national regulations/standards and the requirements for safe diving regardless of any other role which it may also be required to undertake.

IMCA D 035 makes recommendations about the selection of vessels of opportunity for diving operations. Prior to mobilisation it is recommended that a suitable person (this may be the diving supervisor) should inspect the site and decide on the optimum location for the diving system. The level of services should also be assessed.

Diving should only be carried out from vessels or floating structures which are stationary by means of anchors or a combination of anchors and mooring ropes or which maintain position using a dynamic positioning (DP) system. For diving operations only DP with IMO equipment class 2 or 3 should be used, which means that a loss of position will not to occur in the event of a single fault in any active component or system (*Ref. IMCA M 103, IMCA D 010 and 113 IMO*).

All vessels should also be audited on a yearly basis using the Common Marine Inspection Document (IMCA M 149).

7.6.2 Live-Boating

'Live-boating', which is the practice of supporting a diver from a non-DP vessel which is under power and making way, should not be used.

7.6.3 Small Work Boat, Supply Boat or Standby Vessel

The smallest type of vessel used in offshore diving operations is a small craft for mobile or portable surface supplied systems. IMCA D 015 makes recommendations about the equipment and crewing of such craft. In all cases, these craft will be working from a larger support vessel or support location and should remain within close vicinity and in line of sight at all times. They are restricted to operating in good weather and good visibility. Sea conditions need to be such that the diver can safely enter and leave the water and that the craft can be safely launched and recovered by the support vessel.

Small work boats, supply boats or standby boats may be used in certain operations. These vessels are not specifically designed for diving operations and have a number of limitations:

- lack of manoeuvrability;
- low grade navigation systems;
- very low capability offshore mooring or position keeping systems;
- minimal deck space;
- no, or very low capacity, crane facilities;
- low electrical power reserves;
- limited personnel accommodation;
- poor weather susceptibility for over-side operations;
- lack of marine crew familiarity with diving operations.

These limitations need to be taken into account when considering the work scope and location of the vessel.

7.6.4 Small Air Range Diving Support Vessels and Larger Supply Boats

These vessels can be convenient for diving operations and while they will normally not have all the limitations listed in 7.6.3 above, they will still have some of these limitations.

Again such vessels can be used in a number of situations, but they still need to be carefully assessed prior to the project to ensure that the limitations of the vessel are nevertheless acceptable in relation to the proposed work scope and envisaged environmental considerations.

Often, the vessel's crew will be familiar with diving operations which can be very advantageous in difficult operating conditions or in an emergency.

7.6.5 Purpose-Built Diving Support Vessels (DSVs)

Such vessels are relatively expensive in comparison to other vessels due to the range of capabilities they can provide, such as the ability to operate air and saturation diving simultaneously. ROVs may also operate from such DSVs to assist divers and carry out underwater tasks.

7.6.6 Fixed Platforms

While the fixed nature of an installation results in the absence of a number of the limitations imposed by floating structures, there are a number of specific problems associated with operating from a fixed platform such as:

- the need to comply with specific, often onerous, zoning requirements in relation to hydrocarbon safety;
- space limitations leading to difficulty in installation of surface support equipment;
- additional safety requirements imposed on personnel such as training in H_2S emergencies;
- the possibility of a power shutdown due to a preferential trip operation;
- tidal effects on the diver making relocation difficult;
- deployment and recovery may be complicated by the height between the platform and sea level;
- additional hazards resulting from operations undertaken inside the platform structure;
- emergency evacuation (*Ref. IMCA D 025*);
- intakes and outfalls.

In addition all platforms operate a 'permit-to-work' system which governs the operation of diving systems and may result in operational delays.

7.6.7 Temporarily Fixed Platforms

Included in this category are various large structures which may in themselves be mobile but are intended to remain in one location during work. They may be maintained in that location by moorings, DP systems or other means. Examples would be drilling rigs, crane barges, accommodation barges, etc. These may present to diving operations similar hazards to those of a fixed platform and while zoning and hydrocarbon safety requirements will normally apply to drilling rigs, other types of platform may have no such limitations.

These platforms may, however, have other hazards to diving operations such as anchor wires, DP systems and propellers and submerged pontoons (*Ref. IMCA D 010*).

7.6.8 Specialist Locations

These can include multi-support vessels (MSVs), lay barges, trenching barges or specialised marine vessels.

Every specialist location will present different problems which will need to be carefully considered at the planning stage. On many specialised vessels one of the main limitations on diving operations is that the primary task, for example pipelaying, cannot be interrupted without serious consequences.

It is important that all diving operations being conducted from a specialist location are planned to conform to a set of procedures agreed specifically for that location with the client (*Ref. IMCA D 010*).

7.6.9 Dynamic Positioning

Many of the above types of support location can be held in a fixed position by the use of dynamic positioning.

DP vessels and floating structures use position reference systems (e.g. differential global positioning systems (DGPS), taut wire, hydroacoustic positioning references (HPR), Artemis, Radius and fan beam laser) to determine the vessel's/structure's actual location with respect to the seabed and other sensors such as gyros, vertical reference units, wind speed and direction sensors to determine heading, pitch and roll measurement and the forces acting on the vessel. All this data is used by the computer to calculate the force and direction needed to be outputted from the thrusters to automatically keep the vessel in position. The DP console provides the interface between the computer and the DP operator.

When diving operations are carried out from a DP vessel or floating structure the DP system needs to be arranged in a redundant configuration so that failure of any part of the system essential to station keeping will not cause loss of position. To confirm this is the case an FMEA and FMEA proving trials need to be carried out which should be updated when any changes to the DP system take place (*Ref. IMCA M 103, M 166, M 178, 113 IMO*).

In addition, annual DP trials need to be carried out (*Ref. IMCA M 139*).

Dynamic positioning has its own inherent limitations and hazards in relation to diving operations:

- No system keeps the vessel or floating structure static. All allow it to move in a predetermined 'footprint'. Although DP systems are very reliable, all have the possibility of failure (*Ref. 115 DPVOA*);
- DP uses the thrusters and propellers at all times, which means that divers and their umbilicals can be at risk from these items or the wash that they generate (*Ref. IMCA D 010*).

For the above reasons, it is important that a thorough assessment is carried out prior to the offshore operation to establish what the capabilities and limitations are of the DP system on the proposed vessel or floating structure. This can then be compared with the required scope of work and a decision made about suitability and any restrictions which may need to be put on the operation.

Only vessels and floating structures complying fully with all aspects (such as number of reference systems, levels of redundancy, crew competency etc.) of IMCA guidelines and IMO requirements should be used (*Ref. 108 DPVOA, IMCA M 103, IMCA M 117, IMCA M 139, IMCA M 140, IMCA M 166, IMCA M 178, 113 IMO*). IMCA D 010 provides further guidance on diving operations from vessels in DP mode.

7.7 Launch and Recovery Procedures and System Certification

Because of the variety of diving systems, support locations and deployment systems, it is not possible to define every launch/recovery procedure and system in this document.

It is the responsibility of the diving supervisor to ensure that a safe launch/recovery procedure exists that is understood by all members of both the diving and the support installation crews. The procedure should progress in smooth, logical steps and be designed so that all personnel involved in the operation are fully aware of the situation at all times.

A diving contractor should ensure that the launch and recovery system(s) used for diving operations have been tested and certified by a competent person.

(*Ref. IMCA D 018, IMCA D 004, IMO Code of Safety for Diving Systems 1995 Resolution A.831(19), IMO Guidelines and Specifications for Hyperbaric Evacuation Systems - Resolution A.692(17), IMCA Guidance for Hyperbaric Evacuation Systems* (under development)).

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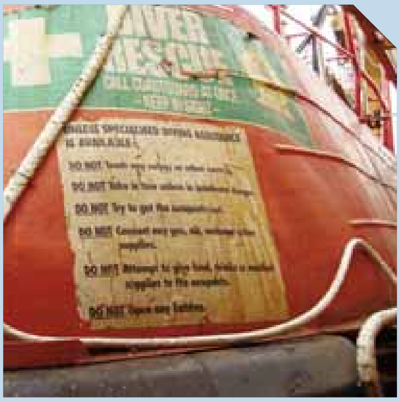

Emergency and Contingency Plans

8.1 Diving Emergencies

The diving contractor's operations manual should contain a section laying out the actions required of each member of the diving team in the event of a foreseeable emergency occurring during operations.

The following list, which is not exhaustive, identifies the type of possible emergencies to be considered:

- dealing with an injured or unconscious diver;
- fire in a chamber or around the dive system;
- evacuation from a vessel or fixed/floating structure which is on fire or sinking;
- loss of pressure in chambers or bell;
- faulty or broken equipment;
- approach of severe weather.

8.2 Lost Bell/Emergency Bell Recovery Contingency Plan

A contingency plan and appropriate procedures, which have been risk assessed, should be in place. These plans/procedures should include the equipment and personnel required to locate and rescue a lost closed diving bell and also the plans/procedures for a closed bell, which is still attached to the vessel/ fixed/ floating structure, but which is severed from its main lift wire and or umbilical. These plans/procedures should identify the actions required by the diving contractor and other personnel, and the provision of specific equipment, such as locators *(Ref. AODC 009, AODC 012, AODC 061, AODC 019)*.

The bell needs to be capable of sustaining the lives of trapped divers for at least 24 hours.

8.3 Habitats

A contingency plan and appropriate procedures, which have been risk assessed, should be in place and include the equipment and personnel required for recovery of divers when they are trapped in a habitat.

For an emergency situation the habitat needs to be capable of sustaining the lives of the trapped divers for at least 48 hours.

8.4 Hyperbaric Evacuation

8.4.1 General

In an emergency appropriate arrangements need to be in place to evacuate all divers under pressure to a safe place.

8.4.2 Surface Supplied Diving

A contingency plan and appropriate procedures, which have been risk assessed, should be in place. These should include the personnel and equipment required for the evacuation of a surface supplied diver from a stricken vessel or fixed/floating structure with omitted decompression. The plans/procedures should cover the method of evacuation of the diver (with adequate oxygen and medical supplies during transit) to a designated chamber identified for recompression.

8.4.3 Saturation Diving

In an emergency, divers in saturation cannot be evacuated by the same methods as other crew members. For all saturation diving operations, a hyperbaric rescue facility needs to be provided that, in the event of a vessel or fixed/floating structure evacuation, is capable of evacuating the maximum number of divers that the dive spread is capable of accommodating, to a designated location where the divers can be decompressed in a safe and comfortable manner.

Special arrangements and procedures, which need to be risk assessed, should be in place, to evacuate the divers safely while keeping them under pressure, for example, in a purpose built hyperbaric rescue vessel (HRV) or a chamber designed for that purpose (HRC), capable of being removed from the worksite to a safe location while maintaining the divers at the correct pressure and with life support for a minimum of 72 hours (*Ref. IMO Guidelines and Specifications for Hyperbaric Evacuation Systems Resolution A.692(17)*).

The exact design of such equipment and its method of deployment will depend on the facilities available, the number of divers to be evacuated, the location of the worksite, etc. These factors will need to be considered during the risk assessment, which should include the transfer into the HRV or HRC, launching, towing/steaming/transportation, recovery and decompression phases of an evacuation. The HRV or HRC should be capable of being launched when normal power supply is unavailable.

In addition a life support package (LSP) should be kept at a suitable location from where it can reach the HRV/HRC within reasonable time (*Ref. IMO Guidelines and Specifications for Hyperbaric Evacuation Systems - Resolution A.692(17), IMCA Guidance for Hyperbaric Evacuation Systems* (under development), *IMCA D 027, IMCA D 004, IMCA D 024*).

8.5 Emergency Training

The diving contractor should develop generic emergency training scenarios and procedures. Trials should be carried out to train personnel and to test the adequacy of the procedures and equipment.

8.6 Diving Contractor's Contingency Centre

While in operation, the diving contractor should maintain, in immediate readiness, a contingency room with adequate communications facilities, all relevant documentation and other necessary facilities for the contingency team, in case of an emergency.

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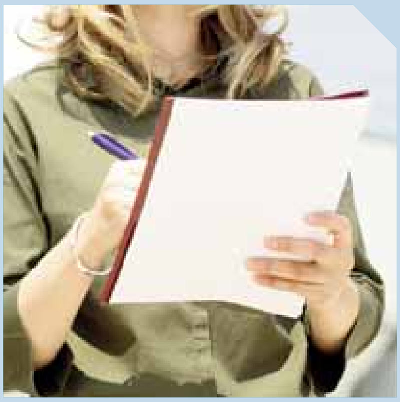

Documentation/Audits

9.1 Diving Project Plan

Before any diving is carried out there needs to be a diving project plan in place. See 7.1 for a list of documents and procedures it should contain.

9.2 Safety Management Systems Interface Documents

Prior to commencement of the project a safety management system interface document should be in place, which reflects and defines the safety management interface between client, diving contractor, sub-contractors and third parties. The document should include the relevant documentation and management systems of all parties involved as well as the responsibilities, communication protocol, emergency response, operational procedures and practices for managing health and safety during the project.

9.3 Adverse Weather Working Policy

The diving contractor should have guidelines and weather limits for working in adverse weather, written relative to the capability of the vessel or floating/fixed structure.

9.4 Risk Management Process

A risk management process should be in place (see also 7.2), including a risk management process matrix. This matrix should include the risk identification and management at all stages of the project, the personnel to be involved and the responsible person(s). Part of the risk management process is management of change.

9.5 Risk Assessment

A risk assessment should include the initial risk evaluation and risk level (e.g. high, medium, low) and, if required, further risk reducing measures and the residual risk level. Based on the risk assessment the decision on whether the work can go ahead safely and what precautions need to be taken can be made. The risk assessment should also identify onshore/offshore personnel responsible for ensuring the precautions agreed during the risk assessment are carried out.

9.6 Self Auditing/HAZOP/FMEA

Each diving contractor should have a process in place for self-auditing for their diving systems and equipment in accordance with IMCA guidelines. DP systems, vessels and ROV systems also need to be audited in accordance with IMCA guidelines.

Furthermore a systematic review of the diving system and its sub-systems should be carried out. This may take the form of a HAZOP. In addition an FMEA may be used to provide a systematic assessment for the identification of potential failure modes, to determine their effects and to identify actions to mitigate the failures (see also 4.4).

9.7 Management of Change

Each diving contractor should have in place a management of change procedure which describes what actions need to be taken if there is a need to revise an existing approved design, fabrication or work/installation procedure and how to manage change associated with unplanned events that may arise during the offshore works.

Normally a formal review of the change should take place to ensure that safety is not compromised.

When an offshore risk assessment is required senior personnel, typically the diving superintendent/offshore manager, vessel master, diving supervisor, project engineer and client should carry out this risk assessment. The contractor's management of change procedure needs to describe clearly the process to be followed, including the requirement for offshore and onshore reviews and risk assessments and who needs to give approval offshore and onshore both from the contractor and the client, for any revision or change. See also 7.2 (*Ref. IMCA S&L 001*).

9.8 Reporting and Investigation of Incidents

In order to learn from near-miss incidents and incidents and prevent them from happening again diving contractors should have a procedure in place for reporting and investigation of near-miss incidents and incidents. The findings of these investigations should allow the contractor to take the appropriate corrective actions (*Ref. IMCA SEL 016*).

IMCA operates an anonymised safety flash system for the dissemination of information on incidents and the lessons learned from them.

9.9 Equipment Certification and Planned and Periodic Maintenance

Guidance exists on the frequency and extent of inspection and testing required of all items of equipment used in a diving project, together with the levels of competence required of those carrying out the work (*Ref. IMCA D 018, IMCA D 004*). All of the equipment used in a diving operation will need to comply with at least these requirements. Suitable certificates (or copies) will need to be provided at the worksite for checking.

Diving equipment is used under offshore conditions, including frequent immersion in salt water. It therefore requires regular inspection, maintenance and testing to ensure it is fit for use, e.g. that it is not damaged or suffering from deterioration. Regular maintenance is an important factor in ensuring the safe operation of a diving system.

Diving contractors should give due consideration to recommendations given in manufacturers' maintenance manuals, amount of use, previous operational experience and guidance given in IMCA D 018 and IMCA D 004.

9.9.1 Use of Diving Equipment Checklists

Many complex action sequences are required during diving plant and equipment testing and maintenance and there is a risk that steps may be omitted or undertaken out of sequence. A suitable way to ensure the thoroughness of such sequences on each occasion is the use of pre-prepared checklists that require the relevant personnel to tick a box to demonstrate correct completion.

Diving contractors will need to prepare and authorize the use of such checklists. A typical equipment check is described below in outline format.

9.9.2 Pre- and Post-Dive Checks

Prior to diving commencing and after diving has been completed, a series of simple tests and examinations should be carried out by a competent person to confirm that equipment is in good condition. These checks should include:

- a brief visual and touch inspection prior to any power being turned on;
- examination of the system for cracks and dents, loose parts, unsecured wires or hoses, oil spots, discolouration, dirty camera lens etc.;
- brief operation of each function to ensure proper response;
- loose bolts or couplings should be tightened or, if necessary, replaced;
- all mechanical parts should be kept clean and lubricated;
- areas of potential corrosion should be examined and any necessary preventative or corrective measures undertaken;
- major mechanical components should be regularly checked for alignment and abrasion;
- the handling system should be checked for structural damage;
- electrical lines and connections should be examined and any hydraulic system inspected for leaks, abrasions and oil leaks. Fluid levels should be regularly checked;
- a function test should be performed on all brakes and latches.

9.10 Spare Parts

Diving operations are often undertaken in remote offshore areas. Diving contractors should therefore ensure that an adequate serviceable supply of spare items is available, particularly for those items which are essential to continued operation and safety.

Documents should be in place showing the items in stock, minimum stock levels and items on order.

9.11 Equipment and Certificate Register

An equipment register will need to be maintained at the worksite, with copies of all relevant certificates of examination and test as well as design specifications and calculations of the equipment (see also 4.14.3).

9.12 Operating Procedures

The operating procedures need to consist of a diving contractor's standard operating rules and any site-specific risk assessments and procedures. The procedures should cover the general principles of the diving techniques as well as the needs of the particular operation. They will also need to provide contingency procedures for any foreseeable emergency.

The management of a project should be clearly specified together with a defined chain of command.

Many factors need to be considered when preparing the procedures for a specific project. A risk assessment will need to identify site-specific hazards and their risks. Based on this information, the procedures will then need to state how these hazards and risks can be controlled. An exhaustive list of hazards and risks is not possible but some are highlighted in the previous sections (see also 7.1).

9.13 Manuals and Documentation

A major factor in a safe and efficient diving operation is the supply of a comprehensive set of manuals, checklists and logbooks appropriate to the operation. It is the responsibility of every contractor to ensure that each diving system is supplied with the necessary documentation including at least the following:

- contractor's operations manual;
- system equipment technical manuals;

- daily diary/report book;
- planned maintenance system;
- repair and maintenance record;
- systems spares inventory;
- pre-/post-dive checklist.

9.13.2 Reference Documentation

Diving contractors should be familiar with all relevant legislation for the areas in which they are operating and the various advisory publications relevant to diving operations. Some examples of the latter are listed in the bibliography at the end of this document.

9.14 Diving Operations Log

Diving contractors should ensure that a written record is kept on a daily basis of all the activities carried out and of any other relevant factors.

There is no specific format that this document should take. However, the following is the minimum information which should be recorded:

i) Name and address of the diving contractor;

ii) Date to which entry relates (an entry must be completed daily by each supervisor for each diving operation);

iii) Location of the diving operation, including the name of any vessel or installation from which diving is taking place;

iv) Name of the supervisor making the entry and date on which the entry is made;

v) Names of all those taking part in the diving operation as divers or other members of the dive team;

vi) Any codes of practice which apply to the diving operation;

vii) Purpose of the diving operation;

viii) Breathing apparatus and breathing mixture used by each diver in the diving operation;

ix) Bail-out pressure and content;

x) Decompression schedule containing details of the pressures (or depths) and the duration of time spent by divers at those pressures (or depths) during decompression;

xi) Emergency support arrangements;

xii) Maximum depth which each diver reached;

xiii) Times at which the divers leave atmospheric pressure and return to atmospheric pressure plus their bottom times;

xiv) Any emergency or incident of special note which occurred during the diving operation, including details of any decompression illness and the treatment given;

xv) Any defect recorded in the functioning of any plant used in the diving operation;

xvi) Particulars of any relevant environmental factors during the operation such as partial pressure oxygen, CO_2, water temperature as appropriate;

xvii) Toolbox meetings and job safety analyses carried out;

xviii) Management of change applied offshore to revise a procedure;

xix) Near-miss and incident reporting;

xx) Any other factors likely to affect the safety or health of any persons engaged in the operation.

9.15 Divers' Personal Logbooks

Divers need to keep a detailed daily record of any dives they have carried out. There are various hard bound logbooks available for this purpose, including those published by IMCA. However, any suitable logbook can be used. The following is the minimum information which needs to be entered in the diver's logbook:

i) Name of diver;

ii) The name and address of the diving contractor;

iii) The date to which the entry relates (an entry must be completed daily for each dive carried out by the diver);

iv) The name or other designation and the location of the installation, worksite, craft or other place from which the diving operation was carried out;

v) The name of the supervisor who was in control of a diving operation in which the diver took part;

vi) The maximum depth reached on each occasion;

vii) The time the diver left the surface, the bottom time, and the time the diver reached the surface on each occasion;

viii) Where the dive includes time spent in a compression chamber, details of any time spent outside the chamber at a different pressure;

ix) The type of breathing apparatus and mixture used by the diver;

x) Any work done by the diver on each occasion, and the equipment (including any tools) used in that work;

xi) Any decompression schedules followed by the diver on each occasion;

xii) Any decompression illness, discomfort or injury suffered by the diver;

xiii) Any other factor relevant to the diver's safety or health;

xiv) Any emergency or incident of special note which occurred during the dive.

The entry must be dated and signed by the diver and countersigned by the supervisor.

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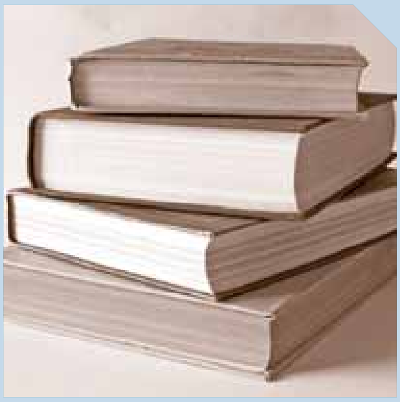

Bibliography/References

The following is a list of documents which give more detailed information on subjects covered in this code.

Further details on all IMCA/AODC/DMAC publications and their latest revisions are available from IMCA (www.imca-int.com). DMAC publications are also available as free downloads from www.dmac-diving.org

IMCA publications issued under AODC:

AODC 009 *Emergency isolation of gas circuits in the event of a ruptured bell umbilical*
AODC 012 *Bell emergency location equipment trials*
AODC 014 *Minimum quantities of gas required offshore*
AODC 016 *Marking and colour coding of gas cylinders, quads and banks for diving applications*
AODC 019 *Emergency procedures – provisions to be included for diving bell recovery*
AODC 020 *Length of divers' umbilicals from diving bells*
AODC 026 *Diver emergency heating*
AODC 028 *Diver's gas supply*
AODC 031 *Communications with divers*
AODC 032 *Remotely operated vehicle intervention during diving operations*
AODC 034 *Diving when there is poor surface visibility*
AODC 035 *Code of practice for the safe use of electricity under water*
AODC 037 *Periodic examination of bail-out bottles*
AODC 038 *Guidance note on the use of inert gases*
AODC 039 *Emergency air bottles in diving baskets*
AODC 047 *The effects of underwater currents on divers' performance and safety*
AODC 048 *Offshore diving team manning levels*
AODC 049 *Code of practice for the use of high pressure water jetting equipment by divers*
AODC 054 *Prevention of explosions during battery charging in relation to diving systems*
AODC 055 *Protection of water intake points for diver safety*
AODC 061 *Bell ballast release systems and buoyant ascent in offshore diving operations*
AODC 064 *Ingress of water into underwater cylinders charged by means of a manifold system*

IMCA Diving Division publications:

IMCA D 002 *Battery packs in pressure housings*
IMCA D 003 *Oxy-arc cutting operations underwater*
IMCA D 004 *The initial and periodic examination, testing and certification of hyperbaric evacuation launch systems*
IMCA D 006 *Diving operations in the vicinity of pipelines*
IMCA D 007 *Overboard scaffolding operations and their effect on diving safety*
IMCA D 010 *Diving operations from vessels operating in dynamically positioned mode*

IMCA D 013	*IMCA Offshore diving supervisor and life support technician certification schemes*
IMCA D 015	*Mobile/portable surface supplied systems*
IMCA D 016	*Underwater air lift bags*
IMCA D 018	*Code of practice on the initial and periodic examination, testing and certification of diving plant and equipment*
IMCA D 019	*Diving operations in support of intervention on wellheads and subsea facilities*
IMCA D 021	*Diving in contaminated waters*
IMCA D 023	*Diving equipment systems inspection guidance note (DESIGN) for surface orientated (air) diving systems*
IMCA D 024	*DESIGN for saturation (bell) diving systems*
IMCA D 025	*Evacuation of divers from installations*
IMCA D 027	*Marking of hyperbaric rescue systems designed to float in water*
IMCA D 028	*Guidance on the use of chain lever hoists in the offshore subsea environment*
IMCA D 030	*Surface supplied mixed gas diving operations*
IMCA D 031	*Cleaning for oxygen service: Setting up facilities and procedures*
IMCA D 033	*Limitations in use of SCUBA offshore*
IMCA D 035	*The selection of vessels of opportunity for diving operations*
IMCA D 037	*DESIGN for surface supplied mixed gas diving systems*
IMCA D 039	*FMEA guide for diving systems*
IMCA D 040	*DESIGN for mobile/portable surface supplied systems*
IMCA D 041	*Use of battery-operated equipment in hyperbaric conditions*
TBA	*Guidance for hyperbaric evacuation systems* (under development)

IMCA Diving Division information notes:

IMCA D 05/07	Diver and diving supervisor certification

IMCA Marine Division publications (including those issued under DPVOA):

IMCA M 103	*Guidelines for the design and operation of dynamically positioned vessels*
108 DPVOA	*Power system protection for DP vessels*
113 IMO	*Guidelines for vessels with dynamic positioning systems* (MSC Circular 645)
115 DPVOA	*Risk analysis of collision of dynamically positioned support vessels with offshore installations*
IMCA M 117	*The training and experience of key DP personnel*
127 DPVOA	*Guidelines to the issue of a flag state verification acceptance document*
IMCA M 139	*Standard report for DP vessels' annual trials*
IMCA M 140	*Specification for DP capability plots*
IMCA M 149	*Common marine inspection document*
IMCA M 166	*Guidance on failure modes and effect analyses (FMEAs)*
IMCA M 175	*Operational communications: Part 1 - Bridge and dive control*
IMCA M 178	*FMEA management guide*
IMCA R 004	*Code of practice for the safe and efficient operation of remotely operated vehicles*

IMCA Safety, Environment & Legislation (SEL) publications:

IMCA S&L 001	*Guidance for the management of change in the offshore environment*
IMCA SEL 016	*Guidance on the investigation and reporting of incidents*

IMCA Training, Certification & Personnel Competence (TCPC) publications:

IMCA C 002	*Competence assurance and assessment - Guidance document and competence tables – Marine Division*
IMCA C 003	*Competence assurance and assessment - Guidance document and competence tables – Diving Division*

Publications of the Diving Medical Advisory Committee (DMAC):

DMAC 01	*Aide mémoire for recording and transmission of medical data to shore*
DMAC 02	*In water diver monitoring*
DMAC 03	*Accidents with high pressure water jets*
DMAC 04	*Recommendations on partial pressure of O_2 in bail out bottles*
DMAC 05	*Recommendations on minimum level of O_2 in helium supplied offshore*
DMAC 06	*The effect of sonar transmissions on commercial diving activities*
DMAC 07	*Recommendations for flying after diving*

DMAC 11	*Provision of first aid and the training of divers, supervisors and members of dive teams in first aid*
DMAC 12	*Safe diving distance from seismic surveying operations*
DMAC 13	*Guidance on assessing fitness to return to diving after decompression illness*
DMAC 15	*Medical equipment to be held at the site of an offshore diving operation*
DMAC 17	*The training and refresher training of doctors involved in the examination and treatment of professional divers*
DMAC 21	*Guidance on the duration of saturation exposures and surface intervals between saturations*
DMAC 22	*Proximity to a recompression chamber after surfacing*
DMAC 28	*Provision of emergency medical care for divers in saturation*

International Maritime Organization (IMO) documents:

IMO Resolution A.831(19)	*IMO code of safety for diving systems*
IMO Resolution A.692(17)	*IMO guidelines and specifications for hyperbaric evacuation systems*
IMO MSC/Circ.645	*Guidelines for vessels with dynamic positioning systems*

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Country-Specific Appendices

The following country specific appendices are currently in place:

- IMCA D 12/05 – *Gulf of Mexico Annex*
- IMCA D 08/00 – *Middle East Appendix*
- IMCA D 03/99 – *UK Appendix*