days was located at the Australian Institute of Marine Science (AIMS). Thirteen of these required evacuation, the remaining eight presented after completion of the trip and the vessel’s return to Cairns, some time after their last dive.

Reports from the chamber indicated that, with few exceptions, these incidents were of a minor nature. Of the 21 cases, three were suffered by staff members, giving an incidence of three cases per 30,000 staff dives, or one per 10,000.

There were eighteen incidents in non-staff divers, giving a ratio of eighteen incidents in 276,000 dives or one per 15,300 dives.

In the period 1990 to date, we have had four cases of DCI, all requiring evacuation from Cairns. These were all non-staff injuries. In this period staff conducted 25,000 dives. It should be noted however, that our instructors were, until January 1993, doing as many as 50 ascents on any one three day trip and most of these were in rapid succession. After January 1993, the number has been reduced to a maximum of twenty ascents on any three day trip. These ascents are generally conducted in eight to ten m of water.

The four non-staff injuries were incurred during a total of 230,000 dives, giving a ratio of one per 57,500, an improvement of nearly 400%.

We can attribute this improvement in results to:
1. Strict adherence to “deepest dive first”. This policy is enforced by a mandatory break of a minimum of 12 hours out of the water for any deviation from this basic policy.
2. A limiting of maximum depth for certified divers, unless under direct supervision or training, to 30 m.
3. Limiting alcohol intake and encouraging more rest. We actively discourage partying on board during trips.
4. We now calculate and check all dive profiles and ensure compliance with “no decompression” table limits on each dive.
5. Any accidental entry into decompression is penalised by a minimum of six hours out of the water, depending on the severity.

In summary, we feel that the improved basic safe diving principles we have introduced in the last five years have significantly improved our safety record.

While we are not qualified, and have no intention of trying, to draw medical conclusions from these limited statistics, we feel that it is vitally important to put these statistics forward as actual data for consideration and evaluation by this group.

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A CASE FOR SAFETY

Phil Percival

Australian regulatory structure

Australian offshore production operations are at present conducted in the States of Western Australia and Victoria, and in the Northern Territory. Those operations located within State waters are under State jurisdiction, whilst operations in Federal waters, generally beyond 3 nautical miles from land, are covered by Federal jurisdiction but controlled by the adjacent State authorities on behalf of the Federal Government. The effect of this arrangement is to provide uniform offshore petroleum legislation throughout Australia.

Offshore facilities

Australia has a wide range of offshore production facilities which include Northern North Sea style platforms such as North Rankin A and Goodwyn A, smaller Southern Gasfields type platforms in the Bass Strait and floating production and storage vessels like those in the Timor Sea. There are also a variety of unmanned platforms and jack-up rigs serving as production platforms. As the development trends take us into deeper waters, new and cost effective methods of hydrocarbons recovery will be found. The use of concrete platforms has already been introduced in the Bass Strait, and is being examined in Western Australia. Large gas fields are awaiting favourable economic conditions for further development on the North West Shelf.

Piper Alpha, a catalyst for change

The Piper Alpha offshore production platform disaster in the North Sea was a catalyst for a significant
rethink on safety in the offshore petroleum environment. Lord Cullen’s UK public enquiry made 106 recommendations directed at the improvement of safety, and many of these were aimed at management of safety rather than hardware. It was Lord Cullen’s view that operators appeared to have safety systems in place but that the management of them was lacking. A quick review of Piper Alpha will help us to focus on this view.

At about 10 p.m. on 6 July 1988 an explosion occurred in the gas compression module on the Piper Alpha platform, 176 km north east of Aberdeen. This initial explosion put the main control room and main power supplies out of action and caused extensive damage to hydrocarbon processing equipment. It was followed immediately by a large fire in the oil separation module, which gave rise to a massive plume of black smoke which engulfed the north end of the platform. This fire was fed by oil from the platform and a leak in the main oil line to the shore, to which the pipelines from the Claymore and Tartan platforms were connected.

At about 10.10 p.m. there was a second major explosion which caused a massive intensification of the fire. This was due to the rupture of the gas pipeline from Tartan. Ruptures of risers on the gas disposal pipeline to Frigg and the gas pipeline connecting Piper with Claymore further intensified the fire on Piper.

There is evidence that the emergency shutdown system was activated and emergency shutdown valves on the gas pipeline risers probably closed, although extended flaring pointed to the failure of a valve on the Claymore riser to close fully. The other emergency systems on the platform failed immediately or within a short period of the initial explosion. In particular, the fire water system was rendered inoperative either due to physical damage or loss of power. At the time of the initial explosion the diesel fire pumps could not be started remotely as they were in manual mode.

The platform structure collapsed as a result of the explosions, initially forcing men to jump into the sea out of shelter on the pipe deck. The east quarters module lost its structural support and tipped to the west, crushing the west quarters module, and then tipped northwards into the sea. Between 10.30 p.m. and 12.15 am. the centre of the platform collapsed. The risers from the gas pipelines and the main oil pipeline were torn apart. The north side of the platform slowly collapsed until the additional accommodation module slipped into the water.

There were 226 men on the platform at the time. Sixty two were on nightshift duty while the remainder were in the accommodation. The system for control in the event of a major emergency was rendered almost entirely inoperative, smoke and flames outside the accommodation made evacuation by helicopter or lifeboat impossible.

Diving personnel on duty escaped to the sea along with other personnel on duty at the northern end and the lower levels of the platform. Other survivors who were on duty made their way to the accommodation, and a large number of men congregated near the galley on the top level of the accommodation. Conditions there were tolerable at first, but deteriorated greatly owing to the entry of smoke. A number of personnel, including 28 survivors, reached the sea by use of ropes and hoses or by jumping off the platform at various levels. At no stage was there a systematic attempt to lead men to escape from the accommodation.

To remain in the accommodation ultimately meant certain death. Sixty one persons from Piper survived. Thirty nine had been on night shift and 22 had been off duty. One hundred and thirty five bodies of the 165 persons who died were later recovered. The principal cause of death in 109 cases (including 79 recovered from the accommodation) was inhalation of smoke. Fourteen apparently died in an attempt to escape from the platform. Few died of burns. Two members of the crew of a fast rescue craft were also killed.

Piper Alpha had a permit to work system but it was not being used correctly, there were fire-pumps but they were isolated from automatic start-up, there were emergency procedures but they did not work and there was management but it did not function effectively. To cap it off there was a regulatory authority that did not have the incentive to effectively administer offshore safety.

Lord Cullen recommended that offshore petroleum operators should be required to demonstrate their commitment to safety through the preparation of a Safety Case. He considered that the responsibility for offshore safety should be put more clearly on the companies rather than the regulator.

In Australia the Commonwealth and State governments, industry and unions formed a tripartite committee known as COSOP to monitor the outcome of the UK enquiry, and to assess the applicability of the Cullen recommendations to the Australian offshore industry. The Safety Case concept was unanimously adopted and has been legislated in Australia for new offshore installations. Similar requirements for existing installations and MODUs (mobile off-shore drilling units) will be effective no later than 1st July 1996.

The Safety Case

So what is a Safety Case and what implications does it have for the diving industry?

A Safety Case is the formal means by which an operator demonstrates to the regulator that he has
identified all of the major hazards that could potentially affect his installation, that he has taken steps to eliminate or mitigate the risk of those hazards becoming reality, and has a safety management system which is designed to deal with any residual risk, including ongoing identification of new hazards.

The Safety Case is a living document that is conceived at design, has a life cycle through construction, installation and operation, and terminates after abandonment.

Let us us look at the essential elements of a Safety Case. There are three key elements:-

- General description;
- Formal safety assessment; and
- Safety management system.

The general description is a comprehensive document with supporting drawings covering installation location, environmental conditions, design basis, codes and standards, etc. Enough to give the assessors an understanding of the total project.

Formal safety assessment is a methodical identification of hazards, an assessment of consequences and an analysis of probabilities. It may be done qualitatively, quantitatively or both! It is used to demonstrate to the regulator and to the operator that risks have been reduced to as low as reasonably practicable. This may be done by some form of cost benefit analysis.

In layman’s terms the formal safety assessment will tell us what could go wrong, why it will not go wrong and if it does go wrong what will be done to minimise loss.

The third element of the Safety Case is the safety management system. This is the system that will ensure that residual risk, that is the risk that cannot be engineered out, will be managed in a way that reduces risk to personnel to a level that is as low as is reasonably practicable or ALARP.

A typical safety management system contains these sub-elements and most of you will be familiar with them:-

- Safety policy and objectives
- Organisation and responsibilities
- Procedures for design, construction, modification, maintenance and operations
- Management of contractors
- Employee involvement
- Personnel standards, recruitment and training
- Emergency response system
- Incident reporting and investigation
- Performance review and audit

**Practical implications**

One of the major practical implications of the new regime is to move away from prescriptive legislation towards objective setting legislation. The roles of the regulator will be to work with the operators in preparing their Safety Cases, assess Safety Cases, and audit Safety Cases. From a regulatory point of view it is seen as consultative until the Safety Case is approved, and inspectorial after approval. The significant difference being a move towards self-regulation and the removal of constraints that impede the application of technological change to design and operation.

Another important practical implication is the tripartite process. Government is seeking to ensure that employees are participating effectively in the new regime. Participation does not just mean information giving, it also means active involvement in identifying occupational health and safety risks, and in the implementation of control measures to reduce those risks to a reasonably practicable level.

In summary those things that were previously taken for granted are now required to be demonstrated to employers, employees and government. Note the word “demonstrated”. Not described but demonstrated. This means that those operations, maintenance, safety and emergency procedures manuals that were previously gathering dust on the shelves must now be actively implemented, monitored, audited and improved in a quality managed way. It also means that design engineers, who previously referred to codes and standards, can to a certain extent use a more entrepreneurial approach but will be held accountable for not just the end results, but also for the ongoing results.

In respect to the diving industry the major impact comes from the interface between diving/marine and petroleum operations in areas such as supply vessels, standby craft, construction barges, diving support vessels, MODUs, FPSOs (floating processing, storage and off-loading facilities) and shuttle tankers. Where these vessels are operating on petroleum sites, the title holder is responsible for including their operational safety interfaces in his Safety Case. As an example, if a Diving Support Vessel (DSV) is to be located alongside a production platform for a work program then new potential hazards are being introduced, and more people are being exposed to them. This scenario will require the diving/marine operator to prepare a vessel/diving Safety Case/Report, and the production operator to prepare a bridging document which links the two operations together and demonstrates that risk has been reduced to as low as reasonably practicable.
The way ahead

Increasing offshore oil and gas production levels present new challenges to our industry. Let us examine some of these using the benefits of experience gained in other parts of the world where similar growth has taken place.

First the aviation industry. It is well known that helicopter travel represents a significant proportion of risk to those who travel offshore. In the United Kingdom this has been learned from bitter experience with helicopter accidents claiming many lives. Here we have been more fortunate but nevertheless lives have been lost. Our superior weather conditions and relatively short runs reduce the risk significantly. However this tranquil picture is sometimes broken by the need for mass evacuation during cyclone conditions. This is the time when the operation is most at risk. Fast turnarounds, full payloads, deteriorating weather conditions and the absence of marine rescue craft as they head for shelter.

Another potential risk that can creep up slowly on the aviation industry is gradual change brought about through development. More flights, platforms further away from shore, more variety in heli-decks and operational procedures. To overcome this problem area the WA Department is seeking to work with the Civil Aviation Authority in conducting a joint audit of all offshore helicopter operations in the second half of this year.

A second area that needs to keep pace with offshore growth is the preparedness of State emergency services to deal with a major offshore emergency. In Western Australia arrangements for State emergency response plans are the responsibility of the Police Commissioner through the State Emergency Management Advisory Committee (SEMARC). This Committee recently approved the review and overhaul of State plans for the offshore industry taking into account new and planned facilities, national resources and stake holders. Mutual aid is also being encouraged as an essential ingredient to robust major emergency response planning similar to the North Sea sector clubs. It must, of course, be remembered that the operator is always responsible for the safety of his personnel until they are transferred to a “place of safety”. A place of safety in this context means a place where normal services, including medical attention, are restored.

Diving operations represent another significant risk area and are a major challenge to industry. Currently diving is strictly regulated through prescriptive directions issued by the Department under the Petroleum (Submerged Lands) Act. In keeping with the new Safety Case regime there is a requirement to replace prescriptive regulations with objective setting regulations. The challenge here is for the diving industry to demonstrate that it is capable of self-regulation through the introduction of management systems that set out to continuously improve safety.

In Australia, and in Western Australia particularly, we have an enormous future in the offshore hydrocarbons industry. Along with an increase in production must come an increase in professionalism at every level and across the spectrum of the petroleum, aviation, diving, maritime and offshore construction industries. There is still something of the Wild West out there which, while it has been admirable in forming part of our special pioneering history, is not applicable to 21st century technology.

Today we are striving to “manage risks” not “take risks”.

Phil Percival works within the West Australian Department of Minerals and Energy, Petroleum Division Safety Branch as an Occupational Health and Safety Assessor. He has three primary portfolios under his care: Inspector of Diving WA, Chairman of the State Emergency Management Advisory Committee on Emergencies in the Offshore Petroleum Industry and Safety Case Manager for the Woodside Offshore Petroleum Goodwyn A Platform. He commenced working in the offshore industry in 1975 and progressed through the ranks as a Diver/Paramedic, Life Support Supervisor and Safety Trainer working in the North Sea, New Zealand, Borneo, India, Vietnam and Australia. His address is Petroleum Operations Division, Safety Branch, Department of Minerals and Energy, 100 Plain Stree, East Perth, Western Australia 6004.

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