

# SAFETY CASES AND CERTIFICATION IN THE PROPOSED NEW ZEALAND OFFSHORE PETROLEUM REGULATORY REGIME

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## Abstract

Until 1 April 1993 the offshore petroleum industry in New Zealand was principally regulated by the Petroleum Act 1937 and the Petroleum Regulations 1978. On 1 April 1993 the Health and Safety in Employment Act 1993 came into force. This Act emphasises the need for employers to take all practicable steps to protect employees from possible sources of harm. Safety management systems are an essential element in reducing the risk of an employee's exposure to harm. New draft Petroleum Regulations propose to regulate the offshore petroleum industry using a combination of safety cases and certification although prescriptive regulations are still used in relation to critical areas such as casing setting depths.

## Introduction

The Piper Alpha disaster of the 6 July 1988 resulted in the deaths of 165 of the 225 persons on board the platform and two of the crew of the fast rescue craft deployed after the accident. The findings of the public inquiry conducted by Lord Cullen were published in 1990 in the HMSO report "The Public Inquiry into the Piper Alpha Disaster". The report contained 105 recommendations. These can be divided into broad groups with the following aims:

- introduction of safety cases
- introduction of goal-setting legislation
- provision of single regulatory agency for offshore safety with a specialist Inspectorate
- involvement of the workforce in the development of safety systems
- integration of the permit to work system into the safety management system
- maintenance of an incident database
- provision of an appropriate temporary safe refuge
- provision of appropriate means for evacuation, escape and rescue
- providing by regulation for appropriate totally enclosed motor-propelled survival craft, standby vessels, and personal survival and escape equipment
- providing adequate training in emergency procedures

## Legislation

### General

Until 1 April 1993 health and safety aspects of offshore petroleum exploration activity were regulated under the Petroleum Act 1937 and Petroleum Regulations 1978. On 1 April 1993 the Health and Safety in Employment Act 1992 (HSEA) revoked the safety application of the Petroleum Act to petroleum exploration activities for which licences had been issued prior to 1 October 1991 when the Crown Minerals Act 1991 (CMA) came into force. The safety

application of the Petroleum Act to all remaining petroleum exploration activities was finally removed with an amendment to Section 107 of the CMA which received Royal Assent on the 28 September 1993. Since that time petroleum offshore exploration activity has been under the jurisdiction of the HSEA. Draft Petroleum Regulations have been formulated following consideration of both the Australian and UK regulatory regimes and consultation with major industry participants. Regulations are expected to be promulgated under the HSEA in 1994. The Draft Petroleum Regulations require the keeping of both certification and safety case documentation to ensure compliance with the proposed regulatory regime.

### Health and Safety in Employment Act 1992

The HSEA is applicable to nearly all places of work including offshore petroleum production and exploration activities. The HSEA uses a three-fold approach to maintaining acceptable standards of health and safety. Two proactive approaches use responsibilities of persons in the place of work and the development of regulations incorporating safety cases. The final reactive approach involves enforcement.

Responsibilities are placed on almost everyone in the place of work.

Employers have the most onerous duties. An employer is defined in the HSEA as "a person who or that employs any other person to do any work for hire or reward..". Employers are required to:

- take all practicable steps to ensure the safety of employees while at work
- ensure effective methods are in place for identifying and either eliminating, isolating or minimising hazards as they may affect employees
- provide employees with information on monitoring of hazards in the place of work
- identify hazards and provide sufficient training to prevent harm to the employee or any other person

- involve employees in the development of health and safety procedures

Owners, lessees, occupiers, self-employed persons, principals and employees are also required to ensure that all practicable steps are taken to prevent harm to any person. "Approved codes of practice" can be adopted under the HSEA. These codes contain statements of preferred work practices and may be adopted following consultation and notification of interested parties. Finally enforcement is undertaken by Inspectors.

The maximum penalty for a deliberate breach of the HSEA which is likely to cause serious harm is NZ\$100 000 and one year's imprisonment. An unintentional breach that causes serious harm can incur a fine of up to NZ\$50 000. Serious harm includes permanent loss of bodily function, amputation of a body part, loss of consciousness, or hospitalisation for more than 48 hours.

Proactive penalties available to Inspectors include improvement and prohibition notices, the serving of which may be appealed to a District Court. An appeal operates as a stay of notice.

#### Development of Draft Petroleum Regulations

The existing Petroleum Regulations rely mainly on the following regulatory instruments to ensure that health and safety in the workplace meets acceptable standards, for example in the case of offshore petroleum exploration:

- specification of casing and blowout prevention equipment
- specification of personal safety equipment, criteria for effective evacuation and signage
- certification of structural components and lifesaving equipment by certifying agencies acceptable to the Secretary
- designation of the positions of person-in-charge and evacuation officer as statutory positions to be held by persons with suitable qualifications
- inspection of fire-fighting systems
- designation of Institute of Petroleum Model Codes of Safe Practice or other codes acceptable to the Chief Petroleum Inspector as sound and accepted engineering practice

The Draft Petroleum Regulations, which are designed to be promulgated under the HSEA, were drafted following detailed consideration of

- "The Public Inquiry into the Piper Alpha Disaster" (Cullen 1990)
- "Draft Offshore Installations (Safety Case) Regulations" (Health and Safety Commission 1992)
- Australian "Report of the Consultative Committee on Safety in the Offshore Petroleum Industry", (Department of Primary Industries and Energy 1991)

The Draft Petroleum Regulations minimise the number of Inspectorate approvals and monitoring information required while providing for the Inspectorate to ensure that adequate safety systems are in place to protect persons from serious harm.

Internationally recognised codes such as the Institute of Petroleum "Drilling and Production Code for Offshore Operations" have been adopted into the regulations with a schedule to the regulations containing a list of codes to be used in the event that the principal code is not applicable or contains insufficient detail on sound and accepted engineering practice (refer Appendix 1).

A number of other significant changes were also made to the regulations. These included:

- abolishing Inspectorate approvals for well designs but requiring notification to the Inspectorate of relevant information
- requiring approval of safety cases prior to operation or abandonment of an installation except in some instances relating to well-drilling operations (refer Appendix 2)
- more comprehensive certification covering all equipment and including consideration of design, construction, operation and abandonment (refer Appendix 3)
- requiring temporary safe refuge for manned installations
- more comprehensive provision of life-saving equipment particularly immersion suits, torches, smoke hoods and fireproof gloves
- requiring standby vessels with effective search and rescue equipment
- improved identification of installations

The overall effect of the implementation of the HSEA and the Draft Petroleum Regulations is clearly defined spheres of accountability and standards. Functional responsibilities are outlined in table 1.

## Safety Cases

### General

The requirements for safety cases in the Draft Petroleum Regulations have been designed to be consistent with international practice. This has been achieved by liaising closely with the Offshore Safety Division of the Health and Safety Executive in Great Britain and participating in the Australian National Safety Case Working Group. This group was established by the Department of Primary Industry and Energy with the aim of ensuring that nationally uniform standards are maintained in relation to the assessment of safety cases.

The DPR makes provision for two safety cases. The first covers design, installation, construction, operation and maintenance activities. The second covers abandonment operations.

### Information

Principal information necessary in order to effectively formulate the safety case is a schedule and layout of plant, materials and equipment; quality assurance information for design, manufacture, installation and operation of plant, materials and equipment; details of the safety management system and statistical data (where possible) for component and process failure such as that detailed in the World

Table 1. Functional responsibilities.

Position	Responsibility
Employer	Hazard detection and mitigation. Employee information.
Principal, owner, occupier, person who controls the place of work	Ensure sound work practice complied with on site.
Certifying authority	Inspection to approved standards.
Inspectors	Auditing of certifying agents and installations. Approval of safety cases.

Offshore Accident Database maintained by Det Norske Veritas.

### Documentation

Key elements of the safety case document are:

- description of facilities
- description of safety management system with the permit to work system including: policy and objectives; organisation and responsibilities; planned inspections; task analysis and procedures; personnel standards and training; employee involvement; contractors and services; engineering controls; group meetings; emergency preparedness; accident/incident investigation and analysis; and programme evaluation system
- formal safety assessment (FSA):
- recommendations for installation modifications and review of the safety case where appropriate

### Formal safety assessment

Critical risk assessment parameters used during the FSA include:

IRPA — the individual risk per annum of harm or death depending on context. Note that it does not in itself state how many injuries may occur on any one operation. Typical ranges of the IRPA for death for work related activities are  $1 \times 10^{-3}$  to  $1 \times 10^{-6}$ . The figure for IRPA in the offshore petroleum sector in the last 10 years is about  $1 \times 10^{-3}$  (Pape 1993)

PLL — the potential loss of life which is statistically likely to occur during the course of the project

CBA — cost benefit analysis which assess the costs of losses against the benefits of the expenditure for modifications

ICAF — the individual cost per avoided fatality is a qualitative parameter which sets an arbitrary financial limit on expenditure required to prevent the death of an individual.

The following steps are advisable in order to demonstrate by way of FSA that any one particular installation meets health and safety employment requirements by taking all practicable steps to protect employees from harm. Note that where inadequate statistical information exists a larger degree of engineering judgement will need to be exercised in finalising an installation configuration for which all practicable steps have been taken to minimise harm to employees.

1. Identify hazard and operability studies.
2. Conduct hazard analysis or failure modes, effects and criticality analysis.
3. Eliminate, isolate and minimise within budget constraints and repeat step 2 following process modifications if necessary.
4. Where appropriate assemble statistical data to assist in the identification of high risk operations.
5. Apply quantitative risk assessment where practicable to critical areas such as evacuation, escape and rescue, temporary safe refuge, fire and gas protection systems, emergency shutdown systems, blowdown facilities, emergency power supplies, emergency communication and alarm systems. Configure to recognised industry standards where appropriate.
6. Identify the individual risk of death per annum (IRPA) and potential for loss of life (PLL) against a benchmark IRPA typically  $4 \times 10^{-4}$ . This figure is based on accepted occupational and travel risks of about  $3 \times 10^{-4}$  along with minimum hydrocarbon event contribution of  $1 \times 10^{-4}$  (Kennedy 1993).

7. Apply cost benefit analysis to areas where budget constraints may apply. A typical figure for the Individual cost per avoided fatality may be NZ\$15 000 000 (Kennedy 1993). Where the figure is in excess of this then step 2 should be repeated to ensure that the most cost-effective means of reducing the risk of harm has been found.

8. Summarise IRPAs and PLLs for final platform configuration

### Other factors

In assessing the adequacy of the safety case the Inspectorate would evaluate documentation supporting the key elements described above and would also examine the following aspects:

- Consultation with the workforce or representatives to ensure that all practicable steps have been taken to protect employees from harm.
- Company commitment to ensure that the risk of harm to employees has been minimised and not assessed against a predetermined risk level.
- Formal programme of review to ensure that the safety case is updated in line with project developments.

### Certification

Certification is retained in the Draft Petroleum Regulations to emphasise accountability and maintain an effective audit trail. Certification is an integral part of the formulation of the safety case and requires that each component or process be certified as complying either with a recognised code or with sound and accepted engineering practice (Appendix 3).

### Conclusion

The proposed promulgation of new Petroleum Regulations under the Health and Safety in Employment Act 1992 will require safety cases to be formulated for offshore installations. The Regulations propose to retain a certification requirement for all aspects of the installation to maintain clear accountability for the implementation of sound and accepted engineering practice.

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## Appendix 1: Codes of Practice

Institute of Petroleum Model Code of Safe Practice in the Petroleum Industry —

Part 4 "Drilling and Production Safety Code for Onshore Operations" 1986.

Part 8 "Drilling and Production Safety Code for Offshore Operations" 1990.

Part 15 "Area Classification Code for Petroleum Installations" 1990.

International Maritime Organisation "Code for the Construction and Equipment of Mobile Offshore Drilling Units" 1989.

International Maritime Organisation "International Convention for the Safety of Life at Sea" 1991.

The following codes are from the American Petroleum Institute:

RP2C Specification for Offshore Cranes — March 1988.

RP2D Recommended Practice for Operation and Maintenance of Offshore Crane — June 1984.

RP2I Recommended Practice for In-Service Inspection of Mooring Hardware for Floating Drilling Units — May 1987.

SPEC2F Specification for Mooring Chain — Oct 1988.

RP2I Recommended Practice for In-Service Inspection of Mooring Hardware for Floating Drilling Units — May 1987.

RP2L Recommended Practice for Planning, Designing and Constructing Heliports for Fixed Offshore Platforms — Jan 1986.

RP2P Recommended Practice for the Analysis of Spread Mooring Systems for Floating Drilling Units — May 1987.

RP2Q Recommended Practice for Design and Operation of Marine Drilling Riser Systems — April 1984.

RP2R Recommended Practice for Design Rating and Testing of Marine Drilling Riser Couplings — May 1984.

RP2X Recommended Practice for Ultrasonic Examination of Offshore Structural Fabrication and Guidelines for Qualification of Ultrasonic Technicians — Sept 1988.

SPEC4E Specification for Structures Drilling and Well Servicing Structures — June 1988.

SPEC4F Specification for Drilling and Well Servicing Structures — May 1985.

RP4G Recommended Practice for Maintenance and Use of Drilling and Well Servicing Structures — Jan 1992.

RP5C1 Recommended Practice for Care and Use of Casing and Tubing — May 1988.

SPEC6A Specification for Valves and Wellhead Equipment — Oct 1989.

SPEC7 Specification for Rotary Drilling Equipment — Aug 1990

SPEC8A Specification for Drilling and Hoisting Equipment — May 1985.

RP8B Recommended Practice for Hoisting Tool Inspection and Maintenance Procedures — Jan 1990.

RP9B Recommended Practice on Application, Care and Use of Wire Rope for Oil Field Services — May 1986.

Spec 14A Specification for Subsurface Safety Valve Equipment — Jan 1988.

RP14B Recommended Practice for Design, Installation, Repair and Operation of Subsurface Safety Valve Systems — Jan 1990.

SPEC16A Specification for Drill Through Equipment — Nov 1986.

RP16E Recommended Practice for Design of Control Systems for Drilling Well Control Equipment — Oct 1990.

RP17A Recommended Practice for Design and Operation of Subsea Production Systems — Sept 1987.

RP53 Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells — May 1984.

RP54 Recommended Practices for Occupational Safety for Oil and Gas Well Drilling and Servicing Operations — Dec 1991.

RP57 Recommended Practices for Offshore Well Completion Servicing, Workover and Plug and Abandonment Operations — Jan 1986.

RP59 Recommended Practices for Well Control Operations — Aug 1987.

RP62 Recommended Practices for Evaluation of MODU Emergency Power Systems and Fire Protection Systems — Oct 1988.

RP64 Recommended Practices for Diverter Systems Equipment and Operations — July 1991.

RPT-1 Recommended Practice for Orientation Programme for Personnel going Offshore for the First Time — Oct 1990.

RPT-6 Recommended Practice for Training and Qualification of Personnel in Well Control Equipment and Techniques for Completion and Workover Operations on Offshore Locations — Oct 1986.

RPT-7 Recommended Practice for Training of Personnel in Rescue of Persons in Water — Oct 1990.

## Appendix 2 : Particulars for Safety Cases

**Part I Particulars to be included in a safety case for the design, construction, operation and maintenance of an installation.**

1. A general description of the means by which the management system of the owner is intended to ensure that the structure and plant of the installation will be designed, constructed, operated and maintained in a way which will minimise hazards.
2. Details of any significant hazards which may cause a major accident that have been considered in the safety case.
3. Details of quantitative risk assessments and any consequent measures proposed to ensure that hazards are minimised.
4. Details of the proposed frequency and scope of reviews of the safety case.
5. A description of
  - (a) the principal features of the design of the installation, and the arrangements and procedures for its completion;
  - (b) the arrangements and procedures for the construction and commissioning of the installation, which are intended to ensure that hazards are minimised.
6. Particulars of plant for the detection of gas, fire and smoke, the prevention and mitigation of fires, and the protection of persons from their consequences.
7. A demonstration that all practicable steps have been taken to ensure that plant, the functioning of which is needed in a major accident
  - (a) to control its consequences, or
  - (b) to ensure the safety of persons,will be capable of functioning in conditions of fire, explosion, flooding, any inclination or strong vibration.

8. A scale plan of the intended location of the installation and of anything to be connected to it, and particulars of
  - (a) the meteorological and oceanographic conditions to which the installation may foreseeably be subjected; and
  - (b) in the case of an installation which requires supporting on the sea-bed, the properties of the sea-bed and subsoil at its location.
9. A description, with scale diagrams, of the main and secondary structure of the installation and its materials, its plant, and any connections to be made to any pipeline or installation.
10. Particulars of the main requirements in the specification for the design of the installation and its plant, including any limits for safe operation and use specified therein.
11. Particulars of the main requirements in the specification for the design of the installation and its plant, including the principal codes of practice to be complied with and any limits for safe operation or use specified therein.
12. (a) The limits of the environmental conditions beyond which the installation cannot safely be stationed or operated.
- (b) The properties of the sea bed and subsoil which are necessary for the safe stationing and operation of the installation.
- (c) The locations in which the installation may be stationed and operated safely.
13. Particulars of each operation to be carried out, including
  - (a) activities on and in connection with the installation relating to each operation;
  - (b) a description of any wells or pipelines containing risers to be connected to the installation; and
  - (c) a programme of operations.
14. The maximum number of persons
  - (a) expected to be on the installation at any time; and
  - (b) for whom accommodation is to be provided.
15. The provision to be made
  - (a) for a temporary refuge to prevent significant harm from explosion, fire, heat, smoke and toxic fumes, and
  - (b) for facilities capable of operating and monitoring emergency shut down systems and emergency alarms and maintaining communication with onshore facilities.
16. Particulars of escape routes, embarkation points, and plant (including lifeboats) to be provided to enable the full and safe evacuation, escape and rescue of persons to take place in an emergency.
17. Particulars of plant and procedures for diving support and hyperbaric rescue.
18. A statement of the performance standards which the temporary refuge, escape routes, embarkation points and lifeboats will be designed to meet, including the minimum period for which they will remain capable of functioning in conditions of fire, explosion or toxic fumes.
19. A demonstration, by reference to the results of quantitative risk assessment, that performance standards used in relation to the installation are adequate to minimise hazards.

**Part II: Particulars to be included in a safety case for the abandonment of an installation**

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1. Sufficient particulars, including a programme of works, to demonstrate that the proposed arrangements, methods and procedures for
  - (a) dealing, by way of abandonment or otherwise, with any wells to which the installation is connected;
  - (b) decommissioning the installation; and
  - (c) demolishing or dismantling the installation take adequate account of the design and method of construction of the installation and its plant and minimise hazards.
2. A scale plan of the location of the installation and of anything connected to it, and particulars of
  - (a) the meteorological and oceanographic conditions to which the installation may foreseeably be subjected; and
  - (b) the properties of the sea-bed and subsoil at its location.
3. A description, with scale diagrams, of the main and secondary structure of the installation and its materials, its plant, and the connections made to any pipeline or installation.
4. Particulars of the operations which were being carried out, including
  - (a) activities on and in connection with the installation relating to each operation; and
  - (b) a description of any wells connected to the installation.
5. The maximum number of persons at work on the installation during decommissioning, demolition or dismantlement.
6. Particulars of plant and arrangements for the detection of gas, fire and smoke, the prevention and mitigation of fires, and the protection of persons from their consequences.
7. Particulars of escape routes, embarkation points and plant (including lifeboats) to enable the full and safe evacuation, escape and rescue of persons to take place in an emergency.

**Appendix 3: Form for Certification**

Pursuant to Regulation 37 the following information is required

..... [Name or description of installation]

I hereby certify that the following parts of the installation have been designed and/or constructed and/or operated and/or maintained and/or abandoned (delete as appropriate) in full compliance with the codes of practice listed below:

PART [description] CODE OF PRACTICE

The following parts do not comply with the codes of practice specified in Regulation 13 of these regulations. I hereby certify that the items listed below have been designed and/or constructed and/or operated and/or maintained and/or abandoned (delete as appropriate) in accordance with sound and accepted engineering practice.

PART [description]

I hereby certify that the installation has been designed and is proposed to be constructed and/or operated and/or maintained and/or abandoned (delete as appropriate) in accordance with codes of practice specified in Regulation 13 of these regulations or in accordance with other sound and accepted engineering practice.

Signed ..... Date .....

Certifying authority