

# OFFSHORE MAJOR ACCIDENT REGULATOR



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## Assessment Principles for Offshore Safety Cases (APOSC)

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## Assessment Principles for Offshore Safety Cases (APOSC)

Issued August 2016

### Foreword

The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015 (SCR015) require operators and owners to submit safety cases for their installations. The Offshore Major Accident Regulator (OMAR) ('the Competent Authority') assesses each case to decide if it is satisfied with the duty holder's approach to identifying and meeting health, safety and environmental needs. This document (APOSC) sets out the principles against which OMAR assesses safety cases; it represents the distilled experience on which OMAR draws when assessing safety cases. The principles should be widely known by industry managers, technical experts and employees, enabling a common understanding of the process.

We believe the 1992 Safety Case Regulations, the 2005 Regulations and the supporting regulatory regime have played a significant part in improvements to health and safety offshore. The changes brought about by the revision of the regulations in 2015 will allow us to build on these successes and include environmental aspects within the regime. There is however no room for complacency. Vigilance remains important as changing circumstances; advances in technology and new knowledge require the continuing review of existing risk control measures and arrangements.

The safety case regime provides a continuing challenge, both to the regulated and to the regulator. There are no short cuts to success. This revised version of APOSC should make the process of safety case assessment clear, and we believe all concerned will find it helpful. Finally we would like to thank all those who contributed to its development.

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## Changes to APOSC

The Offshore Installation (Offshore Safety Directive)(Safety Case etc.) Regulations 2015 came into force on 19 July 2015. This new version of the 'Assessment Principles for Offshore Safety Cases' (APOSC) has been published to accompany the other guidance being made available for these new Regulations. This version of APOSC replaces the version published in March 2006, which was itself the replacement of the original HSG181 booklet.

There are significant changes to the regulatory requirements as a result of the introduction of SCR2015. These are identified in L154<sup>1a</sup>. OPRED (formerly DECC) and HSE, working in partnership as the OMAR, have revised APOSC to the extent necessary to reflect those regulatory changes, modifying principles as required and introducing three new principles, Principles 37-39. Obsolete principles that related to combined operations in the transition between the 1992 Safety Case Regulations and SCR2005 (2004 Principles 36-40) have also now been removed. A decision was taken to add the new principles to the end of APOSC, this is no reflection of the significance of these principles and simply allows the existing principle numbers to remain unaltered as many other documents refer to the principles by number.

The main changes introduced in SCR2015 that impact upon APOSC include:

### 1. Application

SCR2015 applies to oil and gas operations in external waters, that is, the territorial sea adjacent to Great Britain and any designated area within the United Kingdom Continental Shelf (UKCS). For these activities they replace the Offshore Installation (Safety Case) Regulations 2005 (SCR2005). Activities in internal waters (e.g. estuaries) continue to be covered by SCR2005. As SCR2015 builds upon the requirements of SCR2005 APOSC can apply to both within the limits of the regulatory requirements that are relevant. All regulation numbers now quoted and terminology used refers to SCR2015 and readers are directed to Operations Notice 84<sup>26</sup> for further information about how to interpret new and existing guidance for each regime.

### 2. Major accident

SCR2015 has redefined a 'major accident'. The definition of 'major accident' lists types of events involving, or with the potential for, serious injury or loss of life. The definition also includes major environmental incidents resulting from these events.

### 3. Corporate Major Accident Prevention Policy (CMAPP)

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SCR2015 requires a duty holder to produce a Corporate Major Accident Prevention Policy (CMAPP). The CMAPP establishes the duty holder's overall aims and arrangements for managing and controlling major accident hazards and how those aims are to be achieved and arrangements put into effect by the officers of the duty holder.

#### 4. Safety and Environmental Management System (SEMS)

The duty holder must now prepare a document setting out its safety and environmental management system. The previous requirement under SCR2005 for a 'management system' to address safety has been extended to incorporate relevant environmental aspects. The use of the term 'management system' is inclusive and can still be used within the revised context but references to safety management systems must be revised for cases complying with SCR2015.

#### 5. Internal Emergency Response Duties

Certain duties under PFEER are now designated 'internal emergency response duties' in the SCR2015 regime. A description of these duties together with the OPEP produced under OPRC 1998 deliver the description of the internal emergency response arrangements. This description must be included in the safety case. Together these arrangements are known as the Internal Emergency Response Plan (IERP).

#### 6. Safety and Environmental Critical Elements (SECEs)

The verification scheme requirements under SCR2015 have been extended to cover environmental aspects and are no longer referred to as safety-critical elements but safety and environmental critical elements (SECEs).

#### 7. Verification & Well Examinations Scheme

The verification requirements in SCR2015 have been updated to accommodate new duties, and well examination requirements for wells in external waters have been revoked from DCR, updated to accommodate new principles and duties, and placed in SCR2015. These new duties include competence and sharing of information.

The above changes, including the revision of terminology and/or definitions of familiar terms, have implications for industry that must be understood to ensure compliance within the relevant regulatory regime. Any application of the terminology must be accompanied

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by a thorough understanding of the scope and interpretation relevant to the particular regulatory regime being applied.

The additional requirements outlined above apply to the SCR2015 regime and do not apply to the SCR2005 regime. A case that is accepted under the SCR2015 is also accepted under the SCR2005 regime as the new requirements are incremental upon the SCR2005 requirements. A duty holder may still submit a safety case for acceptance under the SCR2005 regime however it would only allow for operation in internal waters.

It should be noted that the requirement for risks to be reduced so far as is reasonably practicable is a key feature of primary UK health and safety legislation. Thus the SCR2015 changes do not mean that a lower standard of safety demonstration is required, nor do the changes imply significant changes to the safety case assessment processes.

## Further information

Any queries concerning APOSC should be addressed to:

Health and Safety Executive  
Aberdeen International Business Park (AIBP)  
Building 2 Level 1  
Dyce Drive  
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## Introduction

1. A duty holder is required by SCR2015 to submit a safety case to OMAR for each installation. This is a written demonstration of the duty holder's approach to identifying and meeting health, safety and environmental needs that has to be updated whenever necessary, to reflect changing knowledge and operational conditions. OMAR must accept the safety case before an installation can operate. In reaching a decision about acceptability, OMAR assesses the content of the safety case – the APOSC principles guide that assessment. It should be noted that there are a suit of offshore environmental regulations that relate to the assessment and management of environmental impacts.
2. APOSC is for use by OMAR assessors and industry safety and environmental practitioners. In publishing this document, OMAR aims to provide an understanding of how OMAR evaluates the acceptability of safety cases, by setting out the principles against which cases are assessed, with explanations of what is required.
3. Safety cases should take account of each principle to the extent necessary to provide an adequate demonstration, and also include the factual information required by SCR2015.
4. APOSC complements the guidance on the Regulations<sup>1a</sup>. They should be read together. OMAR has developed an approach to assessment that utilises topic assessment templates to guide and record assessment. These templates are available to duty holders and should also be referred to for further information
5. The principal matters to be demonstrated in a safety case are that:
  - a) the management system is adequate to ensure compliance with statutory health, safety and environmental requirements; and for management of arrangements with contractors and sub-contractors,
  - b) adequate arrangements have been made for audit and for audit reporting,
  - c) all hazards with the potential to cause a major accident have been identified, their risks evaluated, their likelihood and consequences assessed and that suitable measures have been, or will be, taken to control those risks to ensure that the relevant statutory provisions will be complied with<sup>2</sup>.
  - d) for non-production installations, all major hazards have been identified for all operations the installation is capable of performing

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6. In addition, the SCR2015 Schedules list factual information and other particulars to be included in each safety case.
7. SCR2015 requires the preparation and operation of a verification scheme and where appropriate, a well examination scheme, which includes plant provided to comply with specified Prevention of Fire and Explosion, and Emergency Response (PFEER) regulations<sup>3</sup>. The safety case should refer to the principles of the scheme(s) and describe how the objectives will be achieved. SCR2015 is prescriptive in what the description(s) contained in the safety case should include and this is given in regulation 13. A description which does not include all the required elements is unlikely to be accepted.
8. The Pipeline Safety Regulations 1996<sup>4</sup> (PSR) and SCR2015 verification requirements impose a network of interrelated duties. The major accident prevention document required under PSR regulation 23 may contribute to arguments in a safety case, and where appropriate should be referenced in the case.
9. For the purposes of the safety case, the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995<sup>5</sup> deem any part of a pipeline connected to the installation, and associated apparatus or works, located within 500 metres of the installation, to be part of the installation. The case also needs to take account of any equipment beyond the 500 metre zone on which the safety of the installation may depend. This includes the interaction between the installation and others linked by pipeline, and the effect that an interconnected pipeline system could have on the installation.
10. The term 'duty holder' is used throughout APOSC. This refers to the person (whether owner or operator of an installation) on whom duties are placed by SCR2015, particularly in relation to the preparation of a safety case.

## Factual information

### Principle 1

**The factual information should meet the SCR2015 requirements and provide sufficient detail to support the arguments made in the case**

11. The factual information, which should be provided for all safety cases, includes information about the installation, the plant and systems, the location and external environment, and the activities to be carried out on, or in connection with, the installation. These particulars are linked to hazards with the potential to cause a major accident, including those that could result in a major environmental incident.

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12. The case must contain the particulars required by regulation 17 or 18 for production or non-production installations respectively and the relevant Schedule(s). The case should be a self-contained document which: (a) presents the main arguments clearly and succinctly; and (b) includes sufficient supporting detail to lend conviction to the arguments made in the case.
13. The safety case must be clearly bounded and distinguished from supporting material. Merely referring to particulars contained in other documents is not allowed if these particulars (or documents) are intended to be an integral part of the case for safety. Additional supporting material may be referenced.

## Management of health, safety and environment

### Principle 2

**The safety case should demonstrate that the management system is adequate to ensure compliance with SCR2015 and the relevant statutory provisions**

14. SCR2015 requires a safety case to demonstrate that the duty holder's management systems are adequate to ensure compliance with the relevant statutory provisions, and that there are satisfactory arrangements for the management of contractors and sub-contractors. SCR2015 also includes specific requirements for the safety and environmental management system (SEMS) in regulation 8 and schedules 2 and 3 which must be described in the safety case. The term 'relevant statutory provisions' is defined in HSWA section 53.
15. The required demonstration of the adequacy of the management system is not restricted to the management of major accident hazards.
16. A safety case which does not include the following elements in the descriptions of the management system is unlikely to demonstrate that the system is adequate:
  - a) Plan
    - determining your policy
    - planning for implementation
  - b) Do
    - profiling the risks
    - organising for health & safety
    - implementing the plan

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- c) Check
    - measuring performance
    - investigating accidents and incidents
  - d) Act
    - reviewing performance
    - learning lessons
17. Standards and guidance relating to health, safety and environmental management systems are widely available. The HSE publication 'Managing for health and safety'<sup>16</sup> provides further advice on health and safety management systems and the publication 'Environmental Management System Requirements in relation to OSPAR Recommendation 2003/5'<sup>25</sup> is also relevant.

## Principle 3

**The description of the management system should show an appropriate level of control during each phase of the installation life cycle, including design, construction, commissioning, operation, decommissioning and dismantlement**

18. It should be clear who has overall charge of activities, including the communication arrangements between the responsible persons on and offshore, during normal operations and in emergency conditions. Particular attention should be paid to authority levels, treatment of exceptional conditions, lessons learned from incidents, and performance standards.
19. Where another installation or vessel (for example diving support vessel (DSV) or heavy lift vessel (HLV)), carries out work in combination or in connection with an installation, the case should summarise the arrangements in place for coordinating the management of their activities with the management systems for the installation. This should include steps to ensure that suitable audits and assurance checks have been undertaken on both installations, or the installation and the vessel, to ensure activities can be carried out safely.

## Control of major accident hazards

20. A key part of a safety case is a demonstration that all hazards with the potential to cause a major accident, including those that could result in a major environmental incident, have been identified, their risks evaluated and that measures have been, or will be, taken to control those risks to ensure that the relevant statutory provisions will be complied with.

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21. An acceptable safety case will demonstrate that a structured approach has been taken which:
- a. includes and implements the duty holder's Corporate Major Accident Prevention Policy (Principle 37)
  - b. identifies all major accident hazards, including those that could result in a major environmental incident (Principles 4 & 39),
  - c. evaluates the risks from these hazards (Principles 5 & 39),
  - d. describes how an appropriate approach to risk assessment has been adopted, and how uncertainties in risk assessment have been taken into account (Principle 9),
  - e. identifies and considers a range of potential measures for further risk reduction (Principles 10 & 39),
  - f. presents systematic analysis of each of the identified measures and views formed on the safety and environmental benefit associated with each of them (Principles 10,11 & 39),
  - g. presents an evaluation of the reasonable practicability of the identified measures (Principles 12,13 & 39),
  - h. explains the implementation (or planned implementation) of the identified reasonably practicable measures (Principles 14 & 39),
  - i. describes how major accident hazards are managed (Principles 15-20),
  - j. describes the internal emergency response arrangements (Principles 21-25 & 38);
  - k. describes how the representatives of the workforce, including safety representatives, were consulted on the preparation, review or revision of the safety case (Principle 4);

There may be some overlap between these activities.

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## Major accident hazard identification

### Principle 4

**A systematic process should be used to identify all reasonably foreseeable major accident hazards including those that could result in a major environmental incident, that apply to the installation, together with potential initiating events or sequences of events**

22. The hazard identification methods applied will depend on factors such as the systems involved (i.e. types of plant and equipment, including protective devices) and the operational activities. All significant foreseeable activities associated with the installation should be considered and all major accident scenarios described. A structured approach should be taken to ensure that no major accident hazards, initiating events or sequences of events, are overlooked. A comprehensive process for identifying these hazards would normally include consultation with the workforce and if appropriate, contractors and suppliers.
23. All reasonably foreseeable initiating events or sequences of events should be considered. Some major accident scenarios may arise from a particular sequence or combination of events, for example a gas release followed by a failure to isolate the affected components. In this context, an evaluation should be made of the effects of failure of plant together with a failure of equipment or persons to prevent, detect, control or mitigate the hazardous conditions.
24. The sequence of activities and their relationship in time with other foreseeable activities should also be considered as possible initiating events e.g. well workover and servicing operations together with other activities on the installation.
25. The appropriateness of the hazard identification method(s) should be explained. No single method is universally appropriate. Examples are:
  - a. hazard and operability studies,
  - b. failure mode and effect analysis,
  - c. safety reviews,
  - d. industry standard or bespoke checklists.

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## Major accident risk evaluation

### Principle 5

**The methodology and evaluation criteria adopted for major accident risk assessment should be clear**

26. The case should summarise the duty holder's approach to risk assessment including the methods and criteria used to demonstrate that risks from major accidents are controlled to ensure compliance with the relevant statutory provisions.
27. A typical approach consists of describing:
  - a. the risk assessment methodology,
  - b. the risk evaluation criteria

#### **a) The risk assessment methodology**

28. Risk assessment involves identifying the possible consequences of major accident scenarios and evaluating their likelihood. This may include a description of the preventative measures relevant to the identified major accident scenarios, and an analysis of their strengths and weaknesses.
29. An adequate risk assessment helps in understanding how major accident hazards can arise, what prevents them from occurring and (where there are few barriers to occurrence) what can be done to increase the number of barriers and/or make the barriers more effective. The case should describe how this has been done, by the appropriate use of qualitative or quantitative methods.
30. SCR2015 does not specifically prescribe the use of quantified risk assessment (QRA). However QRA may be appropriate in the consideration of some of the risks, for example those affected by decisions on repair options or test/inspection intervals. Other risks may be addressed more appropriately by the use of semi-quantitative or qualitative techniques.
31. The logic for the choice of risk assessment methodology should however be explained i.e. why QRA, semi-quantitative or qualitative techniques have been used for particular risks. The explanation should cover the approach taken to assess the risk and consequence of all major accident hazards including those that could result in a major environmental incident.

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32. HSE has published a document to provide further guidance on risk assessment for offshore installations<sup>7</sup>.

## b) Risk evaluation criteria

33. For quantified assessment, one accepted approach is to consider how major accident risks contribute to total individual risk. All sources of risk, including non-major hazard type occupational risks, should be included.
34. There is a need for criteria to judge the overall acceptability of risks. One approach presented by HSE<sup>8,9</sup> shows how risk can be viewed as a continuum with three regions:
- a region of low risk which is broadly acceptable;
  - a region of intermediate risk which is acceptable if ALARP;
  - a region of high risk which is unacceptable.
35. In the broadly acceptable region, the potential for further risk reduction is low. Nevertheless the duty holder should consider whether there are additional reasonably practicable measures to reduce risk (for example regarding good industry practice) and ensure that vigilance is maintained to ensure that risks remain in this region.
36. In the intermediate risk region, risks are acceptable provided they are known, controlled and ALARP. As the risk approaches the limits of acceptability the greater will be the degree of rigour required to demonstrate that risks have been reduced so far as is reasonably practicable, there is a particular responsibility on the duty holder to show that all reasonably practicable measures have been taken.
37. In the unacceptable region of risk, the benefits to be gained by taking additional risk reduction measures may be so large that any consideration of cost may be irrelevant.
38. A safety case can show that a particular activity is acceptable either by showing that the activity represents established good practice, or that it presents a similar or lower level of risk to one that would be considered to represent good practice<sup>10,11,12</sup>.
39. An individual risk of death of  $10^{-3}$  per year has typically been used within the offshore industry as the maximum tolerable risk.

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## Principle 6

**Any criteria for eliminating the less significant risks from detailed consideration in the major accident risk evaluation should be explained**

40. It may be appropriate to eliminate the less significant risks from further consideration at an early stage of the evaluation. The criteria for making such decisions should be explained. However, care is needed not to subdivide risks so far that the individual elements appear trivial, while collectively still representing a substantial risk.

## Principle 7

**The assessment should take account of people exposed to exceptional risks**

41. Particular attention should be paid to people who may be exposed to risks significantly higher than the average for the installation as a whole. This may arise, for example, from the type of work carried out, or its location, or from people not being able to reach the temporary refuge (TR).
42. Care is also needed where risks appear to be low solely because of low occupancy of the hazardous areas, for example on a normally unattended installation. In such cases it is more appropriate to consider risk exposure on an occupied year basis instead of a calendar year. To provide a balanced picture, the risks from helicopter travel may need to be considered, particularly with respect to workers based onshore or who travel frequently i.e. to normally unattended installations.

## Principle 8

**The major accident risk evaluation should take account of human factors**

43. The risk evaluation should consider people as both a key element in safe operation and as a potential cause of major accidents and their escalation.
44. Where lines of defence against major hazards and escalation are presented, the role of the human element in these should be made clear and a demonstration provided that this can be delivered reliably when required.
45. Safety and environmental critical tasks should be analysed to demonstrate that task performance could be delivered to the specified performance when required. This demonstration should draw upon recognised good practice in human factors.

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46. The occupational factors, which may affect a person's well being at work and their ability to perform safety and environmental critical tasks, are relevant. Examples are multi-tasking and long hours of work.
47. Human performance problems should be systematically evaluated<sup>13</sup>. This should involve evaluating the feasibility of tasks, identifying control measures and providing an input to the design of procedures and personnel training, and of the interfaces between personnel and plant. The depth of analysis should be appropriate to the severity of the consequences of failure of the task.
48. The effects of hazards on human performance should be evaluated to ensure decision-making capability or the ability to evacuate or escape does not become impaired.

## Principle 9

### **Conclusions reached in risk assessment processes should take uncertainty into account**

49. Quantitative and qualitative risk assessment arguments should be subject to adequate considerations of uncertainty and of the relative merits of engineering judgement and good practice.
50. The amount of support provided by QRA is likely to depend on the complexity of the events to be modelled, any assumptions to be made, and the degree of uncertainty in the methods and data to be used.
51. Particular attention should be paid to the use of QRA arguments to justify not implementing risk reduction measures. If engineering judgement or good practice point towards a different conclusion, the circumstances will warrant a detailed explanation.
52. HSE has published a separate guidance document on risk assessment for offshore installations<sup>7</sup> that contains a more detailed discussion of the issues surrounding the choice of risk assessment methodologies. Guidance on the impact of uncertainty on QRA is also available from Oil and Gas UK<sup>14</sup>.

## Principle 10

### **The identification of risk reduction measures should be systematic and take into account new knowledge**

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53. There is a continuing duty to keep risks and possible further risk reduction measures under review to take account of changing circumstances, advances in technology and new knowledge. This means challenging the adequacy of existing measures and considering any additional practicable measures. This is particularly relevant to cases submitted under SCR2015 regulation 24(2).
54. SCR2015 requires that a safety case is kept up to date. Thus all changes need to be considered systematically whether or not the change generates a requirement for the safety case to be resubmitted to OMAR.

## Principle 11

**The reasoning behind the choice of risk reduction measures to be implemented should be described. Decisions on implementation should take reasonable practicability into account**

55. In many instances, safety and environmental risks will be controlled to a level that ensures compliance with SCR2015 and the relevant statutory provisions by adopting a series of measures involving inherently safer design, prevention, control and mitigation. This requires a balanced and integrated approach to the choice of risk reduction measures and to risk management. It is important that identified risk reduction measures are not viewed in isolation from one another. All options, or combination of options, which are reasonably practicable should be considered.

## Principle 12

**Risk reduction measures identified, as part of the risk assessment, should be implemented if they are reasonably practicable**

56. If a measure is practicable and it cannot be shown that the cost of the measure is grossly disproportionate to the benefit gained, then the measure is considered reasonably practicable and should be implemented.
57. Cost Benefit Analysis (CBA) is the numerical assessment of the costs of implementing a design change or modification and the likely reduction in fatalities that this would be expected to achieve. It suffers from the same problems with uncertainties as QRA when used as an input to decision-making. Therefore it should be used cautiously in support of qualitative or engineering arguments.
58. In making an assessment of reasonable practicability, there is a need to set criteria on the value of a life or implied cost of averting a statistical fatality (ICAF). HSE's 'Reducing Risks Protecting People' document<sup>8</sup> sets the value of a life at

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£1,000,000 and by implication therefore the level at which the costs are disproportionate to the benefits gained. In simplistic terms, a measure that costs less than £1,000,000 and saves a life over the lifetime of an installation is reasonably practicable, while one that costs significantly more than £1,000,000, is disproportionate and therefore is not justified. However case law indicates that costs should be grossly disproportionate and therefore costs in excess of this figure (usually multiples) are used in the offshore industry. In reality of course there is no simple cut-off and a whole range of factors, including uncertainty need to be taken account of in the decision making process.

59. In the offshore industry there is a need to take account of the increased focus on societal (or group) risk, i.e. the risk of multiple fatalities in a single event, as a result of society's perceptions of these types of accident. Therefore the offshore industry typically addresses this by using a high proportion factor for the maximum level of sacrifice that can be borne without it being judged 'grossly disproportionate'; this has the effect of increasing the ICAF value used for decision-making. The typical ICAF value used by the offshore industry is around £6,000,000, i.e. a proportion factor of 6. OMAR considers this to be the minimum level for the application of CBA in the offshore industry.
60. Use of a proportion factor of 6 ensures that any CBA tends towards the conservative end of the spectrum and therefore takes account of the potential for multiple fatalities and uncertainty. Although a proportion factor of 6 tends to be used, there are no agreed standards and it is for each duty holder to apply higher levels if appropriate, for example in very novel designs.
61. Guidance on the ALARP decision-making process, aimed at helping to assess the relative importance of the various factors involved is also available from Oil and Gas UK<sup>15</sup>.

## Principle 13

**In deciding what is reasonably practicable, the case should show how relevant good practice and judgement based on sound engineering, management and human factors principles have been taken into account**

62. 'Good practice' means those standards for controlling risk that are recognised by OMAR as satisfying the law when applied in an appropriate manner. This may be achieved by reference to conformance with appropriate codes, standards and guidance. OMAR has set out such information in guidance<sup>16</sup>. A lower standard would not normally be acceptable. However, it may be possible to construct a robust argument to show that the measures adopted are likely to achieve an equivalent or higher standard of health and safety.

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63. Account should be taken of foreseeable harsh conditions, unusual operational schedules, and novel designs of wells or equipment. Where good practice is not clearly established, or may not adequately safeguard against the risks, the significance of the risks should be systematically assessed to show that the measures taken, or to be taken, are appropriate<sup>10,11,12</sup>.

## Principle 14

**Where remedial measures are proposed to reduce risk, the timescale for implementing them should take account of the extent of such risks and any practical issues involved**

64. Remedial work programmes should be considered against the need to reduce risks to levels that are consistent with relevant statutory provisions. Temporary mitigation measures, applied to reduce risk until remedial measures are in place may also be appropriate. Such measures could include additional management controls or restrictions on operations.

## Major accident risk management

65. The principles of risk control and health and safety management are set out in the Management of Health and Safety at Work Regulations 1999<sup>17</sup> regulation 4 and Schedule 1. Requirements for assessing environmental impacts are contained in the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)<sup>24</sup> and the requirements for response and remedial measures are contained in the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998<sup>21</sup>.

## Principle 15

**Measures taken to manage major accident hazards should be described**

66. A hierarchical approach should be used for managing major accident hazards, taking account of the effect of each measure in a balanced and integrated way. The recommended hierarchy is:
- elimination and minimisation of hazards by design (inherently safer design),
  - prevention (reduction of likelihood),
  - detection (transmission of information to control point),
  - control (limitation of scale, intensity and duration),
  - mitigation of consequences (protection from effects).
67. Inherently safer design and measures to prevent and control major accident hazards merit the highest priority, because of their greater effectiveness and

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dependability in reducing risk compared with systems of work and similar procedural measures. For more information see HSE Research Report OTH 96 521<sup>18</sup>.

68. For a new installation, the greatest scope to eliminate or minimise hazards is at the design stage. The design process should address all contributors to risk from major accident hazards, with emphasis on the most significant risks. Risks should be reduced to ensure compliance with the relevant statutory provisions primarily through sound engineering design, supported by appropriate management controls and human factors assessment. For existing installations, the scope for increasing inherent safety or for prevention or control is more limited, but should still be addressed.
69. In explaining the measures taken to manage major accident hazards, the safety case should consider the effects from fire, explosion and toxic gas, and from events such as loss of stability or station keeping ability, which have the potential to affect the integrity of the installation.

## Principle 16

**The safety case should explain how inherently safer design concepts have been applied to safety and environmental risk in the design decisions taken**

70. This principle is relevant to all stages of the installation's life cycle. The principle thus also applies to the notifications, such as are required for design and combined operations.
71. Inherently safer design requires the hazard management strategy to be developed at a very early stage in the design process. The strategy might reference, for example:
  - a. concept selection, for example platform vs. subsea development, attended vs. unattended, floating vs. fixed, single vs. multiple structures, pre-drilling of wells,
  - b. installation location and orientation,
  - c. substitution of hazardous processes by less hazardous ones,
  - d. segregation of hazards,
  - e. reduction in complexity,
  - f. reduction of subsurface uncertainty, for example by seismic surveys,
  - g. riser location and routing,

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- h. allowance for human factors, for example by fail-safe, error-tolerant designs,
- i. materials selection,
- j. corrosion, erosion and stress concentration in design,
- k. design which facilitates inspection and maintenance.

## Principle 17

**The measures for preventing major accident hazards should take account of the various activities undertaken during the installation's current phase of operation**

72. Measures to prevent major accident hazards should be considered for the current stage in the installation's life cycle. The case should be revised and updated as necessary to ensure that it continues to reflect current operational conditions. Life cycle activities may include:
- a. drilling and maintaining wells,
  - b. operating temporary systems for well production testing,
  - c. operating the production system in the 'steady state', including routine and non-routine activities,
  - d. operating in the steady state during maintenance, whether undertaken by contractors or directly employed staff,
  - e. planned changes from steady state, arising from changes in plant, substances, procedures or people,
  - f. all reasonably foreseeable emergencies,
  - g. decommissioning, dismantling and removal of facilities, plant, equipment or substances.
73. The arrangements for managing hazardous activities carried out simultaneously with other, possibly hazardous, activities should be described. Examples include:
- a. simultaneous wellbore and production operations,
  - b. simultaneous drilling and workover activities,
  - c. maintenance, construction or commissioning activities simultaneous with drilling or production operations.

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## Principle 18

**Appropriate detection measures should be provided for any reasonably foreseeable event requiring an emergency response**

74. The safety case should include information on detection systems. Their primary function is to give warning of the existence of a hazard or of conditions which could lead to a hazard.
75. Such conditions include:
  - a. those which could affect the integrity of the installation and its position keeping, including structural failure, ballast system fault, dynamic positioning system fault, heading control fault, mooring line failure, foundation weakening, extreme weather, excessive inclination and flooding,
  - b. those involving accumulation of flammables, uncontrolled hydrocarbon release, hydrocarbon fire and fire from other sources,
  - c. smoke, toxic gas or fumes entering the TR and accommodation area,
  - d. detection of vessels on a collision course with the installation.

## Principle 19

**Appropriate control and mitigation measures should be provided to protect against the consequences of a major accident**

76. These measures could include (amongst others):
  - a. ballast/elevation control systems,
  - b. operating and maintenance philosophy,
  - c. minimisation of hazardous inventories,
  - d. emergency shutdown systems,
  - e. fire and gas control systems,
  - f. ventilation control systems,
  - g. arrangements for evacuation and rescue,
  - h. system diversity and redundancy,

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- i. mooring line emergency release,
- j. well control equipment and systems,
- k. control systems to prevent loss of containment,
- l. oil pollution emergency plans.

## Principle 20

### **Arrangements for controlling an emergency should take account of likely conditions during emergency scenarios**

77. The measures described above may be required to function:
  - a. in the presence of potentially flammable mixtures of hydrocarbons,
  - b. during or after a fire,
  - c. after the mechanical shock of an explosion,
  - d. during or after flooding or submergence,
  - e. for floating installations, during abnormal inclination or movement of the installation.
78. Account should be taken of the extent to which an emergency system may be partially or totally ineffective. This may be due to initial incident damage or latent defects.
79. Account also needs to be taken of the need for the continued availability of staff to carry out emergency procedures.
80. The case should describe how these systems are intended to control emergency situations, (for example, how shutdown systems limit the inventory released in an emergency). Shutdown system applications include:
  - a. wells,
  - b. processes,
  - c. pipelines,
  - d. supply of power or fuel to prime movers,
  - e. electrical power supplies and equipment.

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81. As another example, the case should describe how HVAC systems disperse gas or smoke, and are shut down to prevent smoke, fire or gas spreading to occupied areas.
82. The expected consequences of a shutdown delay or failure of the ventilation systems, and the contribution this would make to the escalation of a major accident scenario, should be considered.

## Emergency response

- 82a SCR2015 introduced the concept of the internal emergency response arrangements. These arrangements bring together the results of the PFEER regulation 5 assessment and the Oil Pollution Emergency Plan (OPEP) and form the Internal Emergency Response Plan (IERP). The scope of Principle 21 has been extended in this revision of APOSC, Principles 22-25 still relate to the PFEER aspects of emergency response and an additional principle, Principle 38, relates to the OPEP arrangements.

## Principle 21

### The measures and arrangements for the management of safety and environmental emergencies should be identified

83. SCR2015 requires a demonstration that the safety and environmental management system (SEMS) is adequate to ensure that there are appropriate arrangements to protect people and the environment from identified hazards. The safety case should describe how the duty holder has ensured there are, or will be, appropriate measures in place for securing effective emergency response, including:
  - a. The identification of the various events that could give rise to the need for evacuation, escape, rescue or pollution response to avoid or minimise a major accident,
  - b. The evaluation of the likelihood and consequences of such events.
84. The case should include information from the results of the PFEER regulation 5 assessment, which form the basis of the major hazard risk assessment, and the description of the OPEP to show that the measures taken, and arrangements in place, are likely to be appropriate for protection of people and the environment from the various events that could give rise to:
  - a. A major accident; or

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- b. The need for evacuation, escape, rescue or pollution response to avoid or minimise a major accident
- 85. One way to do this would be to include examples of appropriate standards of performance for the various measures provided. Alternatively, the case should include a description of the methodology used to develop these performance standards, the basis for them and how they are derived.
- 86. The arrangements can include equipment, physical (active and passive) systems, operational procedures, managerial structures and planning.
- 87. There should be arrangements for consultation and co-operation with others likely to be involved, for example HM Coastguard, pipeline operators, standby vessel owners, SOSREP and environmental pollution responders.

## Principle 22

**The Temporary Refuge (TR) should provide sufficient protection to enable people to muster safely, to permit the emergency to be assessed, and to allow the emergency response plan to be executed**

- 88. The TR should be a place where personnel can muster safely in an emergency, monitor and assess the developing situation, and either take control action or initiate evacuation. An enclosed structure may not always be the most suitable TR.
- 89. The TR function should be defined for all identified hazards.
- 90. There should be sufficient safe access routes from all potentially occupied locations to the TR. The TR may be on a bridge-linked structure.
- 91. The protection provided by the TR may be critical to the success of the emergency response. The description should include how it will withstand the effects of fire, explosion, smoke and toxic gas (including secondary effects such as impacts). The case should show that the TR is capable of delivering its required functions for as long as is necessary during major accidents.
- 92. The design of the TR should take account of the size and layout of the installation and the numbers and distribution of persons on board. Allowance should be made for the effects of incapacity, injuries, darkness, smoke and damage to access and exit routes.

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## Principle 23

**Criteria should exist that describe the Temporary Refuge integrity (TRI) and the time over which TRI needs to be maintained against all hazards identified in the risk assessment. The safety case should demonstrate that these criteria are met i.e. that TRI would be maintained for the necessary time**

93. A loss of TRI means a loss of the capacity of the TR to perform its required functions. Three main types should be considered:
  - a. loss of structural support,
  - b. deterioration of life-support functions at TR locations,
  - c. loss of command or communication functions.
94. Loss of command or communication functions will affect the information available for making decisions and the capacity to mitigate the incident and/or organise safe evacuation.
95. Demonstration of TRI, and the time for which TRI need to maintained, is likely to require modelling of the consequences of various accident scenarios identified during the systematic hazard identification process.
96. Measures that could improve TRI and the associated time, should be evaluated to ensure the TR is capable of delivering its required functions for as long as is necessary during major accidents.

## Principle 24

**Evacuation and escape arrangements should be integrated in a logical and systematic manner, taking account of the environment in which they may need to function**

97. There should be a clear distinction between means of evacuation and means of escape. Evacuation means leaving the installation and its vicinity in a systematic manner and without directly entering the sea. Escape devices may cause people to enter the sea with little or no protection, so the likelihood of survival is likely to be lower than that for evacuation systems; the need to use them should be very infrequent. Escape devices should nevertheless be chosen on the basis that they will ensure, so far as is reasonably practicable, the safe escape of people, should evacuation arrangements fail.

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98. The evacuation and escape arrangements should allow everyone to reach a place of safety. Providing personal protective equipment for residual risks is important, but this should not be a substitute for protected evacuation and escape routes, safe muster areas and a TR.
99. Additional muster areas should be considered for hazards that are not mitigated by a conventional enclosed TR. An example might be the loss of stability of a floating installation.
100. Endurance times should exist for access and evacuation routes, embarkation points and totally enclosed motor propelled survival craft (TEMPSC).
101. The endurance times should take account of the time needed for people to travel from their work stations to a TR, possibly helping injured colleagues.
102. Exits and evacuation routes may be required for some time after the development of a major accident, and should be protected accordingly. Shielding or other protection for TEMPSC and evacuation points may be necessary to provide adequate endurance time.

## Rescue and recovery

### Principle 25

#### **Effective rescue and recovery arrangements should be provided to cope with major accidents**

103. The case should demonstrate that effective rescue and recovery arrangements have been made for all the identified major accidents.
104. Realistic estimates should be made of the survival and recovery times for individuals under the anticipated conditions for each event. The survival time should exceed the recovery time by a margin sufficient to demonstrate that there is a good prospect of survival, taking uncertainty into account.

### Life cycle requirements

105. Many of the above principles apply throughout the life cycle of an installation. This section highlights matters relating to those stages in the life cycle of an installation that require additional consideration.

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## Design

106. SCR2015 requires a design notification for a new production installation that is to be established, and for OMAR to comment on the design. Similar requirements exist for installations that are relocated and for installations that are converted from non-production to production. They do not require acceptance by OMAR, but OMAR will be guided by APOSC in making comments. The duty holder is required to include reference to the comments made by OMAR, and how they were addressed, in the subsequent safety case.
107. The level of detail required in the design notification will be less than for the operational safety case, but should show the main philosophies, the basis for concept selection, the layout and the risk prevention measures. The notification should be submitted before the submission of the field development programme to the Oil and Gas Authority (OGA), at a time when it would not be difficult or expensive for the duty holder to take into account any matters relating to health, safety and the environment raised by OMAR. OMAR will raise such matters within three months of submission.

## Principle 26

**A Design Notification should describe how the principles of risk evaluation and risk management are being applied to the design to ensure that major accident risks, including those that could result in a major environmental incident, will be controlled so as to ensure compliance with SCR2015 and the relevant statutory provisions**

108. These principles involve a hierarchical approach (see principle 15). Their application is appropriate from the earliest stages of design, including concept selection.
109. It should be clear how good engineering practice will be used during the detailed design of the installation, as a basis for demonstrating that major accident risks will be controlled so as to ensure compliance with SCR2015 and the relevant statutory provisions.
110. Policies (and procedures where appropriate) should be described for the prevention, detection, control and mitigation of major accident hazards during operations.

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## Principle 27

**Well engineering aspects, especially those that refer to well operations before the start of facility operations, should be included in the Design Notification**

111. Wells connected to an installation are the major source of hydrocarbon hazard. The design of the wells can significantly affect the level of risk to the installation. Design features of the installation may limit the design options for the well. Similarly, design features of the well may dictate the selection of the installation's drilling facilities and the sizing of the utility facilities. These, in turn, may affect the overall development concept.
112. Well-related hardware selection, which can only be addressed satisfactorily during the design stage, could include
  - a. Pre-drilling and tie-back designs, including the suspension design of pre-drilled wells;
  - b. Well conductor sizing;
  - c. Hole sizes and planned depths;
  - d. Well-head arrangements and distances;
  - e. Unusual drilling or completion procedures;
  - f. Planned methods of secondary oil recovery;
  - g. Unusual drilling rig arrangements;
  - h. Unusual work over or maintenance operations;
  - i. Novel completion or well-head equipment requiring long lead times.
113. Other wells related matters, concerning detailed design, minor hardware or operations management may be better addressed in the operational safety case.

## Combined operations

114. [OBSELETE] .
115. Where an installation is likely to engage in combined operations, the safety case for the installation should contain generic information on combined operations safety. The information should include summaries of the arrangements for coordinating the management systems of the two installations. The case should also include a summary of arrangements for a review of the safety and

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environmental aspects of combined operations. This review should take place before a particular combined operation occurs.

116. Under SCR2015, a Combined Operations Notification is required. That notification should include a review of the relevant information provided in the operational safety cases of the separate installations. The review should deal with any hazards with the potential to cause a major accident and provide a description of any risk control measures introduced as a result of the review. OMAR will be guided by APOSC in considering these notifications. Combined operations notifications do not however require acceptance by OMAR.
117. If combined operations are planned that are outside the scope of those operations covered by the operational safety case, a revised safety case submission is required.

## Principle 28

### **The management system should address the additional risks associated with combined operations**

118. This should include the arrangements in place for the interfacing of the management systems, identification of any new major accident hazards, and for risk evaluation relating to the combined operations. The prevention, detection, control and mitigation strategies to be adopted for these additional hazards should be addressed.
119. The decision, command and communication arrangements should be described. The relationships and arrangements for co-operation between the parties involved should also be defined.
120. Where other vessels, for example DSVs and HLVs, are working during a combined operation (or otherwise), the case should show how the management of their activities is intended to be coordinated with the management systems for the installation(s).

## Principle 29

### **A systematic approach should be taken to assessing the impact of combined operations on the conclusions of the operational safety case for each installation**

121. Any aspects that may require further consideration should be identified and addressed. These may include:

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- a. duties on plant or equipment in relation to their limits of operation (for example fire water systems),
- b. structural loadings (for example use of additional or temporary equipment, close proximity of jack-up spud cans to installation piles),
- c. restrictions (for example on mooring patterns) due to pipelines or other vulnerable subsea or topside structures,
- d. reliability/availability restrictions on plant or equipment (for example due to interconnection of indication, alarm or communication systems).

## Principle 30

**A systematic approach should be taken to identifying and assessing any additional major accident hazards arising from combined operations. These can be new hazards or changes to existing hazards**

122. The techniques used to identify and assess any additional major accident hazards should be described, and the results summarised in the case. Reference can be made to the techniques and assessments for the individual installation cases.
123. This assessment should cover all aspects of the combined operation, from the arrival of a mobile installation to its departure. This should include hazards introduced by vessels that are not installations, for example anchor handling vessels.
124. The case should also address:
  - a. maintenance, construction or commissioning activities carried out simultaneously with well operations on installations working in a combined operation,
  - b. integration and harmonisation of the various safety systems,
  - c. the TR, and evacuation and escape arrangements,
  - d. new performance standards for the combined operation
  - e. integration of the oil spill response arrangements

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## Principle 31

**The measures for emergency response should be appropriate to the particular combined operation**

125. Any restrictions or conditions imposed by the combined operation or by the placement of installations or equipment (for example, changes to the availability of escape routes, lifesaving appliances, fire-fighting equipment or additional measures to protect the environment) should be considered. Any limitations on these arrangements should also be considered, for example bridge link disconnection in adverse weather.

## Principle 32

**Elements that become safety and environmental critical elements (SECEs) as a result of combined operations should be identified and made subject to verification. They may be parts of the individual installations, or additional plant or equipment provided for the combined operations**

## Decommissioning and dismantlement

126. The principles of assessment of safety cases will also apply to the revision of a fixed installation operational safety case that deals with its ultimate decommissioning (SCR2015 regulation 24(1) or 24(2) as appropriate) or final dismantlement (SCR2015 regulation 20). In particular:
- a. the extra information requirements relates to activities which are directly involved with the decommissioning and removal of plant, equipment and dismantlement of structures,
  - b. the health and safety of people and protection of the environment involved in the transport and disposal of decommissioned or dismantled items are outside the scope of SCR2015 (and SCR2005),
  - c. the environmental impacts not associated with a major accidents during offshore operations are outside the scope of SCR2015 (and SCR2005),
  - d. where non-production installations are involved in decommissioning or dismantlement, the safety case may need to be revised to address the combined operations implied by their use. A Combined Operations Notification will also be necessary;
  - e. if a heavy lift vessel, which is not categorised as an installation is involved, a notification is not needed, but the safety case should indicate how the management arrangements are co-ordinated

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## Principle 33

**When the safety case is revised to deal with decommissioning or dismantlement, the sequence of events should be described, from cessation of production to dismantling of the structure**

127. The decommissioning and dismantlement programmes should follow a logical sequence, taking account of the progressive reduction in the availability of plant and equipment on the installation. The major accident risks from activities relating to dismantlement, including those that could result in a major environmental incident, should be considered. The need for and availability of facilities for emergency response should also be assessed.
128. The process may include a time lag between operations ceasing production and eventual dismantlement. The plant may be decommissioned but the installation maintained intact pending removal. Maintenance and verification should continue, to prevent the installation from deteriorating to an extent that those on board, or those who will be engaged in the dismantling operation, may be put at risk.
129. Well abandonment operations can occur at any time during the life of an installation. However, when the installation itself is being decommissioned, there may be some wells that have yet to be abandoned. The well abandonment policies and procedures should be described in the operational safety case. The arrangements made by well operators in complying with the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996 (DCR)<sup>19,20</sup> will contribute to the requirements of SCR2015. Well operators are required to ensure the safe physical condition of wells at all stages of the cycle, from design and commissioning through to abandonment.

## Principle 34

**The case should describe the extent and availability of systems provided to prevent major accidents during decommissioning or dismantlement**

130. Operators have a duty under DCR<sup>19,20</sup> to ensure that installations are decommissioned and dismantled in such a way that, so far as is reasonably practicable, they will have sufficient integrity to enable the work to be carried out safely. Similarly there are requirements under OPPC<sup>21</sup> and OCR<sup>22</sup> to prevent pollution from offshore operations. The decisions and arrangements made by operators to ensure compliance with DCR, OPPC and OCR will contribute to meeting the safety and environmental requirements of SCR2015.
131. The operational status of relevant plant, equipment and systems should be summarised. This includes plant and arrangements for:

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- a. gas, vapour, oil mist, smoke or toxic fume detection,
  - b. fire detection, prevention and mitigation,
  - c. facilitating escape, evacuation and rescue,
  - d. mechanisms for loss of containment detection.
132. Sufficient detail should be included to demonstrate that the management systems, including emergency arrangements, can be effectively implemented.

## Principle 35

### **Any additional major accident hazards arising from decommissioning or dismantlement should be identified**

133. Many of the hazards during decommissioning or dismantlement will be similar to those that arise during the production phase for plant and equipment, and during the construction phase for structures. However, an additional hazard identification exercise should be carried out. This should take account of the changing activities and changes in the installation's ability to respond to hazards. For example, in-service deterioration or modifications to the structure may affect its strength for lifting operations.
134. It may be appropriate to screen each significant phase of the decommissioning and dismantlement process separately. This allows full account to be taken of the safety and environmental risks associated with concurrent activities.

## Principle 36

### **The management system should demonstrate that effective control will be maintained throughout decommissioning or dismantlement**

135. The description of the management system should follow the guidance in principle 2, but should also highlight:
- a. any significant changes in the management and organisation occurring during decommissioning or dismantlement,
  - b. any special management controls,
  - c. arrangements for management of emergencies for each phase of decommissioning or dismantlement,
  - d. arrangements for appointment of competent contractors and for effective coordination of work,

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- e. arrangements for verification of SECEs.

## Corporate Major Accident Prevention Policy (CMAPP)

### Principle 37

**The Corporate Major Accident Prevention Policy (CMAPP) must provide the commitment of the duty holder's management board, or equivalent, to preventing major accidents, giving a high level overview of how the management and control of major accident hazards will be implemented and achieved throughout the organisation.**

- 136 The CMAPP must be prepared by the legal entity that is the duty holder, contain the specified information and demonstrate a commitment to achieving the regulatory requirements, as a minimum.

## Environmental Emergency Response

### Principle 38

**The safety case should demonstrate that in the event of a major accident with the potential to cause pollution response arrangements are in place.**

- 137 The safety case should adequately describe the oil pollution response arrangements that are detailed in the installation's Oil Pollution Emergency Plan as required under the OPRC Regulations<sup>23</sup> and associated guidance.
- 138 The description should cover:
  - a) the internal response arrangements governing oil pollution response (outlining who is responsible for all levels of the tiered response to any oil pollution incident and a summary of how the notification and reporting process will occur); and
  - b) the OPEP interface arrangements, including the arrangements for combined operations, well operations and external response organisations

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## Environmental Information

### Principle 39

**The safety case should demonstrate that major accident hazards which have the potential to cause a major environmental incident have been considered and the environmental consequence (environmental effects) assessed.**

- 139 The safety case should provide an adequate summary of recent environmental baseline information and assessment of major environmental incident potential. A major environmental incident could only occur as a result of a major accident causing damage to protected species and natural habitats and has significant adverse effects on reaching or maintaining the favourable conservation status of such protected habitats or species. Where a major accident could result in a major environmental incident, its likelihood and the potential environmental consequence (environmental effects) should be assessed and an adequate summary presented in the safety case, or relevant notification, including a description of the technical and non-technical measures envisaged to prevent, reduce or offset them, including monitoring. The summary should include links or references to existing environmental impact assessments for the production installation (in PETS Production Application EIA) where the detailed assessment should be presented.

## References

*All references are correct at the time of publication. Some references are subject to revision to reflect SCR2015, and other changes. Reference should be made to ON84<sup>26</sup> and care should be taken to locate the current version of any material referred to.*

- 1a A Guide to the Offshore Installations (Offshore Safety Directive)(Safety Case etc.) Regulations 2015 L154 HSE Books 2015  
<http://www.hse.gov.uk/pubns/books/l154.htm>
- 1b A guide to the Offshore Installations (Safety Case) Regulations 2005 L30 HSE Books 2006 ([www.hse.gov.uk/pubns/books/l30.htm](http://www.hse.gov.uk/pubns/books/l30.htm))
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- 3 Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995. Approved Code of Practice and guidance L65 HSE Books 1997 ISBN 0717613860

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- 4 A guide to the Pipelines Safety Regulations 1996 L82 HSE Books 1996 ISBN 07176 11825
- 5 A guide to the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 L70 Second edition HSE Books 2002 ISBN 0 7176 2572 9
- 6 Managing for Health and Safety HSG65 3<sup>rd</sup> Edition HSE Books 2013 ISBN 9780717664566
- 7 Guidance on Risk assessment for Offshore Installations, Offshore Information Sheet No 3/2006. (<http://www.hse.gov.uk/offshore/sheet32006.pdf>)
- 8 Reducing risks, protecting people HSE Books 2001 ISBN 071762151 0 (<http://www.hse.gov.uk/risk/theory/r2p2.pdf>)
- 9 The tolerability of risk from nuclear power stations revised edition HSE Books 1992 ISBN 0118863681
- 10 Principles and guidelines to assist HSE in its judgements that duty holders have reduced risk as low as reasonably practicable ([www.hse.gov.uk/risk/theory/alarp1.htm](http://www.hse.gov.uk/risk/theory/alarp1.htm))
- 11 Assessing compliance with the law in individual cases and the use of good practice ([www.hse.gov.uk/risk/theory/alarp2.htm](http://www.hse.gov.uk/risk/theory/alarp2.htm))
- 12 Policy and Guidance on reducing risks as low as reasonably practicable in Design ([www.hse.gov.uk/risk/theory/alarp3.htm](http://www.hse.gov.uk/risk/theory/alarp3.htm))
- 13 Reducing Error and Influencing Behaviour HSG48 HSE Books 1999 ISBN 7176 2452 8
- 14 Guidelines for Quantitative Risk Assessment Uncertainty Issue 1 EHS08 UK Offshore Operators Association Limited 2000
- 15 Industry Guidelines on a Framework for Risk Related Decision Support EHS13 UK Offshore Operators Association Limited 1999
- 16
- 17 Management of Health and Safety at Work Regulations 1999.

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- 18 Improving inherent safety HSE Research Report OTH96 521 HSE Books 1996  
ISBN 0717613070 (<http://www.hse.gov.uk/research/othpdf/500-599/oth521.pdf>)
- 19 A guide to the well aspects of the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996: Guidance on Regulations L84 HSE Books 1996 ISBN 0717611949
- 20 A guide to the integrity, workplace environment and miscellaneous aspects of the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996: Guidance on Regulations L85 HSE Books 1996 ISBN 0717611647
- 21 The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 (as amended)
- 22 The Offshore Chemical Regulations 2002 (as amended)
- 23 The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended)
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