Assessment Principles for Offshore Safety Cases (APOSC)

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Foreword

The Offshore Installations (Safety Case) Regulations 2005 (SCR05) require operators and owners to submit safety cases for their installations. HSE assesses each case to decide if a case for safety has been made. This document (APOSC) sets out the principles against which HSE's Offshore Division (OSD) assesses safety cases; it represents the distilled experience on which OSD 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.

There have been substantial improvements in the overall management of offshore risks, with a corresponding fall in incident numbers. I believe the 1992 Safety Case Regulations and the supporting regulatory regime have played a significant part in these improvements. The changes brought about by the revision of the regulations in 2005 will allow us to build on these successes. 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 new version of APOSC should make the process of safety case assessment clear, and I believe all concerned will find it helpful. Finally I would like to thank all those who contributed to its development.

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Changes to APOSC

The Offshore Installation (Safety Case) Regulations 2005 (SCR05) came into force on 6 April 2006. 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 interim version published on the web in March 2004, 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 SCR05. HSE's Assessment principles have changed to the extent necessary to reflect those regulatory changes. The changes include:

1 The replacement of the requirement for a design safety case with the new requirement for an (earlier) design notification. Design notifications will be considered by HSE, but not formally assessed; HSE acceptance is not required. However APOSC is relevant, as the information contained in the notification should eventually be reflected in an operational safety case. HSE will therefore consider design notifications against the relevant APOSC principles and will comment on any apparent failure to consider matters that might subsequently affect the acceptability of the operational safety case.

2 The replacement of the requirement for combined operations safety cases. SCR05 requires the operational safety case for each installation to include generic information and safety analysis about the combined operations with which it will be involved. Advance notification of more detailed information is required for each combined operation.

3 Decommissioning operations and final dismantlement are now considered as stages in the evolution of an operational safety case. APOSC has been amended to reflect these changes.

4 SCR05 does not require a demonstration that risks to people from major accident hazards have been reduced to the lowest level that is reasonably practicable. This has been replaced by a requirement to demonstrate compliance with the relevant statutory provisions for the control of all major accident risks. The term 'relevant statutory provisions' is defined in the Health and Safety at Work etc. Act 1974 (HSWA) section 53 as meaning the provisions of HSWA, any health and safety regulations and existing statutory provisions.

5 The specific requirements for QRA have been removed.

6 There is a duty on the installation operator or owner to consult safety representatives on the preparation, review or revision of safety cases. The safety case should show how this was done.

Points 4 and 5 above continue to require the need for application of appropriate risk assessment techniques and risk reduction measures. The risk assessment techniques may well include QRA in appropriate circumstances, however APOSC now reinforces the need for a judgement as to what is needed in terms of risk assessment.

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 SCR05 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

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Introduction

1. An operator or owner is required by SCR05 to submit a safety case to HSE for each installation. This is a written demonstration of safety that has to be updated whenever necessary, to reflect changing knowledge and operational conditions. HSE must accept the safety case before an installation can operate. In reaching a decision about acceptability, HSE assesses the content of the safety case – the APOSC principles guide that assessment.

2. APOSC is for use by HSE assessors and industry safety practitioners. In publishing this document, HSE aims to provide an understanding of how HSE 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 SCR05.

4. APOSC complements the guidance on the Regulations[1]. They should be read together.

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 and safety 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, and measures have been, or will be, taken to control those risks to ensure that the relevant statutory provisions will be complied with[2].

6. In addition, the SCR05 Schedules list factual information and other particulars to be included in each safety case.

7. SCR05 require the preparation and operation of a verification scheme, which now includes plant provided to comply with specified Prevention of Fire and Explosion, and Emergency Response (PFEER) regulations[3]. The safety case should refer to the principles of this scheme and describe how their objectives will be achieved.

8. The Pipeline Safety Regulations 1996 [4] (PSR) and SCR05 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 [5] 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, operator of an installation or licensee) on whom duties are placed by SCR05.

Factual information

Principle 1

The factual information should meet the SCR05 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.

12. The case must contain the particulars required by regulation 12 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 and safety

Principle 2

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

14. SCR05 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. 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. policy setting

        - policy and objectives,
        - corporate acceptance of responsibility.

    b. organisation

        - structure, accountability and safety culture,
        - professional health and safety advice,

- involvement of the workforce,
- risk assessment systems.

c. planning and standards

- standards and procedures for controlling risks, including workload and working hours,
- permits to work,
- competence and training,
- selection of key personnel,
- control of change,
- selection and control over contractors,
- planning and control for emergencies,
- occupational health.

d. performance measurement

- recording and investigation of incidents,
- active monitoring.

e. audit and review

- auditing,
- review and application of lessons learned.

17. The HSE publication 'Successful health and safety management'[6] provides further advice on health and safety management systems.

Principle 3

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.

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 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.

21. An acceptable safety case will demonstrate that a structured approach has been taken which:

a. identifies all major accident hazards (principle 4),

b. evaluates the risks from these hazards (principles 5-8),

c. describes how an appropriate approach to risk assessment has been adopted, and how uncertainties in risk assessment have been taken into account (principle 9),

d. identifies and considers a range of potential measures for further risk reduction (principle 10),

e. presents systematic analysis of each of the identified measures and views formed on the safety benefit associated with each of them (principles 10,11),

f. presents an evaluation of the reasonable practicability of the identified measures (principles 12,13),

g. explains the implementation (or planned implementation) of the identified reasonably practicable measures (principle 14),

h. describes how major accident hazards are managed (principles 15-20),

i. describes the emergency response arrangements (principles 21-25);

j. describes how the safety representatives were consulted on the preparation, review or revision of the safety case (principle 4).

There may be some overlap between these activities.

Major accident hazard identification

Principle 4

A systematic process should be used to identify all reasonably foreseeable major accident hazards 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, including those that may only affect a few people. 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.

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. SCR05 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.

32. HSE has published a document to provide further guidance on risk assessment for offshore installations[7].

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[8,9] shows how risk can be viewed as a continuum with three regions:

    a. a region of low risk which is broadly acceptable;
    b. a region of intermediate risk which is acceptable if ALARP;

c. 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[10,11,12].

39. An individual risk of death of 10^{-3} per year has typically been used within the offshore industry as the maximum tolerable risk.

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 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.

46. The occupational factors, which may affect a person's well being at work and their ability to perform safety critical tasks, are relevant. Examples are multi-tasking and long hours of work.

47. Human performance problems should be systematically evaluated[13]. 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[7] that contains a more detailed discussion of the issues surrounding the choice of risk assessment methodologies. The United Kingdom Offshore Operators Association (UKOOA) has also published guidance on the impact of uncertainty on QRA[14].

Principle 10

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

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 SCR05 regulation 14(2).

54. SCR05 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 HSE.

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, risks will be controlled to a level that ensures compliance with 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[8] sets the value of a life at £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. HSE 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. UKOOA has also published guidance[15] on the ALARP decision-making process, aimed at helping to assess the relative importance of the various factors involved.

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 HSE as satisfying the law when applied in an appropriate manner. This may be achieved by reference to conformance with appropriate codes, standards and guidance. HSE has set out such information in guidance[16]. 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.

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[10,11,12].

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[17] regulation 4 and Schedule 1.

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:

a. elimination and minimisation of hazards by design (inherently safer design),
b. prevention (reduction of likelihood),
c. detection (transmission of information to control point),
d. control (limitation of scale, intensity and duration),
e. 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 dependability in reducing risk compared with systems of work and similar procedural measures. For more information see HSE Research Report OTH 96 521[18].

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 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,

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.

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 personnel from 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,

i. mooring line emergency release.

j. well control equipment and systems

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.

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

Principle 21

The measures and arrangements for the management of an emergency should be identified

83. SCR05 requires a demonstration that the management system is adequate to ensure that there are appropriate arrangements to protect people from specified hazards and to enable their evacuation. 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 or rescue 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 to show that the measures taken, and arrangements in place, are likely to be appropriate for protection of the people on the installation from the various events that could give rise to:

a. A major accident involving fire or explosion; or

b. The need for evacuation, escape or rescue 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.

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.

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.

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.

Design

106. SCR05 requires a design notification for a new production installation that is to be established, and for HSE 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 HSE, but HSE will be guided by APOSC in making comments.

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 DTI, at a time when it would not be difficult or expensive for the duty holder to take into account any matters relating to health and safety raised by HSE. HSE 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 will be controlled so as to ensure compliance with 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 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.

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. Under SCR05 regulation 27, transitional arrangements have been set up and for a limited period duty holders may choose how to address the SCR05 requirements that apply to combined operations. Where a duty holder elects to submit a combined operations safety case as if under SCR92, the APOSC principles 36-40 from the 2004 version of APOSC will apply. These are in Annex 1. Where the duty holder elects to conform immediately with SCR05, the following guidance and principles apply.

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

116. Under SCR05, 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. HSE will be guided by APOSC in considering these notifications. Combined operations notifications do not however require acceptance by HSE.

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:

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.

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, or fire-fighting equipment) 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 critical elements (SCEs) 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 (SCR05 regulation 14(1) or 14(2) as appropriate) or final dismantlement (SCR05 regulation 11). 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 involved in the transport and disposal of decommissioned or dismantled items are outside the scope of SCR05,

    c. the environmental impact aspects of offshore operations are outside the scope of SCR05,

    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

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 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)[19,20] will contribute to the requirements of SCR05. 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 safety systems during decommissioning or dismantlement

130. Operators have a duty under DCR[19,20] 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. The decisions and arrangements made by operators to ensure compliance with DCR will contribute to meeting the requirements of SCR05.

131. The operational status of safety-related plant, equipment and systems should be summarised. This includes plant and arrangements for:

    a. gas, smoke or toxic fume detection,

    b. fire detection, prevention and mitigation,

    c. facilitating escape, evacuation and rescue.

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 concurrent activities and of the numbers of people exposed.

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,

e. arrangements for verification of SCEs.

References

1 A guide to the Offshore Installations (Safety Case) Regulations 2005 L30 HSE Books 2006 (http://www.hse.gov.uk/consult/condocs/offshore.htm)

2 Offshore Installations (Safety Case) Regulations 2005 Regulation 12 - Demonstrating compliance with the relevant statutory provisions. Offshore Information Sheet No 2/2006 (http://www.hse.gov.uk/offshore/sheet22006.pdf)

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

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 Successful health and safety management HSG65 HSE Books 1997 ISBN 0717612767

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)

11 Assessing compliance with the law in individual cases and the use of good practice (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)

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 Guidance for the topic assessment of major accident aspects of safety cases (GASCET) to be published.

17 Management of Health and Safety at Work Regulations 1999. Approved Code of Practice L21 HSE Books 2000 ISBN 0717624889

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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

Other sources of information

1 The Provision and Use of Work Equipment Regulations 1998 SI 1998/2306 HMSO 1998 ISBN 0110856252

2 Application of QRA in operational safety issues HSE Research report 025 HSE Books 2002 ISBN 0 7176 2570 2 (http://www.hse.gov.uk/research/rrhtm/rr025.htm)

3 A guide to the Offshore Installations (Safety Representatives and Safety Committees) Regulations 1989 L110 HSE Books 1998 ISBN 0717615499

4 Commercial diving projects offshore Diving at Work Regulations 1997 Approved Code of Practice L103 HSE Books 1998 ISBN 0717614948

5 Diving equipment systems inspection guidance note (D.E.S.I.G.N.) AODC 052 International Marine Contractors Association 1995

6 Guidelines for fire and explosion hazard management EHS03 UKOOA 1995

7 Guidelines for the management of emergency response for offshore installations Issue 2 EHS02 UKOOA 2002

8 Guidelines for management of safety-critical elements - a joint industry guide EHS04 UKOOA1996

ANNEX 1: Principles relevant to Combined Operation Safety Cases submitted under transitional arrangements in SCR05 regulation 27 i.e. in conformance with the Offshore Installations (Safety Case) Regulations (1992)

These principles and guidance sections are taken from the 2004 revision of APOSC and will apply when a SCR92 combined operations safety case has been submitted under the transitional provisions of SCR05. These apply between 6 April 2006 and 6 October 2007. This annex will be removed once the transitional period is over.

Combined operations

A1. The accepted safety cases for each installation involved in a combined operation form the starting point of a combined operations case.

2004 Principle 36

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

A2. This should include interfacing of the management systems, identification of any new major accident hazards, and risk evaluation arrangements relating to the combined operations. The prevention, detection, control and mitigation strategies to be adopted for these additional hazards should be addressed.

A3. The decision, command and communication arrangements should be described. The relationships and arrangements for co-operation between the parties involved should also be defined.

A4. Where other vessels, for example DSVs and HLVs, are working during a combined operation, the management of their activities should be coordinated with the management systems for the installations.

2004 Principle 37

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

A5. Any aspects that may require further consideration should be identified and addressed. These may include:

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).

2004 Principle 38

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

A6. The techniques used to identify and assess any additional major accident hazards should be briefly described, and the results summarised in the case. Reference can be made to the techniques and assessments for the individual installation cases.

A7. 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.

A8. 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.

2004 Principle 39

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

A9. 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, or fire-fighting equipment) should be considered. Any limitations on these arrangements should also be considered, for example bridge link disconnection in adverse weather.

2004 Principle 40

Elements that become SCEs 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

This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.