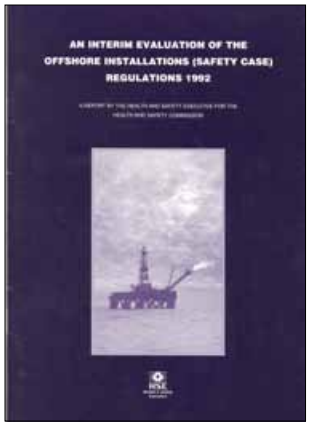
An interim evaluation of the Offshore Installation (Safety Case) Regulations 1992

A report by the Health and Safety Executive for the Health and Safety Commission



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Whenever there is major new legislation, the Health and Safety Executive (HSE) studies the impact and effectiveness that these new regulations have on the industry involved. The Offshore Installation (Safety Case) Regulations 1992 implement some of the principal recommendations from the Cullen Report into the Piper Alpha disaster that occurred in 1988. This interim evaluation report is based on five studies. Two studies were undertaken by HSE and three by external research organizations.

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Summary of the main findings

- Although a number of factors have been at work, including the industry's own initiatives following the Piper Alpha disaster, the overall conclusion – supported by independent research findings – is that the Safety Case Regulations are having a positive impact on the offshore industry's approach to the management of safety.
- Benefits include a more focused awareness of risk, better targeting of safety-related expenditure and improvements in safety management systems.
- The research indicates that managers in general support the safety case concept.
- Workers say they feel more confident about offshore safety now that installations are required to have an accepted safety case.
- There is evidence of a substantial reduction in risk.
- Industry compliance costs to the end of 1995 are estimated to be in the range £1.2 billion – £1.4 billion. This falls within the lower end of the range of £1.2 billion to £2 billion forecast in HSE's cost–benefit assessment.
- HSE will discuss with the industry ways of improving the regime and minimising safety case preparation and assessment burdens.

Introduction

1 It is the normal policy of the Health and Safety Executive (HSE) to undertake a formal evaluation of the impact and effectiveness of major new legislation wherever a substantial change in practice for industry, or indeed the regulatory authorities, is involved and where the results may have implications for the development of HSE's future policies in these or related areas.

2 The Offshore Installations (Safety Case) Regulations 1992 are a notable example of such legislation. Made in November 1992 and introduced with effect from 31 May 1993 (subject to certain transitional provisions), the Regulations implement some of the principal recommendations of the Report of the Public Inquiry into the Piper Alpha Disaster (the Cullen Report). The Piper Alpha disaster, which occurred on 6 July 1988, had resulted in 167 fatalities and the destruction of a major North Sea oil production platform. Examination of the causes of the accident led to the Inquiry making radical proposals directed towards the prevention of another such disaster. The recommendations which the Safety Case Regulations are designed to implement form part of a new approach towards the identification and control of risks arising from major accident hazards offshore, and towards the management and regulation of offshore health and safety as a whole.

3 The Regulations require operators of fixed installations and the owners of mobile installations operating in British waters or UK-designated areas of the continental shelf to submit to HSE a document known as a safety case for each of their installations. The safety case must contain sufficient particulars to demonstrate that adequate systems are in place for the management of health and safety in accordance with statutory requirements, and that measures have been or will be taken to reduce this risks to personnel from major accident hazards to the lowest level that is reasonably practicable.

4 Each safety case is assessed by HSE's Offshore Safety Division with a view to formal HSE 'acceptance'. After the expiry of a transitional period on 30 November 1995, it will be unlawful to operate an installation on the UK continental shelf unless the relevant safety case has been accepted by HSE.

5 Before the regulations were introduced, in accordance with normal practice HSE economists prepared a cost-benefit analysis (CBA) of the proposed legislation. This was subsequently reviewed to take account of the draft Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations (PFEER), one of a set of new regulations intended to complement and support the safety case regime. As part of the evaluation of the effect and operation of the Regulations, some assessment needs to be made as to how far actual costs and quantified benefits correspond with those predicted in the CBA.

6 The present Interim Evaluation Report is based on the results of five studies. Two were undertaken in-house by HSE, and analyse data derived from HSE's assessment of safety cases. Three were undertaken by an external research organisation and deal with the views of management and the industry workforce as to the impact of the Regulations, together with a preliminary review of available evidence as to costs and benefits.

Timing and content of the safety case regulations evaluation project

7 When the draft Regulations were submitted to the Health and Safety Commission for approval in September 1992, it was envisaged that a full evaluation of the effect of the Regulations would not be undertaken until the regime had been fully in force for some two years, that is some two years after the end of the transitional period on 30 November 1995, meaning that a report would not be ready until late 1997 or 1998 at the earliest. The Commission expressed some disappointment at having to wait so long for feedback on the effect of the Regulations, so it was decided to bring forward the main evaluation by a year to late 1996, and to undertake an interim evaluation before the end of the transitional period to cover the first two years of operation.

8 The in-house studies undertaken for this interim evaluation focus on HSE's experience of assessing safety cases and are based on the assessment records of HSE's Offshore Safety Division. The first in-house study (at Annex 2 to the present report) deals with the industry's compliance with the safety case submission requirements and with issues arising from HSE's assessment of the cases submitted up to the end of the first quarter of 1995. The second in-house study (at Annex 3) examines quantified risk data from a limited number of the safety cases assessed to date, and attempts to draw some preliminary conclusions as to the effect of the safety case regime on risks to persons working offshore.

9 The Interim Report also draws on the results of three external studies carried out on HSE's behalf by Aberdeen University Research and Industrial Services Ltd. Two of these surveys were designed to obtain the views of a representative sample of senior managers and the workforce on the impact of the Regulations on offshore operations and the management of safety. In addition, information from the sample of companies participating in the management survey was sought on the costs of compliance with the Safety Case Regulations: this study examines the evidence to date as to the actual costs and benefits attributable to the Regulations, including the expenditure incurred in preparing safety cases and undertaking remedial work on installations.

10 HSE considered it appropriate to contract out these attitude and compliance cost surveys to a third party, in order to introduce an independent element into the evaluation exercise and encourage frank responses from interviewees.

11 HSE proposes to follow up the compliance cost component of the surveys in a full evaluation of the Regulations to be undertaken in 1996, with a view to obtaining an updated estimate of costs and benefits, though it is not proposed to repeat the management and workforce attitude surveys. This further evaluation would also include a follow-up, in-house study on compliance with safety case submission requirements and on the outcomes of the assessment process, and a more complete study of the effect of the safety case regime on risks to persons, supplemented perhaps by studies of accident statistics and of the operational benefits associated with effective safety management systems.

The interim evaluation findings

The external research studies

12 The results of the external studies were set out in a report to HSE by Aberdeen University. The researchers' Executive Summary of their findings is reproduced as Annex 1 to the present report.

13 The intention was to obtain information from a representative range of types and size of company. The selection criteria included the numbers of installations operated on the UK continental shelf and world-wide and, to ensure representation of the range of nationalities, the country of origin of the company. Installation-based selection criteria were also incorporated into the sampling process, including installation type, installation size, installation age and, for fixed installations, geographical location.

14 HSE had no part in the selection of the companies to be surveyed. This was treated as a matter for the researchers, in order to avoid compromising confidentiality and the independence of responses. By the same token the results of the surveys in Aberdeen University's report to HSE have been anonymised, in order to protect the identities of individual companies and interviewees.

The Senior Management Survey

15 As indicated in Annex 1, a total of 21 companies who were duty-holders under the Safety Case Regulations participated in the survey. Of these,16 were operators of oil and gas platforms and five were mobile drilling rig owners. In addition, the views of contractors were surveyed through interviews with safety managers in four major offshore contracting companies. Interviewees in the main respondent companies included Board Members, Operations Managers, Safety Managers and Offshore Installation Managers (OIMs).

16 The overall conclusion from this survey is that the Safety Case Regulations are generally seen by managers as having had a positive impact on the industry's approach to safety management. Widespread support is said to have been expressed both for the concept of the safety case and of the central role of the Regulations in the development of a goal-setting approach to offshore safety.

17 Among the benefits identified were: a generally heightened safety awareness offshore; a focusing of attention on the most important safety issues and risks, of which the driving forces included the formalisation of risk assessment requirements; and, related to this, the development of a more systematic, risk-based approach to decision-making. The application of more structured thinking to safety decisions was identified not only as a means of improving safety performance but also as a path to greater efficiency in safety-related spending, through targeting resources more effectively.

18 A further area in which the Regulations were found to have had a significant effect was in the review and formalisation of duty-holders' safety management systems. For many companies, safety management systems had existed before the introduction of the Safety case Regulations. However, the new regulatory requirement to demonstrate to HSE not only that such systems exist but that they are adequate to ensure compliance with statutory health and safety requirements was found to have induced companies to review their existing arrangements and place their safety management systems in a clearer framework.

19 It must be acknowledged, however, that other influences on the evolution of safety management systems have been at work in recent years, and some of these are unrelated to the Safety Case Regulations themselves. For example, some respondents to the Senior Management Survey said that a number of business factors had had some influence on the development of safety management systems in their companies during the period since Piper Alpha. Some of the larger production companies noted the importance of internationalisation of their business is helping to promote a more systematic and effective approach to management, in which safety management is integrated into management as a whole through the application of loss prevention and Total Quality Management concepts. For one respondent, the advent of the Safety Case Regulations was a 'happy coincidence' in terms of management system development.

20 Other influences on safety management development noted by respondents included across-the-board health and safety legislation, for example the Health and Safety at Work etc Act 1974 and the Management of Health and Safety at Work Regulations 1992. HSE guidance in the form of the publication 'Successful Health and Safety Management' also appears to have had some positive influence.*

21 An attempt was made in the survey to distinguish the effect of the Safety Case Regulations from other factors bearing on safety management change, such as the impact of the Piper Alpha disaster and the Cullen Report. About one-third of the companies surveyed said they had developed their safety management systems in response to the Safety Case Regulations. Two more, one with a system in place before Piper Alpha, had changed their systems in response to the Regulations. Thus, nine companies out of 21, or just under half of the surveyed companies, acknowledged a direct influence of the Regulations on their safety management systems. The majority of the remainder (10 out of 12) indicated that the main influence on their systems had been the Cullen Report.

22 Some management interviewees who did not view the Safety Case Regulations as a major initiator of change in the industry's approach to managing safety saw the shock of the Piper Alpha disaster itself as the biggest single driving force. However, as the report makes clear, the immediate industry responses to the lessons of Piper Alpha were predominantly technical remedial measures on existing platforms, or changes in the engineering design of new installations, carried out either on the basis of the company's own analyses or in response to immediate post-Piper Alpha legislation, notably the Offshore Installations (Emergency Pipe-line Valve) Regulations introduced by the then Department of Energy in 1989. The majority of respondents, while agreeing that these post-Piper Alpha engineering modifications were important, considered that the most significant changes were not in hardware but in attitudes, awareness, procedures and safety management systems, which are at the heart of the Safety Case Regulations. The point was made that, whereas technical measures are designed to prevent or mitigate rare extreme events, improved safety management systems have impact on day-to-day operations.

** Reference: 'Successful Health & Safety Management' HS(G)65 HMSO 1991 ISBN 0-11-885988-9*

23 Respondents were generally positive about the impact of the changes in their safety management systems (whether driven by the Regulations or not) on safety performance. However, this was generally seen as a long-term future effect and not separable from other contributions to reduced accident frequencies.

24 While there is little evidence of the Regulations being regarded simply as a legislative burden, or of companies adopting an attitude of reluctant compliance, the survey identified a number of problem areas within the new regime. These can be summarised under the following (partly overlapping) headings: bureaucracy/ paperwork burden; legislative overload; fears of a drift back towards prescription; inappropriateness of the regulations to certain sectors; and the extent of reliance on Quantitative Risk Assessment (QRA) and the credence to be attached to the results.

25 A widespread feeling was noted that the safety case preparation, submission and acceptance process was unduly bureaucratic and that both the Regulations and their administration were too inflexible. This was seen as a particular problem for smaller companies, but affected large companies as well. Another common concern was the amount of new legislation being applied offshore. This legislation included the introduction of offshore-specific regulations designed to underpin the Safety Case Regulations – notably the Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995 (PFEER) – and the offshore application of onshore regulations. This created a burden not just for senior management but more particularly for the offshore supervisory staff responsible for overseeing and documenting the relevant procedures.

26 The most widely expressed concern about potential disbenefits of the new regime was fear of a return to prescription. However, this was most frequently expressed not in the context of the Safety Case Regulations themselves but in that of PFEER and its associated Approved Code of Practice (ACoP). One manager noted that the so-called underpinning regulations, with their ACoPs, threatened to dilute the power of the safety case itself.

27 Drilling company managers pointed out that the Regulations had been a response to a major explosion and fire on a large production platform and doubted their relevance to drilling operations. Time and effort were wasted for no real benefit to them. One respondent complained about the burden of producing separate safety cases for each of the company's installations despite some of them being identical in design. This type of sentiment was to some extent echoed by managers in smaller operating companies.

28 Lastly, a range of attitudes was expressed towards QRA. The predominant view recorded was that QRA had played a central role in formalising and systematising companies' approaches to risk assessment and control, and that the effects of this had been generally positive. QRA was seen by many respondents as a useful management tool, for example in establishing a relative ranking of risks, in identifying previously unknown risks and in the more cost-effective planning of maintenance. However, there was scepticism about the extent of reliance on QRA and about the value of the effort required to carry out such studies as part of the safety case preparation and submission process. Some managers expressed doubts about the value of high-level QRA and the extent to which reliance was placed on Potential Loss of Life (PPL) figures derived from such studies. The technical nature of QRA was also seen as a potential obstacle to workforce involvement in the safety case process. QRA was often the single element of the safety case preparation undertaken by outside contractors, rather than in-house, the lack of company expertise or resources being the main reason given for adopting this course.

29 Some of these issues are referred to in the concluding section of this report.

The Interim Compliance Survey

30 The main aim of the Interim Compliance Cost Survey was to identify the incremental expenditure (over and above that relating to normal operational activities) that companies have incurred in order to comply with the Safety Case Regulations, distinguishing this from other expenditures incurred in the aftermath of the Piper Alpha disaster, those incurred to comply with unrelated regulations (such as the regulations requiring in the installation of emergency shutdown valves), and those incurred as a result of (non-safety case related) recommendations in the Cullen report. An attempt was also made to identify benefits and any financial savings that may have been achieved to date.

31 The sample of companies selected for the cost survey was the same as that used for Senior Management Survey. Of the 16 oil companies and five drilling companies selected, 15 oil companies and three drilling companies returned full, quantitative data. The researchers were subsequently able to obtain good quantitative data from the one outstanding oil company in the course of an interview.

32 During the survey, many respondents pointed out that it was difficult to distinguish expenditures associated specifically with the Safety Case Regulations from those arising from the Cullen Report and from companies' own initiatives following Piper Alpha, and indeed to separate these from spending on normal business activities. Nevertheless, the response to the survey was very positive and good quality data were obtained despite the difficulties, enabling the survey team to make an estimate of overall 'Cullen costs' and the proportion attributable to the Safety Case Regulations themselves. HSE is very grateful to the companies involved for their time and trouble in providing data and for their co-operation with the survey team.

33 Detailed information and tables are set out in the relevant section of Annex 1. It will be seen that, after grossing up the data supplied by respondent companies to allow for companies not included, the researchers estimate that aggregate 'Cullen' expenditure, including that on emergency shutdown valves, incurred or committed by the industry from 1988 up to the end of 1995 amounted to between £2.3 billion and £2.6 billion (at 1995 prices). Of this total, expenditure specifically attributable to the Safety Case Regulations is estimated to have amounted to between £1,189 million and £1,355 million (at 1995 prices).

34 Comparison of these results with the estimates in the original cost-benefit assessments is not straightforward. Costs and benefits were aggregated over a 15-year period from 1992-2006 and discounted to 1993. Safety case-specific costs in the revised CBA of September 1994 were estimated to fall within the range £1.6 billion to 2.5 billion. Taking account of some net savings estimated to be achievable as a result of the deregulatory effect of some of the PFEER provisions, a revised total of £1,550 million-£2,400 million was given.

35 For the purposes of the present evaluation exercise, HSE economists have attempted a comparison and reconciliation between the Aberdeen University results and the estimates made in the CBA. This has entailed a reworking of the revised CBA to include estimates of costs up to the end of 1995, at 1995 prices. The results of this reconciliation are summarised in the following table:

Aberdeen University estimates of safety case costs compared with revised CBA compliance costs for the period 1992-1995, at 1995 prices

Aberdeen University estimates		*Revised CBA estimates*	
low	*high*	*low*	*high*
£1,189m	£1,355m	£1,228m	£2,048

36 It will be seen that the figure at the bottom of the range in the revised CBA is a little higher than the lower figure in the external survey. However, the research report indicates that companies had not been able to incorporate all senior management and executive staff time in their estimates and that consequently it might be appropriate to increase total costs by about £100 million. If only half of this is directly attributed to safety case compliance (just over half of total 'Cullen costs' were identified in the survey as safety case-specific), then the small divergence at the bottom of the range is covered. The conclusion, then, is that the research shows that estimated safety case-specific expenditure to the end of 1995 is within the bottom fifth of the range of costs suggested by the CBA.

37 As to benefits, the CBA estimated that the main pay-off would be a cumulative one over a long period and that the predominant element of this would be benefits from a reduction in non-catastrophic accidents due to improved safety management. Estimated cumulative benefits from this source over the 15-year period to the year 2006 were in the range £1.5 billion-£3.5 billion. With a further cumulative benefit of £1.1 billion attributable to the predicted reduction in the risk of a catastrophic accident over the period, total cumulative benefits were estimated to fall within the range £2.6 billion and £4.6 billion. It was, however, stated in the CBA that, while the benefits from improved safety management would become significant over time, they were likely to be modest at first.

38 As the researchers point out, not surprisingly at this early stage quantified financial benefits identified by the surveyed companies were low. However, this estimate does not take account of the further benefits which the industry respondents themselves identified in their interviews with the researchers, even if quantification was not possible. All companies are reported to have stated unequivocally that the Regulations provided considerable unquanitfiable and consequential benefits; these included financial savings due to reduced accident frequencies, reduced plant down-time and reduced loss of production.

39 Another important finding is that many senior industry personnel see considerable value in the focus and use of risk assessment techniques associated with the new regime, particularly in targeting safety-related expenditure effectively.

40 Real benefits, even if difficult to quantify in financial terms, are also said to have arisen from wider changes in safety management philosophy and culture offshore which the Safety Case Regulations are seen as having helped to underpin, and there appears to be a general consensus that the greater awareness associated with the regime should help to encourage efficiencies in safety spending and reduce costs in the future.

41 Lastly, a high proportion of respondents – 15 out of the 16 operating companies surveyed – indicated that the Regulations had had a beneficial impact on their overseas operations. Two respondents, moreover, said that the Regulations were having some impact on their operations onshore. Three of the large oil companies indicated that they had applied a safety case approach world-wide. One said of the safety case model that 'it sets the legislative standard and has a big global impact'. Application appears to have ranged from wholly adopting

the safety case system to adopting the essential elements without the same level of detail as in the UK.

The Workforce Survey

42 The purpose of the Workforce Survey was to complement the management surveys by obtaining information from a representative sample of the general workforce as to the impact of the Safety Case Regulations on various aspects of safety in the offshore industry, including safety awareness, risk perception, consultation and training. Views were obtained using a survey method similar to that employed in an earlier survey conducted by Aberdeen University into the impact of the Offshore Installations (Safety Representative and Safety Committees) Regulations 1989. Questionnaires were issued at ten of the twelve UK heliport terminals regularly used for offshore personnel flights, for completion by outbound passengers. Questionnaires were also distributed to personnel on fixed-wing flights between Aberdeen and Shetland. It was hoped to obtain 1,000 responses. In the event, 1,102 questionnaires were returned.

43 The survey results indicate that general workforce awareness of the existence and nature of safety cases is high. There was, however, some evidence of confusion as to the respective roles of companies and HSE in the safety case process, with almost one in four of the sample believing that safety cases were HSE instructions to companies to carry out safety improvements and over one in five believing that HSE was responsible for producing safety cases. Safety representatives displayed a slightly higher general understanding of the nature of the new regime, though a minority showed a lack of understanding in some areas. For example, 19 per cent of safety representatives appeared to be unaware that management has a statutory duty to consult them on the preparation of safety cases.

44 Just under three-quarters of those surveyed said they had been provided with information on the Regulations. Information on this, and on respondents' own installation safety case, came predominantly from management, though safety representatives appeared to be a significant additional source of information.

45 The survey found that there was general satisfaction amongst those provided with information as to the amount provided (71 per cent of the sample considered that the amount was 'about right'). However, over a quarter of the sample said they required additional information: summary information and information tailored to particular worksites featured prominently in suggestions for additional information, as did regular information on the progress or updating of safety cases.

46 There is an echo of these latter points, and of the further observation that members of the workforce as a whole are relatively unlikely to have taken an active part in safety case-related activities, in one of the findings of the Senior Management Survey. There it is noted that efforts to involve the workforce in safety case-related activities have had mixed success, the problem being how to translate a complex document into information which is intelligible and relevant to workers at all levels and which will enhance understanding of the link between activities at particular worksites and the aims of the safety case as a whole.

47 It should be recognised that the formal regulatory requirements on information and consultation refer to the provision of information to and consultation with offshore safety representatives. These requirements include providing safety representatives with a summary of the main features of the safety case, including any particulars concerning remedial work and the time by which it will be done. However, wider workforce involvement is encouraged in the published HSE

guidance. It is clearly not an easy matter to achieve this aim when dealing with complex documents and highly technical subjects. Part of the answer may lie in training. The Workforce Survey found that formal training specifically relating to the Safety Case Regulations or process is rare among the general workforce. Information on safety cases was, however, included in other forms of training such as an emergency or survival courses and induction training. In many people's view, such training enhanced their understanding of their own role in contributing to improved safety on their installation.

48 In response to questions on safety and risk over 80 per cent of respondents said they thought that both management and workers now paid greater attention to safety issues than they did before 1988, though there was rather less perception of change in the last year. Asked whether they were aware of changes to the way in which their installation had been managed since the beginning of 1993, 42 per cent of respondents said they were. This proportion rose to 53 per cent when only those respondents who had worked on the installation for a year or more were considered. Views as to the effects on safety of these changes were largely positive (ie about 70 per cent of the specified changes were listed in the 'made me feel more safe' category). A high proportion of these changes were in areas attributable to the Safety Case Regulations.

49 Respondents were also asked to state how they felt about their safety as a result of the fact that every offshore installation would be required to have a safety case accepted by HSE in order to operate. The great majority (72 per cent) said it made them 'more confident that risks are being managed/reduced'. Of the remaining 28 per cent , most said they felt no differently. Only eight individuals (fewer that one per cent of respondents) said they felt less confident as a result.

The in-house HSE studies

50 As indicated above, the in-house studies consider evidence of the effect of the safety case regime, including the assessment process, contained in the assessment records of HSE's Offshore Safety Division (OSD). The full texts of the two reports are set out at Annexes 2 and 3 respectively.

The OSD study on compliance with submission requirements and on the outcomes of assessment

51 The conclusions of this study are that the industry generally has made conscientious and effective efforts to comply with the submission requirements. On the basis of the relatively small number of design safety cases (thirteen) submitted by the end of the survey period (31 March 1995), it should, however, be added that a better balance needs to be achieved between the level of detail in submissions and the timeliness of submissions in relation to the evolution of the projects which they cover. This matter is to be pursued further in dialogue with the industry and is referred to again in the concluding section of this report.

52 As to assessment, the formal means by which OSD notifies companies of its concerns arising during the assessment of safety cases is to send a written Issue Note, though matters of concern will normally be discussed informally before this step is taken. Issue Notes are ranked according to severity of the issue raised. The highest levels are Levels 1 (the issue must be resolved before the safety case can be accepted) and 2 (the issue may prevent acceptance of the safety case). By the end of March 1995, thirteen Level 1 notes had been issued and 575 Level 2 notes. Most of these had been satisfactorily resolved by that date.

53 It is possible to make some tentative generalisations as to the types of issue that have been raised so far. The study suggests, on the basis of analysis of a limited sample, that almost 45 per cent of Issue Notes were raised in respect of engineering matters, a further 40 per cent were raised in respect of hazard analysis and risk assessment, and the remaining 15 per cent dealt with management system matters.

54 Table 3 of Annex 2 gives some examples of changes that have been made as a result of OSD raising these issues in the course of safety case assessment. They include the installation of new or modified equipment, more rigorous hazard identification and risk assessment and improved fire protection for emergency escape routes.

55 Table 4 of Annex 2 gives examples of generic issues arising from OSD's assessments, some of which will need to be pursued further with industry bodies. These include questions as to the interpretation and application of 'suitable and sufficient' Quantitative Risk Assessment, particularly in relation to drilling rigs, the adequacy of QRA models and data and the lack of meaningful performance standards for fire and gas detection and passive fire protection.

56 The study makes the point that, in evaluating the impact of the safety case process on offshore safety, and in judging the effect of assessment, account should be taken of its indirect impact. The knowledge that cases will be probed by the regulatory body provides a significant incentive for duty-holders to undertake thorough safety assessments and respond to the results in a positive manner by proposing measures in their cases to enhance safety standards. This indirect effect of the assessment regime may therefore be as great or greater than its direct impact, though the effect is not readily quantifiable.

57 This point may be relevant in balancing the view of sceptics within the industry to the effect that the safety case process has generated a mountain of paperwork for no real improvement in safety. Some respondents to the Senior Management Survey acknowledged that the safety case process, including awareness that the case would be tested by HSE, had encouraged a constructive internal debate within companies which could lead to improvements in the way in which safety was managed. As one manager said: 'The Safety Case Regulations forced us to go back to first principles'. The challenge for the future is how to maintain and enhance the value of the safety case process while minimising the paperwork burden.

The OSD study on the effect of the safety case regime on risk

58 The report at Annex 3 analyses risk-based data extracted from a limited number of selected safety cases in the course of assessment and draws some tentative conclusions as to the effect that the safety case regime may be having on risks to persons working offshore.

59 The thirteen cases selected for this study contained sufficient quantified risk data to enable conclusions to be drawn as to levels of risk on the installations concerned before and after remedial work. The thirteen installations cover a reasonably representative range, by age and type, of the installations present on the UK continental shelf. (Of the most regularly encountered types, only jack-up drilling rigs and mobile accommodation units are not represented in the survey sample.)

60 Table 1 of Annex 3 summarises individual risk (IR) data presented in the selected safety cases. The Initial IR is the estimated risk before implementation of

the remedial work plan set out in the safety case and the Final IR is the estimated risk after the remedial work has been carried out. Using these data, estimates of the Potential Loss of Life (PLL) on the installations were made. Initial expected fatalities for all the installations in the survey were four a year. The total PLL figure after remedial work falls to 1.19 a year, giving an estimated PLL reduction of 2.81 fatalities a year.

61 Most of this reduction (82 per cent) is shown to relate to three of the older installations, which are all first-generation, single-structure production platforms.

62 OSD is careful to point out in this study that the risk reduction shown will very probably be due to a combination of factors, and that it is unlikely to be due to the Safety Case Regulations alone. Practices and procedures offshore are continually evolving, and will include operational changes, process improvements and risk-reducing innovations which may, at least in part, be business-driven. Other driving forces may include legislation other than the Safety Case Regulations, technical guidance and what the study calls 'other post-Piper Alpha activities'. A similar point is made in the Senior Management Survey report: offshore management is likely to be responding to a variety of influences, including commercial considerations, a range of legislation and official guidance, and technical and engineering improvements derived from companies' own analyses following Piper Alpha. It is difficult to separate these effects.

63 Nevertheless, it is possible to say that the evidence available from this limited study suggest that there is a potential for a reduction in the risk of fatalities, when planned remedial measures on the installations concerned have been implemented, of about 70 per cent. This is not inconsistent with the view expressed in the CBA that a 90 per cent risk reduction was achievable over a period of time. However, the risk reduction is likely to be due to a combination of influences and driving forces, not just the Safety Case Regulations themselves.

Conclusions of the interim evaluation, and the next steps

64 The main conclusion of this interim evaluation, based on the evidence of the internal and external studies which contributed to it, is that the Safety Case Regulations appear to be having a positive impact on safety in the offshore oil and gas industry, in terms particularly of a heightened awareness of and more focused attention on risk, improvements in the management of safety and the better targeting of safety-related expenditure.

65 Although the quantified financial benefits identified by managers in their initial response to the Interim Compliance Cost Survey questionnaires were small, the researchers found during interviews that all companies nevertheless recognised that the Regulations had provided considerable further benefits, even if these could not be quantified in money terms at the present stage, such as savings due to reduced accident frequencies, reduced plant down-time and reduced loss of production. There was also the feeling that the greater awareness associated with the new regime would tend to encourage efficiencies in safety-related spending and thus reduce costs in the future.

66 The Senior Management Survey found that most respondents regarded the safety case regime as having put Britain in the forefront of offshore safety legislation. Both the Senior Management and the Interim Compliance Cost Surveys also found that companies with overseas operations were tending to apply at least some of the lessons learned to their operations outside the UK, even where this was not required by local legislation. Application is said to have ranged from wholly adopting the safety case regime to adopting the essential elements without the same level of detail as in the UK. Two respondents to the Interim Compliance Cost Survey are reported to have said that the Regulations were having some impact on their onshore operations as well.

67 The views of the (non-managerial) workforce members who completed questionnaires as to the impact of the Safety Case Regulations also appear to be generally positive. Most respondents to the Workforce Survey said that they believed that both management and the workforce as a whole now paid greater attention to safety than before 1988. Over half of those respondents who had worked on their present installation for a year or more were aware of changes to the way in which the installation had been managed since the beginning of 1993. Most of these changes made the respondents feel more safe. When asked how they felt about their safety as a result of their installation being required to have an accepted safety case, most people (72 per cent) in the survey sample said that it made them more confident that risks were being managed or reduced.

68 Some people in the offshore oil and gas industry are known to feel that insufficient credit has been given to the industry for its own efforts to increase safety since Piper Alpha, and that too much credit has been attached to regulatory activity in general and the Safety Case Regulations in particular. Clearly, a number of factors and driving forces have been at work and it is difficult to distinguish between these effects with any exactitude. Part of the difficulty arises from the fact that some industry action taken before the formal introduction of the Safety Case Regulations is likely to have been taken in anticipation of those Regulations, since the safety case concept was dealt with in some detail in the recommendations of the Cullen Report and in the associated discussion at the Public Inquiry.

69 At the same time, it is difficult to distinguish clearly between the costs arising

from the introduction of the Regulations per se and the substantial additional safety expenditure to which the industry committed itself in the aftermath of Piper Alpha. This was recognised by HSE in the original CBA prepared for the Regulations.

70 Few, however, would argue from this that the advent of the Safety Case Regulations was nothing more than a coincidence in terms of the improvements in safety management and safety awareness offshore that have taken place in the last few years. Summarising its research findings, Aberdeen University says that the Safety Case Regulations are overwhelmingly seen by the industry as having a positive impact on the industry's approach to safety management, and that managers generally support both the concept of the safety case and the central role of the Regulations in the development of a goal-setting approach to safety. Similarly positive views have been expressed by the workforce as a whole.

71 At the same time, HSE recognises that there are some problems and concerns associated with the new regime, and it will be pursuing these in the coming months in consultation with the industry. Some action has already been taken in certain areas.

72 The external researchers noted a widespread feeling among managers that the safety case preparation, submission and acceptance process was unduly bureaucratic, and that the Regulations and their administration were too flexible. Associated with this view were complaints about the paperwork burden that was being generated. Some respondents also had concerns about the extent of reliance on QRA and the credence being attached to the figures generated as a result of such analysis.

73 HSE had noted these views and takes them seriously. It also recognises that the safety case system is still evolving and that both HSE and duty-holders are in the process of learning from their experience of the new regime.

74 The evolution of the safety case assessment procedures is referred to in the OSD report at Annex 2. For example, OSD has adopted a policy of prior discussion with duty-holders on matters of concern before raising a formal Issue Note. This more flexible approach is helpful particularly in the clarification and resolution of such matters as questions of interpretation.

75 The Annex 2 report also draws attention to some HSE concerns with regard to the submission of design safety cases. Some cases were submitted at a stage when OSD's assessment could have only a limited influence on the project in question. HSE is also aware that there is now a growing tendency – partly as a result of the industry's Cost Reduction in the New Era (CRINE) initiative – for 'fast track' project management techniques to be applied to new developments, and the use of 'off the shelf' installations is a prospect for the future. HSE is conscious of the need, in seeking to influence design through the assessment of design safety cases, to take account of operators' programmes and timetables. HSE now intends to address, in consultation with the industry, the best way of achieving a balance between the level of detail included in design safety cases and the timeliness of submissions which would allow both parties to derive maximum benefit from the process.

76 Communication between HSE and the industry associations is already taking place on issues arising from the implementation of the Safety Case Regulations. A permanent body, known as the Senior Managers' Forum, comprising HSE and industry representatives, meets regularly to discuss issues of general interest or concern arising from the assessment of safety cases.

77 The Annex 2 report identifies a number of generic issues which will be considered further by HSE and the industry after the end of the transitional period. These issues include the need for further guidance on the application of QRA. Industry bodies, with advice from HSE, are to consider the concept of 'suitable and sufficient' QRA in relation to mobile units and produce guidance on the balance between qualitative and quantitative risk assessment. HSE will also take up with the industry the question of the adequacy of QRA models and data (for example in relation to ship collision risks). Other actions will include discussions with duty-holders about the achievement of reductions in risks to people on jack-up installations to the lowest reasonably practicable level.

78 HSE intends to return to the evaluation of the Safety Case Regulations next year, when more complete data on costs and benefits may be available and when both HSE and the industry will have gained further experience of operating the regime.

Annex 1 Safety Case Legislation Evaluation Project: Executive Summary

A Study undertaken for the Health & Safety Executive Offshore Safety Division by University of Aberdeen/AURIS Ltd.

I Objectives of the study

The Offshore Installations Safety Case Regulations which came into force on 31 May 1993 and which largely implement the recommendations of Lord Cullen's Report into the Piper Alpha Disaster have brought about sweeping changes in the ways in which offshore safety is controlled and managed. This has involved not only remedial changes to many installations but also the preparation and maintenance of Safety Cases for offshore installations. In addition, the Regulations require operators or owners to provide information on the steps that have been taken, and the systems that are in place, for the management of health and safety, as well as for the control of major accidents hazards.

The objectives of the study carried out by the University of Aberdeen and AURIS Ltd have been to evaluate the impact of the Safety Case Regulations on the offshore industry in terms of the views of senior management, the views of the workforce and the costs of complying with the Regulations.

II The survey sample

The overall Safety Case Legislation Evaluation Project comprises eight elements of which only four are to be undertaken by external contractors, namely:

- the Senior Management Survey
- the Workforce Survey
- the Interim Compliance Cost Survey
- the Final Compliance Cost Survey

The survey was limited to not more that 24 duty holding companies. Since the total number of fixed installation operating companies and drilling companies on the UKCS exceeds that total, it was necessary to select a sample. It was expected that company experiences of implementing the Safety Case Regulations, including meeting the requirement to demonstrate the adequacy of their safety management system, would vary considerably depending on company size and experience. Selection criteria used to incorporate a range of attributes included the number of installations in the UKCS and worldwide, company revenue, country of origin, and activities in other sectors. The same sample of companies was used for the Senior Management Survey and the Interim Compliance Cost Survey.

The relatively short duration of the survey activity resulted in a number of duty holders being unable to respond fully to requests for interviews or data. However, in total 21 duty holders were surveyed – 16 offshore operators and 5 mobile rig owners – and, despite the burdensome nature of the requests for data and

management time, they provided the survey team with complete responses. Indeed, the very co-operative assistance of all duty holders surveyed enabled a full report to be produced by the survey team.

III Senior Management Survey findings

Objectives and methodology

The aim of the Senior Management Survey was to sample the views and experience of offshore industry management personnel on the effects of the Safety Case Regulations on the organisation and operation management in a range on companies.

A sample of 21 Safety Case duty holding companies was surveyed, consisting of 16 oil and gas companies and five drilling companies. The sample was selected using the criteria of numbers and types of installation in the UKCS and worldwide, revenue, country of origin and activities in other sectors, in order to ensure coverage of experiences of Safety Cases implementation. In addition, the views and experiences of major offshore contracting companies were surveyed through interviews with safety managers in four such organisations. The sample of companies selected for the Senior Management Survey was also used for the Compliance Cost Survey.

Interview schedules were designed around five principal research questions:

- what is the relationship between the requirements of the Safety Case Regulations in respect of the management of safety, pre-existing safety management philosophy, policy and practice in the UK offshore industry?
- how have companies in the UK offshore industry responded to the requirements of the Safety Case Regulations in respect of Safety Management? To what extent was the requirement to prepare Safety Cases been seen in terms of compliance with the legislation as opposed to a catalyst for changes in management?
- what are the implications of differing approaches to Safety Cases preparation? How are the lessons from Safety Case preparation work by external consultants absorbed by duty holders?
- how have systems of management auditing evolved, and what influence have the Safety Case Regulations had on this evolution?
- to what extent have lessons learnt from company experience of Safety Case preparation been transferred across the industry?

Interviews schedules were drawn up with the aim of producing quantifiable as well as qualitative data from face-to-face interviews with four categories of manager: a Board Member, a Production Manager, a Safety manager and an OIM in each of the 16 oil and gas companies and five drilling companies, plus a single interview with a Safety Manager in four contracting companies. Interviewing took place between 10th February and 10th April 1995.

The numbers of completed Senior Management Survey interviews are shown in Table 1.

Table 1

	Oil & Gas Companies	Drilling Companies	Contractors	Totals
Companies Covered	16	5	4	25
Individuals interviewed of which:	60	13	5	78
Board Members	15	3	0	18
Operations Managers	15	3	1	19
Safety Managers	16	5	4	25
OIMs	14	2	0	16

Findings

The Safety Case Regulations are overwhelmingly seen by offshore industry as having a *positive impact* on the UK offshore industry's approach to the management of safety. Industry mangers are in widespread support both of the concept of the Safety Case, and of the central role of the Safety Case Regulations in the construction of a goal-setting approach to offshore safety legislation.

There is little evidence of the Regulations being regarded simply as a legislative burden, or of companies adopting an attitude of reluctant compliance to the implementation of the Regulations. The only exception to this was one of the five drilling companies surveyed, whose negative approach was derived mainly from a view that the Regulations were designed to deal with risks associated with fixed production platforms and were therefore inappropriate to offshore drilling operations.

Evidence on the experience of the smaller companies in complying with the Safety Case Regulations was incomplete due to pressure on management time preventing participants of three such companies in the survey. Future evaluation studies may require particular attention to this sector of the industry.

The requirement in the Safety Case Regulations for duty holders to demonstrate that they have an adequate and independently-audited management system has prompted most companies to either review their existing management systems, or to create a formal safety management system for the first time. This has resulted in a significant move towards *formalisation and standardisation of safety regimes*. This effect extends well beyond management, with strong evidence of attempts by companies to devolve the concepts and the policies associated with the Safety Case regime to the operating level.

The Safety Case process is seen by offshore industry managers as having *heightened awareness* of risks and the management thereof throughout the industry, both in management and in the workforce in general. This heightened awareness has been achieved partly through the involvement in the process of preparation of the Safety Case, partly through the identification or re-categorisation of risks as a result of carrying out QRA studies, and partly through the involvement of the workforce in the Safety Case process.

The requirement of the Safety Case Regulations for the formalised risk assessment has *focused attention* on the hierarchy of risks and has thus helped to target resources in controlling the most important risks. The Safety Case regime is also seen as having fostered a more *rational approach to decision making* with risk-

based decisions superseding judgements based on subjective experience.

A number of problem areas in the Safety Case regime were identified by survey respondents. A high proportion of managers expressed concern about the impact of the Regulations on the paperwork burden placed on the industry. This burden was perceived to exist not just at senior management level and not only during the Safety Case preparation process, but also through the fact that more stringent requirements for formalisation and documentation of procedures and practices meant increased paperwork for many offshore personnel too.

Fears were also expressed that the combination of the complexity of the Safety Case Regulations and of Safety Case themselves, implementation and interpretation of the Regulations by the regulatory authority, and the development of new legislation such as PFEER, posed a dual threat of overburdening the industry and moving the legislation back in the direction of prescription.

Drilling company managers expressed concern that the Safety Case regime had been constructed to deal with the hazards of oil and gas production platforms, many of which were irrelevant to the drilling industry. Contractors' management interviewed for the survey also felt that the Regulations had been unable to take account of significant shifts in the responsibility for design and operation from operators to contractors in recent years, and that greater attention would have to be paid to this area in future.

The survey found that managers were generally positive about the value of Quantitative Risk Assessment (QRA) as an aid to management decision-making. The benefits of QRA include the rational ordering of risks, identification of previously unknown risks, more cost-effective maintenance planning and elimination of certain costly procedures. However there appears to be considerable debate within the industry on the extent of reliance on, and the credence to be attached to, the results of QRA studies as part of the installation Safety Case. Some managers expressed doubts about the value of high-level QRA, for example in reaching overall PLL figures, while others had found it difficult to accept the findings of QRA studies when these conflicted with their own judgement based on technical knowledge and operational experience. Finally, the highly technical nature of QRA presented major problems for many companies of securing workforce understanding of and participation in the Safety Case process.

The technical nature of QRA had led most duty holders to contract out this portion of Safety Case preparation. However, many companies had moved away from reliance on, contractors for this work, partly because in-house QRA specialists are more likely to have an understanding of the role of QRA in the company's structure and operations, and are available for consultation on ongoing problems after submission of QRA reports. Future QRA work in the industry, for example as part of the first round of triennial Safety Case re-submissions, is likely to involve a higher proportion of in-house expertise.

Technical remedial work resulting from Safety Case preparation and submission is generally seen to be of less importance, in terms of its contributions to improved safety, than the *changes in management and organisation* fostered by the Regulations. In addition, the benefits or advances achieved by the Safety Case regime are commonly seen as being intangible, in that they may be difficult to measure using traditional approaches to costs and to safety performance. These include changes in awareness, heightened attention to procedures, and more integrated work planning.

Changes in corporate approaches to the philosophy, organisation and practice of safety management were widely recognised as having been a central feature of

the Safety Case Regulations. However, there was considerable variation between respondents, both between and within companies, as to the extent to which the Safety Case Regulations themselves had been the catalyst for such changes.

Among the trends in safety management philosophy identified by interviewees, integration of safety management into generic business management systems was the most significant change taking place in the industry in recent years. On the basis of interview responses alone, there were considerable differences of view, even between managers in the same company, as to the nature and impact of these changes. Safety management systems were more likely to be seen as separate from other aspects of business management when considered in terms of formal documentation and as a high-level management tool. At the operational end of the management, safety management was more likely to be seen as being integrated with business decisions more generally.

Integration of safety management was seen as being achieved mainly through the devolution of safety responsibility to line management, and the replacement of prescriptive, policing approaches to safety department responsibilities, with safety departments taking on a purely advisory role for all levels of the organisation.

Changes in safety management were seen as being driven by a range of influences. Business factors, and the influence of new management approaches such as Total Quality Management, were acknowledged as an influence by a number of companies, while the Piper Alpha disaster itself, and anticipation of the Cullen Inquiry recommendations, were two further major factors. Just under half of the surveyed companies acknowledged that the Safety Case Regulations had had a direct influence on the evolution of their safety management systems, either in terms of forcing them to develop a formal system for the first time, or leading the company to review its existing policies and procedures.

The biggest single influence of the Regulations on safety management systems was the creation of a framework within which existing systems could be formalised or new structures and procedures developed. Reviews of management which had emerged from this process had led to clarification of management responsibilities at each level of the organisation and the formalisation of reporting and auditing procedures.

The timescale of this survey did not permit analysis of changes in safety management other than *through* interviews with managers. Full evaluation of the nature of any changes on safety management would require analysis of the documentary material and changes in operational practice, particularly at supervisory level.

Respondents were generally positive about the impact of the changes in their safety management systems (whether driven by the Regulations or not) on safety performance. However, this was generally seen as being a future, long-term effort and not separate from other contributors to reduced accident frequencies. There was less support for the proposition that safety management changes improved management efficiency with a number of respondents referring to increased procedural and paperwork burdens on managers and supervisors. For the same reason, only a minority of respondents saw operational efficiency as being improved by changes in safety management driven by the Safety Case Regulations and other factors.

Greater workforce involvement was widely seen as a key area of change associated with the Safety Case process. However, much of the change in this area was related to management and organisation developments not derived from

the Regulations, or from the implementation of the 1989 Safety Representative Regulations.

Efforts to engage the workforce in discussions, activities or understanding of the Safety Case and its implications have had mixed success. A recurring theme is the problem of how to translate a technically complex and bureaucratic document into information which is relevant, useful and intelligible to workers at all levels in the industry, and which can enhance workforce understanding of the contribution of their work methods and practices and their risk perceptions and behaviour to the realisation of the aims of the Safety Case regime.

The UK Safety Case regime was seen by most respondents as putting the UK in the forefront of offshore industrial safety legislation. Those companies with other operations overseas were moving towards application of some of the lessons to their operations outside the UK. However a number of respondents made the point that internationalisation of benefits of the Safety Case/goal-setting approach could only be undertaking in accordance with local legislative and economic condition, due to competitive pressure. A minority, confined to the largest oil and gas companies, saw the Safety Case integrated safety management approach as competitive advantage in other markets.

IV Interim Compliance Cost Survey finding

Objectives of the Interim Compliance Cost Survey

The Safety Case Regulations are, according to earlier Health and Safety Executive cost benefit assessments 'intended to achieve a major reduction in the risk of accidents on offshore installations through improving the quality of Safety Management and ensuring that safety related expenditure is better targeted'. It was recognised that the Regulations would involve additional costs in preparing required Safety Cases, in validating them, and in making the necessary hardware and software improvements to win 'acceptance' by the HSE of the Safety Case. As the HSE are obliged to assess the impact of all new legislation in terms of the costs and benefits to the industry, and the nation as a whole, a survey was required to measure the costs to industry of complying with the Safety Case Regulations.

Thus, the key objectives of the Interim Compliance Cost Survey were as follows:

(i) to define the costs and financial benefits attributable to the Safety Case Regulations
(ii) to assess all the costs necessary to comply with the Regulations even where expenditure predates the Safety Case Regulations
(iii) to identify separately other expenditures to comply with unrelated Regulations (for example, requirements to install emergency shutdown valves). These costs are not regarded as part of Safety Case costs; they are part of the broader consequential costs arising from the Piper Alpha disaster and the subsequent implementation of Lord Cullen's recommendations.
(iv) to include an assessment of costs and benefits to organisations other than offshore operators where an impact can be identified.
(v) to focus on estimates of expenditure incurred in preparing Safety Cases and for remedial work arising from the Safety Case Regulations, but in addition to take a wide view and attempt to estimate savings that may have occurred.

During the course of the survey many respondents indicated that it was very difficult to accurately identify incremental expenditures associated with the Safety Case Regulations given the inter-relationship between spending on safety and normal business activities. The difficulty of the task was further compounded by the combined effects of the recommendations of the Cullen Enquiry and resulting regulations, and from the offshore companies' own initiatives following the Piper Alpha Disaster.

However, the response from duty holders to the survey was extremely positive and a wealth of evidence was provided which enabled the survey team to estimate both what might be termed 'Cullen Costs' and the proportion of Cullen Costs which may be attributable to the Safety Case Regulations.

Cullen Costs

By far the most important outcome of the Piper Alpha disaster was, Lord Cullen's enquiry into the accident and the subsequent report which was published in November 1990. A series of recommendations were made by Lord Cullen, and the offshore industry responded almost immediately. In addition to the Cullen recommendations a number of other regulations came into effect, including the Offshore Installations (Emergency Pipeline Valve) Regulations (1989) and the Offshore installations Safety Regulations (1992). The interim compliance cost survey attempted to identify incremental safety expenditure associated with the Cullen recommendations, the Safety Case Regulations and other related regulations.

The survey in effect attempted to identify *regulation driven expenditure*, and *was not intended to identify other safety related expenditure undertaken by the offshore industry on a normal operational basis.* To distinguish total costs captured in the Interim Compliance Cost Survey form other safety related expenditure, total costs are referred to here as 'Cullen Costs'. Total Cullen Costs therefore consist of 3 elements:

(1) Incremental anticipated Cullen expenditure (over and above that relating to normal operational activities) incurred by companies immediately after the Piper Alpha disaster in 1988 but prior to the Cullen recommendations at end 1990.
(2) Plus, incremental safety related expenditure (over and above that relating to normal operational activities) incurred by companies as a direct result of the Cullen inquiry on the Piper Alpha disaster.
(3) Plus, incremental safety case specific expenditure (over and above that relating to normal operational activities) incurred by companies to comply with the safety case regulations introduced in November 1992.

In the text and graphics (1) is referred to as 'anticipated' Cullen Costs, (2) and (3) combined are referred to as 'actual' Cullen Costs.

Interim Compliance Cost Survey methodology

In order to address the objectives of the Interim Compliance Cost Survey the survey team developed a detailed questionnaire comprising both qualitative and quantitative sections. Both parts of the questionnaire were discussed in detail during face-to-face interviews with a senior financial or safety manager representing each duty holder surveyed. The detailed quantitative proforma on costs and benefits arising from all safety related regulations was returned to the survey team after each respondent had several weeks to research and verify that data were available. Questions were asked on spending commitments prior to the Safety

Case Regulations and for the period after the enactment of the Regulations to the end of 1995. Projections were also sought for the period to 2000.

In selecting the sample of oil company and mobile rig operators to be surveyed the joint survey team employed sampling criteria to ensure a good cross-section of respondents. The main concerns were to ensure that the sample represented a reasonable spread by size, parentage, and length of exposure to operations in the North Sea.

Despite the difficulty of the task, as alluded to earlier, all respondents made substantial efforts to provide data in the format requested or in a usable company format. A high success rate was eventually achieved in terms of data returned, as is shown in Table 2.

Table 2

	Interviewed face to face	Full quantitative data returned in questionairre format	Full quantitative data returned in company format	Partial quantitative data returned	No quantitative data returned
Oil companies	16	9	5	1[1]	1[2]
Drilling companies	5	3	0	0	2

[1] *A complete picture of safety related expenditure was compiled for this company from face to face interview notes and from discussions with design houses.*

[2] *From good quantitative data supplied during the face to face interview of the one outstanding oil company, a profile of total Cullen related expenditure was derived for that company.*

Quantitative analysis of compliance cost data provided by duty holders surveyed

Table 3 illustrates Cullen Costs (anticipated and actual) – for all 19 duty holder respondents to the Interim Compliance Cost Survey – committed prior to the Safety Case Regulations. Cullen Costs are shown to rise rapidly from 1989, one year after the Piper Alpha disaster.

Table 3 Offshore Installation (Safety Case) Legislation Evaluation Survey Aggregate data 1988-1992 (16 oil/gas companies and 3 drilling companies)

Expenditures Pre-dating the Safety Case Regulations (£m) (MOD)						
Cost Category	1988	1989	1990	1991	1992	Total
ESVs	4.8	16.5	294.2	111.4	38.5	465.4
Other Remedial Costs	5.6	21.4	71.1	78.6	112.5	289.3
Internal Management Costs	7.9	12.2	19.0	22.3	24.2	85.6
External Consultancy	0.1	6.3	7.0	8.1	8.4	29.9
Other	0.0	0.1	0.4	1.6	5.3	7.5
Total	18.4	56.6	391.7	222.1	188.9	877.7

The largest category of expenditure in the period prior to the Safety Case Regulations related to the fitting of emergency shutdown valves. For the duty holders surveyed a total of £465 million was spent on ESVs in the period 1988 to 1992, with a peak of £294 million being committed in 1990. This expenditure was, of course, a requirement of the Offshore Installations (Emergency Pipeline Valve) Regulations of 1989. The next largest category of spending relates to remedial expenditures including: fitting of SSIVs, HVAC, lighting, fire and gas detection, structural modifications and passive and active fire protection. Internal safety studies and 'forthwith' studies were instigated by many duty holders and represented a substantial element of internal management costs in the period prior to the introduction of the Safety Case Regulations. Between 1990 and 1992 internal management costs relating to the Cullen Recommendations and in anticipation of the Cullen Recommendations, rose from £19 million to £24 million per annum for the duty holders surveyed.

Table 4 provides a functional breakdown of 'Cullen Costs' – reported by survey respondents on an annual basis from 1992 to 1995. The breakdown of costs after the introduction of the Safety Case Regulations indicates that the vast bulk of expenditures reported by duty holders were associated with platform remedial costs. Actual Cullen Costs are shown to rise from £64 million in 1992 to a peak of £331 million in money-of-the-day terms by 1994 for survey respondents. Over the period 1992 to 1995 almost £1 billion of expenditure was committed or projected as a result of the Cullen Recommendations and the Safety Case Regulations.

Figure 1 illustrates total 'Cullen Costs' drawn from the Interim Compliance Cost Survey over the period from the Piper Alpha disaster to 1995. Total 'Cullen costs' amount to £1.9 billion for the 19 duty holders surveyed. A rapid increase in 'Cullen Costs' is shown within the first two years of the Piper Alpha disaster. The majority of this spending related to the fitting of emergency shutdown valves. However, a considerable amount of money was also committed to internal safety studies and other remedial work considered necessary following the disaster.

Lord Cullen completed his report into the Piper Alpha disaster in November 1990 at the peak of the initial spending on incremental safety initiatives by the industry when expenditure rose to almost £390 million. Total spending by respondents to the Interim Compliance Cost Survey fell in 1991 to £222 million but increased steadily after the Cullen Inquiry published its recommendations. In 1994 total 'Cullen Costs' had climbed to £330 million.

Figure 1 Annual Cullen Costs (Anticipated and Actual 1988-1995) for 19 Duty holders (£m) (MOD)

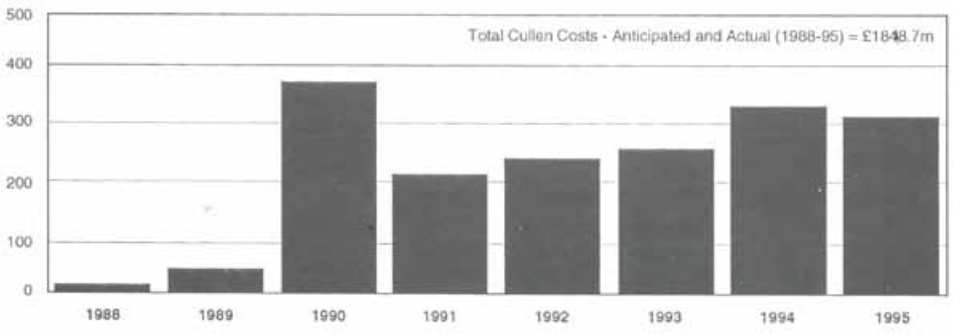


Table 4 Offshore Installation (Safety Case) Legislation Evaluation Survey Aggregate data 1992-1995 (16 oil/gas companies and 3 drilling companies)

Safety Case Preparation Costs (£m) (MOD)					
Cost Category	1992	1993	1994	1995	Total (to 1995)
SC Preparation - new installations	1.3	5.9	7.7	11.5	26.3
SC Preparation - existing Installations	30.3	41.3	21.6	8.9	102.1
SC Preparation – ongoing mods/rev's/abandonments	0.0	0.0	2.4	3.6	6.0
Sub-Total	31.6	47.1	31.7	24.0	134.5
Project Specific Remedial Costs (£m) (MOD)					
gas detection	10.1	19.8	21.0	18.7	69.7
active fire protection	0.6	0.0	3.1	6.1	9.8
ESDVs/SSIVs	0.2	32.4	33.9	11.0	77.5
passive fire protection	0.2	5.0	14.4	12.7	32.2
temporary refuge	5.8	32.8	75.4	87.7	201.7
relocation of accommodation / separate accommodation	0.0	40.0	40.5	40.0	120.5
relocation of risers	0.0	0.0	0.0	0.0	0.0
emergency evacuation, escape and rescue	2.1	7.2	12.1	6.4	27.9
Other	3.2	62.5	82.6	92.1	240.3
Sub-Total	22.2	199.7	283.0	274.7	779.6
Incremental Internal Costs					
Incremental costs of SMS	4.7	6.7	10.1	6.0	27.5
Incremental Safety Dept costs	3.1	7.2	2.3	1.7	14.3
Incremental Safety Training costs	1.1	4.4	2.5	1.9	9.9
Incremental costs of improvements to PTW system	1.0	2.3	1.2	0.5	4.9
Sub-Total	9.9	20.6	15.9	10.2	56.7
Other	0.0	0.0	0.2	0.1	0.3
Sub-Total	0.0	0.0	0.2	0.1	0.3
Total	63.7	267.4	330.8	309.0	971.0

Estimated UKCS Cullen and safety case specific expenditures

The most recent HSE 'cost assessments' suggest that the offshore industry in total may have spent or committed to spend between £2 billion to £2.5 billion on existing field installations on what might be described as 'Cullen Costs'. Only a proportion of this expenditure can be attributed to the Safety Case Regulations. A major element, which must be excluded relates to expenditure on emergency shutdown valves (ESDVs). It was estimated by the HSE that these commitments accounted for around £800 million of total 'Cullen Costs'. Other measures probably amounting to £100 to £400 million (1994 prices) were equally deemed to be attributable to factors other than the Safety Case Regulations. After making allowance for all these factors the HSE estimates that Safety Case Regulation costs were between £800 million and £1.6 billion of total 'Cullen Costs'.

By carefully grossing up data supplied by duty holders, using appropriate averages[3] computed from the survey for the companies not included, the survey team have estimated total UKCS 'Cullen Costs', and the proportion of Cullen Costs attributable to the Safety Case Regulations. Using this approach the survey team's estimate of total incremental safety spending in the seven years since Piper Alpha is between £2.1 and £2.4 billion in money-of-the-day terms. Converting these figures to real 1995 prices would result in a range of £2.3 billion to £2.6 billion.

The difficulties of estimating the costs of the Safety Case Regulations are well known to the HSE and the offshore industry. The cost benefit assessment carried out by the HSE in 1992 noted that 'it is extremely difficult to isolate the additional expenditures arising from the introduction of the Regulations since the industry committed itself to substantial additional safety expenditure arising out of the Cullen Report'. The Interim Compliance Cost Survey results indicate that £1 billion was committed by 16 oil and gas companies and 3 drilling companies in Safety Case specific costs in the period 1992 to 1995. Grossing up these figures to account for spending by oil/gas companies and mobile rig operators not surveyed produced an estimate of total Safety Case specific spending ranging from £1.143 billion to £1.303 billion out of the total £2.1 to £2.4 billion 'Cullen Costs' spend in the period 1988 to 1995 in money of the day terms (see Table 5). In real 1995 prices estimated Safety Case specific spending ranges from £1.189 to £1.355 out of the total £2.3 - £2.6 billion Cullen Costs in the period 1988 – 1995.

[3] *Appropriate averages means an average cost of costs relevant to size of those companies not interviewed*

Table 5 Aggregate UKCS Cullen Costs and Safety Case Specific Expenditure 1988-1995

	Money of the day (MOD) (£)	Real 1995 (£m)
Cost Compliance Survey 'Cullen Costs'	1849	2059
Cost Compliance Survey	1017	1057
'Safety Case Specific Costs' Grossed-up UKCS Oil & Gas Company	2029-2249	2259-2504
Cullen Costs' Grossed-up UKCS Drilling Company	50-120	56-134
'Cullen Costs' Aggregate UKCS 'Cullen Costs'	2079-2369	2315-2638
Aggregate UKCS 'Safety Case Specific Costs'	1143-1303	1189-1355

A serious caveat to bear in mind is the extent to which offshore operators and mobile rig operators have been able to fully incorporate senior management and executive staff time in their estimates. The survey team believed that in many instances management time devoted to Safety Case preparation or the modification of Safety Management Systems was not fully incorporated into company assessments of the costs.

For example, in the responses to the Interim Compliance Cost survey incremental costs associated with incremental internal costs amounted to £56 million over the period 1992 to 1995. Only 6 oil company respondents, however, included management and senior executive time in their cost estimates. If we take average values for the large, medium and small oil/gas companies that did provide data on incremental internal management costs we estimate that an additional £90 million of 'Cullen Costs' may have been incurred since the beginning of 1992 by oil and gas companies. For drilling companies the figure is estimated at around £12 million (assuming around 85 Safety Cases). This suggests an approximate additional spend of around £100 million over and above the £56 million reported in the survey.

Safety case specific benefits

Financial assessments of the benefits of the Safety Case Regulations by duty holders surveyed were, not surprisingly, low. Less than £20 million was reported in total for the period 1988 to 1995. However, this assessment substantially underestimates the benefits that the offshore industry places on the increased risk awareness resulting from the Safety Case Regulations. During the face to face interviews with duty holders all companies stated unequivocally that the Safety Case Regulations provided considerable unquantifiable and consequential benefits. These included, among others, financial savings due to reduced accident frequencies, reduced plant down-time, reduced loss of production and savings arising from increased capital asset protection.

In addition one of the most important findings from the Interim Compliance Cost Survey was the fact that greater management attention to offshore safety was seen in itself as the greatest benefit from the Safety Case Regulations. The focus and use of risk assessment techniques were perceived by many senior industry personnel to be extremely valuable, particularly in targeting safety related expenditure effectively.

Real benefits, even if difficult to quantify in financial terms, were also said to have arisen from wider changes in safety management philosophy and awareness offshore which the Safety Case Regulations were seen as having helped to underpin, and there was general agreement that the greater awareness associated with the new regime would tend to encourage efficiencies in safety spending and reduce costs in the future. In addition, a high proportion of respondents indicated that the Safety Case Regulations had had a beneficial impact on their overseas operations, though again it was not possible to quantify this effect in money terms.

V Workforce survey findings

Objectives and methodology

The survey of the workforce was designed to obtain quantifiable data on the views and experiences of the workforce on issues relating to the Safety Case Regulations.

The survey of the workforce was carried out using a self-administered questionnaire containing 38 questions. Personnel who were current or former Safety Representatives were asked to complete a questionnaire containing an additional 18 questions. The surveys were conducted in heliport and airport terminals used by offshore crew transport flights, and were confined to outbound passengers only. The questionnaires were designed, on the basis of past experience of using this survey method, to be completed in the time available between passengers entering the terminal building, and their flight departures being called. For offshore personnel on fixed-wing flights between Aberdeen and Shetland, questionnaires were distributed by cabin staff, for completion during the flight.

The workforce surveys were carried out over the period 20th February – 3rd March 1995, In addition to fixed-wing flights out of Aberdeen, questionnaires were issued at ten of the twelve heliport terminals regularly used by offshore personnel nights. The required number of questionnaires to be issued at each survey location was determined by obtaining data on passenger flows from operators. This ensured that numbers of questionnaire responses reflected the geographical, installation and employer distribution of the workforce. Target sample size was 1,000. A total of 1,102 questionnaires were returned. These were distributed as shown in Table 6 in terms of the destination of respondents. All questionnaire data were entered into a computer database and analysed using SPSS for Windows software.

Table 6

Survey location /respondent destination	*No. of respondents*
Northern North Sea/East Shetland Basin	288
(fixed wing flights from Aberdeen)	
Central/Northern North Sea	551
(Aberdeen heliports)	
Southern North Sea	263

The sample of 1,102 workers surveyed were distributed by category of employer as shown in Figure 2. 113 of the 1,102 respondents (10% of the sample) indicated that they were either current Safety Representatives, or had been Safety Representatives in the past. Of these, 90 (80%) completed some or all of the additional questions for Safety Representatives at the rear of the questionnaire. These consisted of 45 current and 45 former Safety Representatives.

Of the 45 former Safety Representatives, 38 (84%) had been in post only in the period prior to 1st January 1993. These respondents were separately identified since they could be expected to have had little or no experience of Safety Case related activity during their period as Safety Representatives. This left a total of 52 individuals who had experience of being Safety Representatives during the period since Safety Case preparation work commenced.

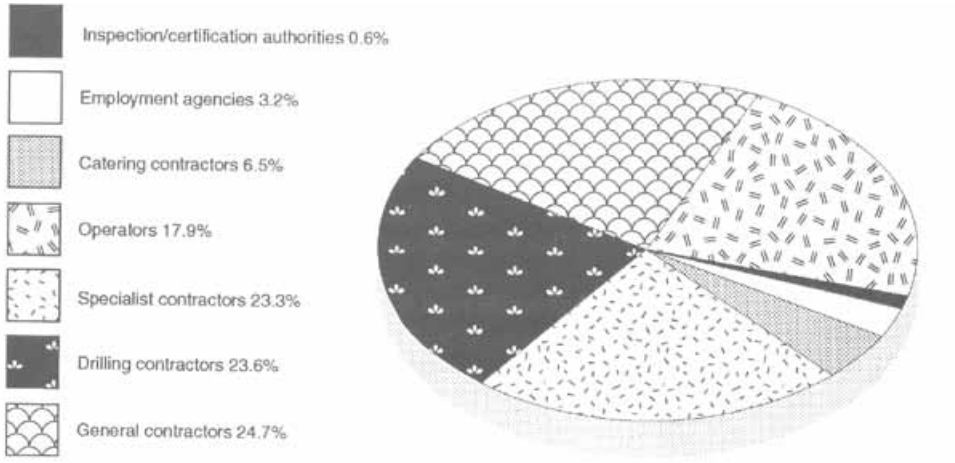


Figure 2 Employer category

Findings

General workforce awareness of the existence and nature of installation Safety Cases appears to be high, with more than 90% of respondents correctly identifying a correct definition of the term.

Some confusion remains, however, concerning the location of responsibility for Safety Cases, with almost one in four of the sample believing that the Safety Cases were HSE instructions to companies to carry out safety improvements, and more than 20% believing that the HSE was responsible for producing Safety Cases. This suggests that the goal-setting intent of the Safety Case Regulations is a message, which has not fully penetrated to the workforce.

Basic knowledge of the definition of a Safety Case was most widespread among oil and gas company personnel and least widespread among caterers. Mote detailed knowledge of the legal requirements and content of the Safety Case Regulations was most prevalent among employees of agencies, oil and gas companies and drilling companies, with catering personnel again showing the least widespread knowledge. Mobile work patterns had no significant effect on workers' levels of Safety Case knowledge.

The Safety Representatives surveyed displayed a slightly higher general understanding of the nature of the Safety Case regime, but a surprising number of them showed a lack of understanding in some areas. Given that the Safety Case Regulations place specific burdens on duty holders to consult Safety Representatives, and give Safety Representatives specific access and consultation rights in relation to Safety Cases, the finding that Safety Representatives are less likely to be aware than non-Safety Representatives that management have a duty to consult them on Safety Case issues is difficult to explain. The fact that current or former Safety Representatives were less knowledgeable than non-Safety Representatives about the legal requirement for Safety Cases is also surprising.

Just under three quarters of those surveyed had been provided with information on the Safety Case Regulations. Information on this and on respondents' own installation Safety Case came predominantly from management, though Safety Representatives appeared to be a significant additional source of information, particularly on the Regulations themselves. Mobile workers were more reliant than others on written sources of information. There appeared to be general satisfaction *amongst those provided with information* on the amount of information provided. However, more than a quarter of the sample thought they required additional information. Summary information, and information tailored to particularly worksites or groups of workers, featured prominently in suggestions for additional information.

Members of the workforce as a whole are relatively unlikely to have taken any active part in Safety Case related activities. This suggests that the focus of the Regulations on Safety Representatives as the vehicle for workforce involvement in the Safety Case process has been adopted generally in the industry. However, for those members of the workforce who had taken part in Safety Case activity, there was an approximate balance between those who had commented on it during preparation, and those who had actually taken part in aspects of its preparation.

Workforce perceptions of changes in management attention to safety issues and changes in workers' attention to safety issues since 1988 show broad similarity. There is a strong perception of greater attention to safety compared to before 1988, but rather less perception of change in the last year. Very few respondents think that workers or management pay less attention to safety. Safety Representatives tend to be more positive about the change since pre-1988 but see less change over the last year than do non-Safety Representatives.

There was no appreciable difference in perceptions of changes in management and workforce attention to safety since 1988 and since 1994 between mobile and non-mobile workers. However, those workers with the most offshore experience were less likely to perceive management and workers as paying more attention to safety now, than was the case for workers with less experience offshore. Among the different employee groups, caterers and drillers were more likely than other categories of employee to perceive that greater attention was now paid to safety by management and workers.

Perceptions of the effects on safety of specific changes in management practices on respondents' own installations over the past two years are overwhelmingly positive. A high proportion of changes noted by respondents are in areas

directly attributable to the Safety Case Regulations. A similarly high proportion of the changes perceived as having a negative effect on safety are in the area of reductions in manning and associated increases in workload. This is an area, which cannot be directly attributed to the Safety Case Regulations. However Safety Case driven increases in the workload of procedures, monitoring and documentation may be a contributing factor.

The biggest identifiable change in workers' perceptions of changes in the way they carry out their work over the last two years was in the awareness of safety and the care taken by workers. This suggests a movement towards greater attention to behavioural, cultural and managerial aspects of safety, and may also indicate that one of the key principles of a goal-setting approach – the acceptance of personal responsibility for safety – is having some impact on the workforce as a whole.

Formal training on the Safety Case Regulations or process is rare in the general workforce, but informal activities, particularly safety meetings and briefings, were regarded as a source of training by many respondents. The incorporation of information on the Safety Case in other forms of training, including emergency or survival courses and induction training, was shown to be important.

As noted above, an unexpectedly large minority of Safety Representatives lacked knowledge of certain key areas of their rights in relation to Safety Cases. This was echoed by the responses to the further questions on rights in the additional section of the questionnaire for Safety Representatives only.

Approximately one third of Safety Representatives felt inadequately informed about the Safety Case, and a slightly higher proportion believed that their constituents were not adequately informed. Notably, while offshore installation management and supervisors were the principal route by which Safety Representatives obtained their information on the Safety Case, the responses indicate that an important secondary source of Safety Case related information is other Safety Representatives.

The responses suggest that relatively few Safety Representatives exercise their Safety Case related rights regularly, beyond reading the Safety Case. However, a higher proportion of Safety Representatives are involved in monitoring Safety Case compliance or conformity, and of these, inspection and auditing activity conducted independently of management appears to be relatively common.

Annex 2

Interim report by HSE Offshore Safety Division on compliance with the Safety Case submission requirements and on the outcomes of the Safety Case assessment process

Safety case submission and assessment

Introduction

1 This section of the report, covering the period 31 May 1993 to 31 March 1995, analyses: (a) the degree of compliance with the submission requirements of the regulations; (b) the process of safety case assessment by HSE; and (c) the outcomes of the safety case assessment process.

Compliance with submission requirements

2 In broad terms, the offshore industry has made conscientious and effective efforts to comply with the submission requirements of the Safety Case Regulations. Cases of non-compliance have been due primarily to misunderstanding of the requirements and have been speedily rectified without the need for formal action by HSE.

Existing installations

3 All pre-operational safety cases for existing fixed and mobile installations (216 cases in total) were received by the statutory deadline of 30 November 1993.

Abandonment safety cases

4 By 31 March 1995, four abandonment safety cases for fixed installations had been received, all in full compliance with the statutory requirements.

Design safety cases

5 Thirteen design safety cases (DSCs) had been received by 31 March 1995. The choice of time at which to submit a DSC is largely a matter of judgement for the duty holder, but HSE is concerned that some DSCs were submitted too late for its assessment to have a significant impact on the project. This is to some extent a consequence of the newness of the regulatory framework, in that some projects were already quite advanced before the requirement for submission of a DSC came into force. HSE believes, however, that the problem is also related, at least in part, to the level of detail presented in some safety cases; it is obvious that detail emerges as a project develops, so that a detailed submission is almost inevitably a late one and vice versa.

6 HSE has adopted a pragmatic approach to this during the transitional period provided for in the Regulations (which enables operations to continue in the absence of formal acceptance of an operational safety case up until 30 November 1995) and has not taken any formal enforcement action in respect of potential breaches of the submission requirements. HSE will be pursuing issues relating to DSCs in further discussions with the industry.

Operations safety cases

7 Three combined operations safety cases had been received by 31 March 1995. Of these, one was not required by the Regulations as the operation was due to cease before the end of the transitional period on 30 November 1995, one was received after the combined operation had commenced (this was due to a misunderstanding of the requirements during the transitional period), and one was received in full compliance with requirements.

Safety case revisions

8 Four major revisions to safety cases under Regulation 9(2) had been received by 31 March 1995. Both HSE and industry have been 'feeling their way' with respect to full implementation of the submission requirements within the transitional period. Whilst there have been minor deviations from the detailed requirements, problems have been rapidly resolved without the need for formal action.

The Health and Safety Executive's assessment process

Development of the assessment process

9 OSD held extensive discussions with employers' organisations (including the UK Offshore Operators Association (UKOOA), the International Association of Drilling Contractors (IADC), and the British Rig Owners Association (BROA)) prior to establishing its arrangements for managing the assessment of safety cases. These discussions culminated in the signing of a Memorandum of Understanding between the parties describing the basis of the assessment process and procedure to be followed for the review by the Executive of any decision by OSD not to accept a safety case.

10 Following these discussions OSD developed formal assessment procedures, a detailed plan for the sequencing of assessments, and systems for maintaining auditable assessment records. These have been subjected to a process of continuous improvement and remain under review to ensure that experience gained during the assessment of early cases is applied to later assessment work.

Senior managers' forum

11 Both HSE and the industry have recognised the continuing value of regular contact on safety case matters. This has resulted in the establishment of a permanent forum of the most senior managers of both OSD and employers' organisations, which meets bi-monthly to progress matters of general interest or concern arising from the assessment of safety cases.

Communication during the assessment process

12 The formal means by which OSD notifies a duty holder of issues arising during safety case assessments is an 'Issue Note'. Assessors will, however, normally discuss their concerns informally with the duty holder before issuing a formal Note. In no instance will a safety case be rejected without the duty holder having first been given the opportunity to resolve the matter or matters raised in an Issue Note.

13 Issue Notes are ranked according to severity of the issue(s) as follows:

Level 1 The issue must be resolved before the safety case can be accepted
Level 2 The issue may prevent acceptance of the safety case.

Issue Notes at severity levels 3 and 4 are also used; these are used respectively for making enquiries (for example, requesting further information) and for confirming progress (for example, that a stage of assessment on a case has been completed).

The acceptance decision

14 The acceptance decision is taken by OSD senior management based on a Case Manager's recommendation. The decision is notified in writing to both the duty holder and to representatives of the workforce (normally installation safety representatives).

15 Where a safety case is not acceptable, the notification explains the reasons and invites the duty holder to discuss the way forward with OSD's Director of Operations.

Outcomes of safety case assessment

16 The substantial demands of assessing all safety cases for existing installations within the transitional period have made this activity the highest priority item in OSD's workplan. Indeed, it ranks very high in the Executive's priority objectives. This has been reflected in the detailed plans for assessment and the application of OSD's resources to the task. After the end of the transitional period the safety case assessment workload will continue to require the input of substantial resources, with design, abandonment, and combined operations safety cases, and revisions to accepted safety cases under Regulation 9, becoming increasingly important components.

17 The primary outcome of OSD's assessment is a decision to either accept a safety case or not; at a subsidiary level there are the conclusions of each stage of OSD's assessment process. Bulk statistical data on the numbers of safety cases for which assessment is completed, and which are accepted, are provided in the following paragraphs and tables. These give a broad picture of the progress made in completing the demanding assessment schedule.

18 A further significant outcome of the assessment process is interaction with the duty holder, the purpose being to clarify the commitments to improvements submitted in safety cases in pursuit of the achievement of risk levels, which are as low as reasonably practicable (ALARP). The extent of this interaction and the resulting changes to safety cases are difficult to measure directly and are dealt with in subsequent paragraphs.

19 The final outcome of assessment is a substantial agenda for both HSE and the industry, aimed at securing long-term compliance with the accepted safety cases and making progressive improvements in health and safety standards. Two major elements of this agenda are **generic issues** and **topics for inspection during the operational phase;** both are discussed briefly in paragraphs 30-33 below.

Operational cases for existing installations – assessment completion and acceptance or non-acceptance

20 Assessment ultimately results in HSE's decision to accept, or not accept, a safety case. The nature of the regime requires HSE to make this decision for all existing installations currently in UK waters by the end of the transitional period. Progress against plan in terms of numbers of acceptances is therefore used as a principal measure of the extent to which both HSE and the industry are effectively implementing the regime.

21 However, there are instances where OSD has substantial safety concerns following assessment, which are discretely identified as Level 1 Issue Notes, and the duty holder is considering the position or needs more time than allowed within OSD's assessment plan to formulate a response. In such instances, in addition to those where the Case Manager has formally reported his recommendation on whether HSE should accept or not, OSD defines its assessment as complete, as further progress on the case will depend on the duty holder's reaction.

22 Where OSD decides not to accept a safety case, the duty holder may ask the members of the statutory Health and Safety Executive to undertake a review of OSD's decision. No safety cases have reached such an impasse to date.

23 Overall statistics by installation type are presented in Table 1, showing both planned and actual progress to 31 March 1995 for completions, acceptances and reviews by the statutory Executive.

Issue Notes

24 As suggested above, the numbers of Issue Notes raising HSE concerns provide an indirect measure of the degree of interaction between OSD and duty holders. It should be noted, however, that changes have occurred in the usage of Issue Notes as a result of OSD's quality improvement systems and since May 1994 the number of Level 1 and Level 2 Issue Notes has significantly declined. Issue Note statistics are provided in Table 2.

25 Analysis of Issue Notes for a limited number of safety cases indicates that around 45 per cent of Issue Notes were raised in respect of engineering matters, a further 40 per cent were concerned with hazard analysis and risk assessment, while the remaining 15 per cent dealt with management system matters.

26 Analysis of duty holders' responses for the same limited number of safety cases suggests that around 10 per cent of Issue Notes led to tangible safety improvements (engineering changes and significant changes to management systems) being made, 45 per cent resulted in clarification of the safety case demonstration, and the remaining 45 per cent were closed out by the provision of supplementary information.

Major changes as a result of safety case assessment

27 Among the most significant measures of the impact of safety case assessment as part of the regime are the changes effected as a result. Table 3 gives some examples of major changes arising from issues raised by HSE during the course of its assessment work up to the end of March 1995. The estimated costs associated with these changes range widely from around £10 thousand up to about £8 million.

28 The number and magnitude of changes resulting from assessment should be viewed within the context of the overall nature of the regime. The knowledge that safety cases will be thoroughly assessed by the regulatory body provides a significant incentive for duty holders to carry out comprehensive assessments, and respond to them in a positive manner by proposing measures in their cases to effect real improvements in health and safety standards. The indirect impact of assessment may therefore be as great if not greater than its direct impact, but this effect is not easily quantifiable. Changes in risk levels resulting from all changes are addressed in Annex 3 to the Interim Evaluation Report.

Enforcement Notices

29 Safety case assessment may reveal issues of concern sufficient to justify the exercise by HSE of its powers of enforcement under the Health and Safety at Work etc Act 1974, in order to ensure the early implementation of remedial works. By the end of March 1995, one installation had been the subject of such enforcement action (in this instance, the serving of an Improvement Notice).

Generic issues

30 In the course of the assessment programme a number of generic issues have been identified which will be subject of further attention by HSE and/or the industry after the transitional period, with a view to securing further improvements in health and safety standards in the future.

31 The issues identified include the need for further guidance on the use of Quantitative Risk Assessment (QRA) and in relation to the development of meaningful performance standards in such areas as fire and gas detection and mitigation.

32 Generic issues are listed in Table 4 and related to the industry sector and/or installation type to which they apply. Where proposals for future action have been agreed, these also are identified.

Topics for inspection arising from assessment

33 HSE's assessment of safety cases forms the basis for the development of a strategic inspection plan for each offshore installation. The establishment and implementation of these plans represents the transition from assessment to the operational phase of the regime. Whilst the composition and priorities assigned to these plans are specific to individual installations, there are a number of commonly occurring topics. Table 5 lists some examples. These range from the need to confirm progress with the implementation of remedial works to checking the implementation and effectiveness of health and safety management systems.

Table 1 – Assessment progress for existing installation safety cases at 31/3/95

INSTALLATION TYPE	STAGE 2		ACCEPTED	REVIEWED BY STATUTORY EXECUTIVE
	PLANNED	COMPLETED		
FIXED INSTALLATIONS				
Fixed Oil and Gas	28	21	21	0
Fixed Gas (Manned)	22	19	18	0
Fixed Gas (Not Normally Manned)	10	7	7	0
Floating Production Facility	7	6	6	0
Floating Storage Unit	3	1	1	0
Sub-Totals for Fixed Installations	**70**	**54**	**53**	**0**
MOBILE INSTALLATIONS				
Semi-sub MODU	22	17	16	0
Semi-sub Accommodation	6	3	3	0
Jack-up MODU	19	18	17	0
Jack-up Accommodation	1	0	0	0
Sub-Totals for Mobile Installations	**48**	**38**	**36**	**0**
OVERALL TOTAL	118	92	89	0

Note: Difference between Completed and Accepted figures is a result of necessary administration associated with formal acceptance; for two safety cases no acceptance is legally required and will therefore not be issued.

Table 2 – Numbers of Issue Notes issued to duty holders by 31/3/95

ISSUE NOTE SEVERITY	NUMBER ISSUED[1]	NUMBER RESOLVED
Severity Level 1	13	12
Severity Level 2	575	533
Totals	**588**	**545**

Note: [1] based on data from HSE's SCS IT System

Table 3 – Examples of major changes arising from safety case assessment

INSTALLATION DESCRIPTION	NATURE OF ISSUE(S) RAISED BY HSE	CHANGE MADE OR COMMITTED BY DUTY HOLDER
Semi-Sub MODU	Failure of Mud/Gas Separator to meet UK Standards	New Mud/Gas Separator Installed
Semi-Sub MODU	Failure to demonstrate ability to dewater lower hull pump rooms in the event of flooding	Installation of further valve actuators, battery back-up system, and relocation of actuator controls
Semi-Sub MODU	Failure to demonstrate risks to persons are tolerable and lack of commitment to upgrading.	Case withdrawn by Duty Holder. Rig no longer marketed in UK.
Semi-Sub MODU	Justification of access to aft lifeboats in the event of fire.	Additional heat protection to routes from TR to lifeboats to be provided.
Jack-Up MODU	Uncertainties in evaluation of risks to personnel and fundamental flaws in application of QRA	Substantial further hazard identification and QRA undertaken, and safety case sections resubmitted.
Jack-Up MODU	Failure of Mud/Gas Separator to meet UK Standards	Separator modified to conform.
Floating Production Platform	Catastrophic failure of mooring system	6 inner mooring lines replaced
Floating Production Platform	Recovery from major flooding	Integrity of ballast pump electrical supplies improved. Air bags to be installed in column tanks
Fixed Oil and Gas Platform	Justification of Upper Boundary for ALARP	Safety upgrades advanced by up to a year, eg providing passive fire protection to structural members.
Fixed Oil and Gas Platform	Riser Emergency Shutdown Valve	Riser to be modified or replaced.
Fixed Oil and Gas Platform	Reliability of TR HVAC emergency power supplies	Modification to ensure suitable and sufficient emergency HVAC power supplies
Fixed Oil and Gas Platform	Jacket post damage redundancy analysis	Detailed reanalysis to be carried out. Additional vertical members to be added subject to analysis results.

Table 4 – Generic issues arising from safety case assessment

NATURE OF GENERIC ISSUE	INDUSTRY SECTOR APPLICABILITY			FUTURE ACTION PROPOSALS
	PRODUCTION	DRILLING	ACCOMMODATION	
Use of 'Suitable and Sufficient' QRA	No	Yes	Yes	Industry Bodies to produce guidance on the balance between qualitative and quantitative risk assessment. HSE to advise.
Degree of Hardware Integrity justification provided by Certificate of Fitness	Yes	Yes	Yes	Design and Construction Regulations will supersede current Certification arrangements and ensure that necessary levels of hardware integrity are demonstrated by independent verification.
Extent of detail to be provided via scale diagrams in the safety case as part of the installation description	Yes	Yes	Yes	Industry Bodies to produce guidance. HSE to advise.
Watertight Integrity and compartmentalisation of Jack-up installations	No	Yes	Yes	HSE will discuss with Duty Holders the achievement of ALARP risks to persons.
Lack of meaningful performance standards especially for fire and gas detection, passive fire protection, and process safety operating parameters	Yes	Yes	Yes	Encompassed in PFEER requirements. HSE providing guidance to industry working groups.
Adequacy of QRA models and data (eg Ship Collision)	Yes	Yes	Yes	Long term development requirements to be discussed with Industry.

Table 5 – Examples of common topics arising from safety case assessment for inspection during the operational phase

INSPECTION TOPICS	INDUSTRY SECTOR APPLICABILITY		
	PRODUCTION	DRILLING	ACCOMMODATION
Progress with implementation of improvement plans	Yes	Yes	Yes
Effectiveness of internal audit of SMS	Yes	Yes	Yes
Effectiveness of competence assurance schemes	Yes	Yes	Yes
Hazard analysis arrangements for design changes	Yes	Yes	Yes
Effectiveness of management of occupational health	Yes	Yes	Yes
OIM emergency response training	Yes	Yes	Yes
Minimisation of ship collision probability	Yes	Yes	Yes
Prevention of multiple mooring line failure	No	Yes	Yes
Testing of emergency arrangements	Yes	Yes	Yes
Effective use of risk assessment techniques and data	No	Yes	Yes

Annex 3 Interim report by HSE Offshore Safety Division on the effect of the Safety Case regime on risks to persons offshore

Introduction

1 Before the Offshore Installations (Safety Case) Regulations were introduced in 1992, HSE economists prepared a cost-benefit analysis (CBA) (1) in which estimates were made of the costs that might be incurred by the industry and the benefits that might arise as a result of the implementation of the safety case regime.

2 The CBA did not clearly estimate reduced risks to persons, but considered that a reduction in the risks of accidents could be expected due to improvements in management and hardware. With respect to management it was stated that 'a compound rate of improvement at perhaps between 5 per cent and 10 per cent a year over the first five years of the regulations and between 2.5 per cent and 5 per cent a year over the next five years should be easily achievable', and experience suggested that management improvements could over a period of time bring about an order of magnitude improvement in safety.

3 The CBA also concluded that hardware improvements should provide a much more dramatic reduction in the risk of a major disaster, predicting an order of magnitude improvement (a 90 per cent reduction) within three years.

4 OSD are now evaluating the impact of the safety case regime. This is being done by a combination of approaches, one of which is to use data from assessed offshore safety cases to examine the extent to which quantified benefits envisaged in the CBA above have been achieved. This is the approach followed in the present paper.

5 The conclusion of this interim assessment, based on the data from a limited number of selected safety cases, is that there is a predicted potential for a fatality reduction, when all the engineering work and planned remedial measures have been completed, of about 70 per cent. Thus, making due allowance for uncertainties and the small size of the safety case sample, there is some indication that a significant risk reduction is in the process of being achieved.

Methodology

6 Risk-based data collected during safety case assessment have been used to draw conclusions about the effect that the safety case regime has had on risks to offshore workers. Analysis of the data collected during safety case assessment so far showed that there was sufficient suitable information associated with thirteen safety cases from which conclusions relating to risk levels before and after remedial work might be drawn.

1 *A normally unmanned installation is usually only occupied for either breakdown or routine planned maintenance.*

7 These thirteen installations (see Table 1) represent a total Population on Board (POB) of 2254 which amounts to about 8 per cent of the offshore population. This estimate is based upon twice the officially-recorded POBs for the installations concerned, which takes account of those who are off duty (onshore), who would normally work on the installation, and those currently working offshore.

8 There is a range of installations covered in this group which, although not representing every type of installation on the UK continental shelf, does include a reasonable selection of those present. Among the installations represented there is a range of ages from some of the earliest structures to some of the most recent. Of the most regularly encountered installations, only jack-up drilling rigs and mobile accommodation units are unrepresented in the survey sample.

9 However it must not be forgotten that procedures and arrangements are continually evolving, driven by a combination of forces. These procedures and arrangements will include operational changes, improvements in processing and other areas of technology, and innovations in risk-reducing measures. The driving forces for these may be varied and will include: seeking efficiency improvements; responding to the Safety Case Regulations, the PFEER Regulations and the revised 4th Edition Guidance (2); and other post-Piper Alpha activities. **The risk reductions shown in safety cases are thus very likely to be due to a combination of elements of some or all of these driving forces.**

Analysis

10 Table 1 summarises the Individual Risk (IR) data presented in the relevant safety cases. The Initial IR is the estimated risk before implementation of the remedial work plan, and the Final IR is the estimated risk after the implementation of the remedial work plan.

11 Experience from assessing safety cases has shown that the risk information presented is variable with respect to scope, format and content, notwithstanding the expected uncertainties in the data itself. This leads to limitations in the way the data can be used.

12 Additionally there is a large range of installations being assessed, ranging from large, first-generation, fully integrated production platforms to smaller modern complexes, and while it may be possible to draw some broad conclusions regarding risk reductions, care needs to be taken in using these data to draw conclusions applying across the industry. In addition, the direction in which the industry is moving in relation to installation arrangement and operation is continually evolving. For example reductions in manning are being sought and remote operation, low maintenance schemes are becoming more common.

2 *The Individual Risk (IR) figures in this report refer to risk of fatality per year. IR represents the chance that a person who is in a location (continuously) exposed to threats to life becomes a fatality due to those threats. An offshore worker is exposed to numerous threats to life including fire, explosion, extreme weather, structural failures, transportation, ship collision etc. An IR of 1.0 x 10^{-3} represents a 1 in a 1,000 chance (0.001) of fatality in a year (of exposure), or if a (theoretical) person was exposed to these risks for 1,000 years, assuming risks remained constant, a probability of fatality of one would be predicted. These figures are not meant to be precise and are associated with many uncertainties, and historical evidence available can be used to test them.*

13 The risk-related data in this summary are uncertain in as much as they are based upon calculations and judgements made by the operator's personnel and contractors. The safety case preparation process may to some extent have addressed some of these uncertainties, but they should not be overlooked in drawing conclusions. Calculated risk results are only a 'snapshot' of a situation that existed at a given time.

14 Nevertheless these limitations should not prevent sensible use being made of the data, for example in making comparisons on a before and after basis, when many of the uncertainties inherent in such calculations will tend to cancel each other out.

15 Using the data in Table 1, estimates of the Potential Loss of Life (PLL) can be made. These are shown diagrammatically at Figure1. Initial expected fatalities for all the installations surveyed were 4 a year. The total PLL figure after remedial work is reduced to 1.19, giving an estimated total PLL reduction of 2.81 fatalities a year. It should be noted that most of this reduction (82 per cent) is due to three of the older installations, numbers 2,9 and 13 in the list at Table 1. The more recent installations, not surprisingly, do not generally have the same scope for risk reduction. A significant percentage PLL decrease was, however, identified for the newest installation surveyed (number 4): this is interesting, in that production did not start until 1993, suggesting that design work began after 1988 and proceeded in parallel with the development of the Safety Case Regulations, yet scope for risk reduction has nevertheless been demonstrated.

Table 1 – Installation individual risk summary

Ref.	*Type*	*Start up date*	*POB*	*Initial IR*	*Final IR*
1	Floating production unit	1981	120	2.5×10^{-4}	2.2×10^{-4}
2	Concrete GB structure	1970	183	2.5×10^{-3}	6.2×10^{-4}
3	Tension leg platform	1981	77	3.8×10^{-4}	2.2×10^{-4}
4	Fixed production steel jacket	1993	146	1.1×10^{-3}	4.4×10^{-4}
5	Semi-submersible	1981	90	1×10^{-3}	1×10^{-4}
6	Normally Unmanned Inst.	1990	10	3.2×10^{-4}	2.9×10^{-4}
7	Normally Unmanned Inst	1990	7	5.2×10^{-3}	5.2×10^{-3}
8	Complex	1968	43	4.8×10^{-4}	2.5×10^{-4}
9	Fixed production steel jacket	1978	155	3.9×10^{-3}	8.3×10^{-4}
10	Complex	1972	43	6×10^{-4}	4×10^{-4}
11	Normally Unmanned Inst.	1989	11	1.7×10^{-3}	7.7×10^{-4}
12	Complex	1980	28	1.1×10^{-3}	4.8×10^{-4}
13	Fixed production steel jacket	1978	214	2.2×10^{-3}	5.2×10^{-4}
	Total POB	**1127**			

16 It is also noticeable that for the older installations the scope for risk reduction appears to be considerably more for single jacket installations than for older complexes, of which there are three represented in this survey (numbers 8, 10 and 12). The three older single structure production installations are all first-generation installations which are undergoing substantial modification work; this is influenced by the safety case regime but is also being driven by commercial interests and field exploitation concerns.

17 It is difficult to attribute specific risk reductions to particular driving forces. It is reasonable to expect that there would be scope for some risk reduction on the older installations because it has been widely recognised that many first-generation installations had fundamental shortcomings in relation to current standards and practices. Some of the risk reduction has, however, resulted from process re-organisations which may not be driven by the safety case regime.

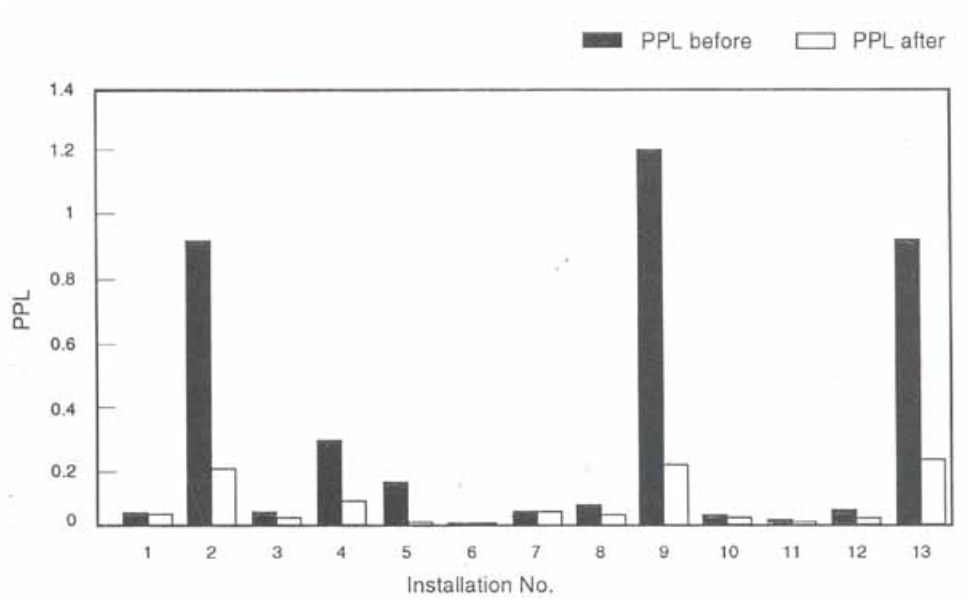
18 In considering these numbers, it should be remembered that there is a continuous development of practices and procedures offshore, with increases in automation and remote operation, manning reductions, changing work patterns and different process operating conditions. Some of these will reduce the number of people exposed to the risks; others may increase the potential for particular hazards to be more harmful. So the risk pattern offshore is not fixed and the figures above are a 'snapshot' of what is in reality a constantly evolving situation.

19 The question arises as to how far the risk reduction figures identified for the surveyed installations could be extrapolated to cover the industry in general. There has been no formal analysis to test how far the thirteen chosen installations are representative of the whole industry, though as noted above they appear to cover a reasonable range of those being operated in the UK sector. However, only by looking at the record at some time in the future will it be possible to draw more positive conclusions as to the reduction in risk.

Conclusions

20 The evidence available from some of the offshore installation safety cases assessed to date indicates that there is a potential for a reduction in the risk of fatalities, when planned remedial measures have been implemented, of around 70 per cent. In general, the scope for risk reduction seems to be greatest on some of the older, integrated installations. These findings are broadly compatible with the view expressed in the original CBA that a 90 per cent risk reduction might be achieved over a period of time across the industry as a whole, though it has to be acknowledged that some of the risk reduction shown may well be due to factors other than the Safety Case Regulations themselves.

Figure 1 Potential Loss of Life (PLL) before and after implementation of Risk Reducing Measures (RRMs)



Based on limited data available from the selected Safety Cases there is a predicted potential for fatality reduction of around 70%. (Uncertainties in the calculations and the representative validity of the sample must not be ignored.)

References

1 Safety Management and Safety Cases (Offshore Installations) Regulations – Costs and Benefits (Revised).

2 Offshore Installations: Guidance on design, construction and certification. Fourth edition 1990, London: HMSO. (Provides guidance on good engineering practice in the design, construction and survey of offshore installations. Also assists owners and Certifying Authorities in interpreting the regulatory requirements on certification.)

Further information

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