



Literature Review on the Perceived Benefits and Disadvantages of UK Safety Case Regimes

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Executive Summary

As part of HSE's ongoing review of the impact of Safety Case Regimes (SCR), a literature review has been undertaken to collate and assess published views on the various UK regimes. This review searched various sources to identify and obtain articles related to the impact of the SCR.

In total some 2,500 articles were identified with approximately 160 containing comment on the impact of the regimes; the remainder of the papers focussed on risk assessment techniques and specific enhancements to plant (e.g. design of Temporary Sites of Refuge on offshore platforms). This report has extracted quotes from these papers summarising the views expressed in the articles. The quotes have been arranged by subject area, reflecting the general content of the literature, rather than industrial sector. Views were generally found to be common across each of the regulated sectors or are considered by the Project Team to be applicable in all sectors. There are exceptions to this but they are relatively few in number, for example the issue of charging by the HSE came out strongly solely in the COMAH literature.

In addition to the literature and conference reviews a series of interviews were conducted to establish more 'personal' experience relating to SCRs. These are discussed within the report and have been used in shaping the categorisation of the comments. Generally the views expressed in the interviews were more critical of the SCR than those found in the published literature, in particular relating to the workload associated with developing a Safety Case and debate regarding the degree of additional value it adds.

The main findings from the published material are:

There are very few objective studies of the impact of SCRs on safety performance. One study covering offshore regulations was identified (commissioned by the HSE) and a number of interview survey reports are quoted. However, overall there are disappointingly few attempts at objective research. This may reflect the difficulty in isolating any possible effects of a SCR from other factors that may affect safety performance.

There is good support for SCRs acting to improve overall hazard identification and control. This is largely due to the need to systematically review and assess systems and processes. In some instances this assessment was the first time the organisation had thought about their operations in such a structured and rigorous way. However, there is some evidence that after the initial identification of improvements (that can lead to a step change in risk reduction), there is less potential over time for identifying improvements. This raises important questions regarding how the regime should be managed and led as it matures, and raises the potential need to shift the focus onto softer issues to ensure that the maximum value is realised over time.

There are mixed views about whether the SCR improves overall safety culture and safety communications within a company. Generally there is a positive view on this with improved workforce understanding of major hazards. The impact in this area, however, appears to be variable and depends very much on the management approach of the company and to some extent the 'spirit' in which the regulations are implemented.

Business issues are more contentious with some companies questioning the cost/ benefit ratio (CBR) of producing and maintaining a Safety Case to comply with the SCR. In one or two instances, it is suggested that it can become uneconomic to continue operations



because of the costs of producing the Safety Case and of carrying out any upgrades to equipment to meet the perceived safety requirements. This tends to be the case for older process plants. In contrast to this however, there are also authors who suggest that the SCR has been a benefit to their business operations through loss prevention and also improvements to business systems. The view of the Project Team in relation to this is that the SCR can potentially benefit companies both in terms of safety and economics. However, this is dependent upon the manner of the implementation and use of the Safety Case as a 'live' working document within the company. In relation to this it is important that companies understand that producing a sophisticated written system does not necessarily add benefits to the company, indeed it may divert resources from controlling risk. Whilst it is important to develop a means of adequately describing the systems in place the description of the system should not become the end in itself.

Security issues and commercial confidentiality regarding details of processes are raised as important issues with regard to COMAH sites and these need to be considered and balanced against the desire for greater openness.

There are many comments within the literature about how the SCR is implemented with a mixture of compliments and complaints against the manner in which the HSE manage the regime. There are concerns and debate over the meaning of key terms such as 'demonstration' and 'ALARP', and that despite the number of articles and debate addressing this, a degree of confusion appears to remain. It is possible that these aspects will become more difficult to assess as focus moves from engineering type assessments (e.g. Quantified Risk Assessment of plant) to 'softer' human, organisational and psychological issues which are generally perceived as being more subjective in nature.

In terms of the CBR of the SCR, there are again mixed feelings evidenced in the papers. As identified above, the attitude of the company to the regime and how they approach meeting the requirements appear to be the key influences on the balance between cost and benefit. It is difficult to comment in detail on the influences that affect this, as there is little indication in the literature on the efficiency of organisations in preparing, producing and managing their Safety Case. There is also relatively little discussion in the literature on the degree to which the SCR requirements are integrated into general business processes and decisions. However, given the potential importance and value of this, it is something that the Project Team believes would benefit from further consideration and investigation.

Between the regulated industry sectors there is generally insufficient evidence to be able to distinguish any systematic differences in the views of the SCR expressed. With the longer established regimes (i.e. nuclear and offshore oil and gas) recent papers tend to focus on the long-term costs and maintenance of the Safety Case; these industries are now familiar with the requirements of the regime and are looking to optimise its demands. Sectors where a SCR has more recently been introduced tend to focus on interpretation of key terms, costs and the relationship with the Regulator (e.g. COMAH). Similar concerns were expressed by the oil and gas industry at the outset of the offshore SCRs. Clearly, newly regulated industries rarely welcome additional costs and are keen to determine what they are required to do to get safety case acceptance. At the outset of a regime, this is not always clearly understood, despite the publication of documents such as assessment principles. There is perhaps still more that can be done to calibrate requirements and expectations should a SCR be introduced into other industries in the future.

The Project Team found little published evidence relating to the rail sector and it is therefore difficult to make many specific comments. However, there does appear to be some degree



of consensus that the SCR is an effective tool to ensure high levels of safety are developed and maintained within the privatised structure of the industry.

Recommendations from this review are:

Ensure that there is a better understanding of the key terms (e.g. 'demonstration') and that there are clear criteria for the decisions required to approve or reject or question a Safety Case submission.

Investigate the longer-term costs of maintaining a Safety Case and how the Safety Case can remain 'live'. The aim would be to ensure costs are driven down and that the impact of the Safety Case remains high.

Consider how safety management can, in reality, be more integrated into business processes and decision-making.

Look to ensure that there is a positive and proactive relationship between the Regulator and the Regulated and review means to ensure the effectiveness of this relationship.

Consider commissioning focussed objective research to develop a clearer understanding of the impact of the regulations in individual sectors (N.B. the Rail Sector is an obvious candidate for this). This could in some respects replicate the type of study that was commissioned by the HSE to evaluate the impact of the offshore regulations.



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Glossary

ALARP	As low as reasonably practicable
BNFL	British Nuclear Fuels
CA	Competent Authority
CBR	Cost-Benefit Ratio
CIMAH	Control of Industrial Major Accident Hazards
COMAH	Control of Major Accident Hazards
EA	Environment Agency
ECOHSE	European Centre for Occupational Health, Safety and the Environment
ERC	Engineering Research Council
ESREL	Safety & Reliability Event run by European Safety & Reliability Association
FABIG	Fire and Blast Information Group
HSC	Health & Safety Commission
HSE	Health & Safety Executive
IBC	Conference organisers
ICHEME	Institute of Chemical Engineers
IEE	Institute of Electrical Engineers
IEEE	Institute of Electrical and Electronic Engineers
NII	Nuclear Installations Inspectorate
PACTS	Parliamentary Advisory Council for Transport Studies
QRA	Quantified Risk Assessment
RoSPA	Royal Society for the Prevention of Accidents
SCR	Safety Case Regime
SRC	Safety Research Council
TRL	Transport & Research Laboratory
UKOOA	UK Offshore Operators Association



1.0 Introduction

This report has been commissioned by the Health & Safety Executive (HSE) to collate documented evidence concerning the benefits and disadvantages of the UK Safety Case Regimes (SCR). It forms part of HSE's programme of work to evaluate the impact of the SCR. HSE has commissioned this research to identify whether, based on existing evidence, industry perceives the SCR as providing benefits or disadvantages to their operations.

SCRs apply to industry with a high risk potential, where there is a possibility of one or more fatalities. It is also becoming increasingly important for industry with the potential to harm the environment where there is a societal impact.

The SCR in the UK is a '*permissioning regime*', with the onus on regulated industry to identify the hazards associated with their activities, determine controls to reduce the risks from these hazards to as low as reasonably practicable (ALARP) and implement these controls. There is a requirement to demonstrate the processes by which this is achieved and this is open to scrutiny by the Regulatory Authorities.



2.0 Background

The HSE are charged with acting as a Regulator or Competent Authority, responsible for ensuring that industry covered by SCR-type legislation complies with their statutory requirements. One of the principal means of achieving this is reviewing and assessing Safety Case submissions that are made to demonstrate that a company has taken all reasonable measures to reduce risks from their operations. This is further supported through site inspections as well as accident investigations.

Part of the HSE's duties also is to consider the impact of SCR legislation. Research reports have been commissioned (e.g. Offshore Legislation, Ref. 6) that try to determine if the SCR has a positive impact upon safety standards. However, drawing a direct link between the SCR and tangible measurements (e.g. accident statistics, number of fatality trends) is problematic because of the wide number of variables and other factors which influence the statistics involved (e.g. changes in technology, industry downsizing).

The HSE believe that SCRs do lead to benefits in terms of improved safety.

Another means of reviewing the views on the various SCRs is to consider published material on the implementation of the legislation. This will provide an overview of what industry and involved parties (e.g. consultants and HSE Inspectors) perceive is happening within the framework and requirements of the legislation.

This report captures the results of such a literature search. It has sought to extract meaningful quotations from various published articles and categorise them into SCR topic areas.



3.0 Aims & Objectives

The aims of this project are as follows:

1. To identify available evidence on the impact of SCRs in the gas, offshore, on-shore (COMAH), railway and nuclear industries
2. To categorise and analyse the evidence in terms of whether:
 - a. it is critical or positive with respect to the SCRs;
 - b. it is original analysis, research, and personal experience or refers to other's work with their own conclusions.
3. To analyse and summarise the findings overall and by sector.
4. To provide an anthology of evidence on the impact of SCRs, both in terms of the regimes' benefits and disadvantages. The anthology will also provide quotes and references for HSC/E speeches and articles etc.

The study has also considered articles outside of the industrial sectors mentioned in the first objective. These have been included as they have parallels to the situation in the UK (e.g. introduction of Seveso II), or express sentiments that are relevant.

It was understood that greater importance should be attached to gathering published quotes from the industries listed in Objective 1.



4.0 Scope

The material used in collating this report is generally in the public and published domain. However, a few interviews were also conducted with safety managers within a number of industries. At the interviewees' request these remain anonymous.

In providing a quote and categorising it, VECTRA in no way endorse either its view or its validity. We have, however, added comments about the quote's author to point out their background and if the paper supports the sentiments of the quote with any evidence.

We have not focussed too heavily on the reasons for the existence of the SCR nor the underlying philosophy of the permissioning regime. Instead, effort has been directed at the experiences and perceptions of people in the various regulated industries who are applying the regulations.

Papers that deal with what constitutes a Safety Case, or what it should contain have not been reported in the findings. This report is interested in the effectiveness and opinions about the regime and not 'how to do it' statements.

Where a specific study has been undertaken to review the impact of a specific set of legislation (notably the AUPEC report on the Offshore Regime, Ref. 6) extracting quotes is problematic, as entire sections of the report would need to be reproduced. Therefore only a selected number of quotes are used to support or refute other sources. The AUPEC report itself provides a unique account of the offshore regulations.

The focus has been on gathering quotes from industry sources. Therefore, Regulator quotes are kept to a minimum.



5.0 Method

5.1 Summary

A number of search methods have been used in identifying information relevant to this project:

1. Literature search of published literature databases
2. Interviews with experienced, industry focussed VECTRA staff
3. Interviews with senior safety management staff within a number of industries
4. Identification of conferences incorporating relevant Safety Case material
5. Search of Internet Sites of organisations with safety interest
6. Review of HSE Archives

The main focus of this research was to identify and extract published quotes, categorise and analyse these quotes. Thus effort was primarily directed at this task.

5.2 Literature Search

A literature search was undertaken covering the following areas:

- ESREL conference listings 1996-2001 where programmes were available
- PSAM conference listings (2002)
- HSE research reports (various offshore series (OTO, OTH, OTI), contract research reports (CRR), and new research reports series (RR))
- Riskworld website
- Society of Risk Analysis Europe annual meeting listings 1996-2002
- Risk Analysis contents Dec 1996 - Dec 2002
- Community Documentation Centre on Industrial Risk catalogues.
- British Lending Library 'Inside' database - cross disciplinary journal contents and conference paper listings 1993-2002
- Various government sites - Parliamentary Office of Science and Technology, Cabinet Office, etc.

The search also included European, US and Australasian comment where relevant, but where explicit searching was done (rather than browsing contents listings) restriction of the search term to 'Safety Case(s)' would have excluded countries and industries where that specific term is not commonly used.

In focussing the search on general discussion of SCRs, papers on risk-based approaches in environmental or safety regulation have not been included (e.g. much of the UK policy material written by ILGRA, HSE's R2P2 etc). A useful site for this is www.cabinet-office.gov.uk/risk.



In practice, much of the material identified related to the UK offshore sector post-Piper Alpha, the UK rail industry, the possibility of introduction in shipping and some nuclear (mostly decommissioning or waste disposal). Other nuclear industry and aviation/aerospace material identified was very technically specific, probably since the use in these industries is mature, and mostly non-UK. Overall, a total of approximately 2500 papers were initially identified, with around 300 papers/reference sources being identified in the search as being potentially relevant. However, the majority of these were found to be peripheral to the issues being addressed in this study. Of the 300 sources identified, around 160 were requested with detailed review of approximately 80.

A potential source of industry comment is the various topic specific professional conferences (e.g. as run by companies such as IBC and IIR). However, the proceedings of these conferences are not published and hence hard to search and to obtain. Some proceedings were obtained as outlined in Section 5.5.

5.3 VECTRA Staff Interviews

Within VECTRA there is considerable experience of producing and advising on SCR requirements. The experience covers all the regulated industries as well as some foreign operations where a similar approach to the UK has been adopted.

Senior staff were asked if they could identify information about the SCRs in their areas of expertise. They were also asked if they could identify industry representatives who may be willing to discuss the impact of SCR on their industry.

In general, the referenced material identified had already been identified in the Literature Search. Staff identified a number of industry contacts that could provide their view of the SCR.

5.4 Industry Interviews

As the main focus of this study was to collate published material, the interviews conducted were limited in number. The main purpose was to identify what people really thought about the SCR and not necessarily the company's stance. This information has been used to shape the categorisation undertaken on the literature in Section 6.0.

Interviews covered the following industrial sectors:

- Nuclear
- Oil & Gas (offshore)
- Onshore process (COMAH) - Chemical, Petrochemical
- Rail



All interviewees wished to remain anonymous.

The basic question structure used for the semi-structured interviews was as follows:

- *Has the introduction of Safety Case/Report requirements improved the identification of major hazards? If 'Yes', how? If 'No' – why?*
- *Has the introduction of the Safety Case/Report requirements improved adequacy of risk control measures? If 'Yes', how? If 'No', why?*
- *Are the requirements placed on duty holders in relation to Safety Case/Report clear and unequivocal?*
- *Is the feedback received on Safety Case/Report submissions clear and adequate?*
- *Are the perceived benefits (if any) considered cost-effective?*
- *Are there improvements that could be made to the SCR process?*
- *Any other comments?*

A summary of the overall findings from the interviews is given in Section 7.0.

5.5 Safety Case Conferences

A search was undertaken and enquiries made with major UK commercial conference organisers, including IBC and IRR, to identify and obtain proceedings from Safety Case-related conferences. In addition to these organisations, searches were also undertaken to identify industry specific conferences which were likely to include material on Safety Cases (for example UKOOA, FABIG, IChemE, IEE) and conferences organised by other relevant bodies (for example HSE's 'Implementing Seveso II Conference'). These searches identified a number of sources already identified in the literature search, and a number of additional papers.

The list of conferences and relevant papers are contained in the bibliography (Section 11.0).

5.6 Web Search

A website search was undertaken, this covered a range of sites including those of the following organisations

- Safety & Reliability Society
- IMechE
- IChemE
- HSE
- HMRI
- IEE
- IEEE
- RoSPA
- HCRC
- PACTS
- Dyadem International Ltd
- Sites related to the MV Estonia
- Offshore Operations Notices
- ECOHSE
- British Safety Council
- TRL
- EPSRC
- SRC
- ERC
- Railtrack



- UKOOA
- RMRI (Risk Management Research Institute)

A number of private sites were also identified which had been set up by individuals with a personal interest in specific events, e.g. Seveso, and the Union Carbide incident in Asia, as well as Flixborough, and the MV Estonia.

Sites were reviewed for any Safety Case content and links. In addition, where search capability was provided on a site the list of search words used in the literature search was applied.

Search engines used were Google, Yahoo, Lycos and Webcrawler.

5.7 Editorial Search

A number of safety-related journals were reviewed in an effort to identify any editorial articles or letters relating to the SCR. The following were identified through interviews with VECTRA staff and were reviewed:

- Modern Railways: for the past 4 years.
- Safety & Health Practitioner 95-97 inclusive and 2001/2.
- The Chemical Engineer last 2 years

Little commentary on SCRs relevant to this project was found. Most articles dealt with detailed methods (e.g. applying risk assessment) rather than discussing the regime itself.

Note that there are potentially many more journals that may have information, but the search was found to be very time consuming, with no simple search engine that could be used to scan editorials. As the return rate was very low, effort was redirected toward published papers and conference proceedings.



6.0 Results from Literature Search

The material gathered during this study has been categorised according to its commentary on the SCR. This facilitates the review of these comments and identifies where conflicting opinions are stated. The categories were developed from an initial review of the literature coupled with discussion of issues the Project Team expected to see addressed.

The total number of papers identified with relevant application to this research was 156 (out of about 2,500 identified in the initial search). The papers fell into industrial sectors as shown in Table 1.

Sector	No Of papers	% of total papers
Offshore O&G	48	31%
COMAH	32	21%
Nuclear	15	10%
Rail/ Transport	17	11%
Shipping	12	8%
Software	7	4%
Aviation	5	3%
Mining	2	1%
General	18	12%
<i>TOTAL</i>	<i>156</i>	

Table 1 Break down of references by industrial sector (note % is rounded)

The 'General' category includes papers that covered a number of sectors or discussed the background to the SCR.

The Project Team further classified the papers in order to distinguish the nature of the paper, from original research through to editorial comments. The Table 2 shows the results of this classification.



Nature of Paper	No of Papers	% of total
Original Analysis	2	1%
Research	4	3%
Editorial	5	3%
Personal Experience (Opinion)	78	50%
Personal Experience (Approach)	44	28%
Regulator	20	13%
Other's with own conclusions	3	2%
<i>Total</i>	<i>156</i>	

Table 2 Break down of references by nature of article (note % is rounded)

As can be seen, there are very few objective research papers. The majority of papers located were considered by the Project Team to be expressive of company or personal opinions or dealt with the overall approach to preparing and managing the Safety Case.

Further categorisation of the papers was considered to be useful for presentation of the results, thus the quotes extracted have been arranged according to the topic of the paper. The Project Team considered the following topics to represent the views identified in the literature:

- *Identification and control of Hazards*
How has the SCR helped with the systematic identification of hazards, their evaluation and implementation of control measures?

Included in this section are comments specific to hazard identification, controls and risk reduction and demonstrability of risk management.

- *Safety Culture and Awareness*
How has the SCR helped with raising overall awareness of safety and risk management, either through involvement in the Safety Case or through improved risk communications?

- *Business and Security Issues*
Has the SCR improved overall business performance?

This section also deals with concerns over business competitiveness and security of installations as certain operational information potentially becomes more publicly available.

- *Process & Implementation*
Specific points about the development and production of a Safety Case are raised here, including clarity of requirements, bureaucracy and definition.



In addition, comments concerning the implementation and enforcement of the regulations are identified, including the relationship between industry and the Regulator.

- *Cost Benefits*
The costs of complying with the SCR and producing a Safety Case and the actual benefits realised are considered in this section.
- *Other Issues*
These comments relate to specific instances of the SCR, where generalisation to the above categories could be misleading.

6.1 Identification & Control of Hazards

6.1.1 Hazard Identification

Quotes captured in this section relate to how the SCR influences the identification of hazards within a company producing a Safety Case.

As would be expected, the Regulators see the benefits of the SCR, in terms of promoting the systematic analysis and identification of hazards e.g.:

'Sometimes the preparation of the safety case is the first time that an operator has systematically analysed how the installation is designed, built and operated. Often the process of preparing the safety case has led to improvements being identified and implemented'. (Offshore Regulator, Ref. 148).

This positive view is also supported by industry with several quotes suggesting that the processes in place for identifying hazards have been improved, with consequent benefits for company's understanding of risks:

'Any review of the SHE (Safety, Health and Environment) systems to the depth the Competent Authority (CA) has required, will produce benefits. Sites have reviewed their processes and found where they should make improvements.' (SHE Advisor at Chemical Company, Ref. 112)

'COMAH has been a learning exercise for industry and the CA but has produced a better understanding of the risks.' (Onshore Petrochemical Company, Ref. 28)

'The industry's drilling contractors have also learned the value of quantitative risk assessment (QRA), which has generally been alien to most drillers until recently'. (Offshore Engineer Article, Ref 105)

'One of the most valuable attributes of risk assessment, particularly in its quantified form, is that it often reveals truths that are not particularly intuitive. It can show that things we have worried about for years are not so important, but other things should really command our attention. This message is not only for internal consumption; the handling of risks has become a matter for public discussion and political debate, far wider in scope than the subject matter of this conference. To survive in this environment, only the highest standards of competence and objectivity will do.' (Independent Risk Management Consultant, Ref. 31)



This view is further supported by the AUPEC evaluation of SCR impact for offshore oil and gas:

'The requirements of the Safety Case Regulations for formalised risk assessment has focussed attention on the hierarchy of risks and has thus helped to target resources in controlling the most important risks...For many companies the process of carrying out a more formal and rigorous programme of risk assessment has led to a significant learning process about the main risk areas, how sources of risk are related to each other and where the blind spots were'. (Independent Review of Impact of Offshore Regulations, Ref. 4)

In considering the nature of Hazard Identification, papers touch upon the issue of how the regulations impact upon different types of hazard; minor as well as major hazards. With the initial focus of regulations tending to be on identifying and managing the major hazards then less serious hazards may be sidelined. However, over time the focus can spread wider to cover other apparently less serious incidents, as illustrated in the offshore industry:

'[The offshore oil and gas] industry is now focussing on occupational safety and on minor accidents and incidents following [the] close attention to addressing major hazards. [They]...are also paying closer attention to the root cause of minor accidents and incidents as they had the potential to escalate or trigger major events'. (Independent Review of Impact of Offshore Regulations, Ref. 4)

In some papers there were concerns about this initial focus on major hazards, and in particular the effort spent by safety staff on undertaking such assessment at the expense of day-to-day duties (see Section 6.5).

In contrast to the generally positive views on hazard identification described above, there is a view expressed by some authors that the SCR has not provided any hazard/risk identification benefit – the 'we already do risk assessment and know our risks' attitude. In the written literature the following quote illustrates this negative stance. Whilst the study was not UK-based (it is Finnish), it is one of the few attempts at systematic review of the impact of regulations and is likely to have parallels with the implementation of Seveso II regulations in this country:

'Most companies in ...[the study]...believe that they were able to fulfil the requirements of the ...[Seveso II]...directive without the need to take a major leap forward ...[in terms of their SMS and risk assessment processes]. Most companies are also convinced that their procedures to identify potential hazards and evaluate the risks were already adequate and that the main deficiency was the incomplete documentation of these practices.' (Onshore Process Plants, Questionnaire/Interview Study, Ref. 89).

6.1.2 Controls & Risk Reduction

Within the literature there are a number of positive statements regarding how the SCRs have helped to improve the control and reduction of risk through improving the comprehensiveness and reliability of the approach to safety. For example:



'Thought processes, risk assessment and mitigation programmes were now more structured and rigorous as a result of the impact of PFEER.' (Independent Review of Impact of Offshore Regulations, Ref. 4)

This view is further supported by a number of comments relating to how the introduction of SCRs has helped to improve the quality of design and operation of plant:

'Process control systems have been reviewed, Storage standards reviewed, background process knowledge questioned and re-formulated, Safety data questioned and changed'. (Positives highlighted at a conference by a speaker from the Chemical Industry, Ref. 112)

'My view at the moment is if you apply...[the Regulations]... correctly on your plant and on your site, it can bring significant safety improvements, it can help you understand better, it can help your staff understand better, how that plant should be operated. I think time will tell whether it really comes to fruition'. (Storage Terminal Site, Ref. 94)

'The requirement to re-assess occupied buildings under COMAH, allied to the availability of advanced predictive tools and techniques, has enabled Shell Expro to develop the design basis of a protective structure for a control room and associated offices that would comply with the HSE target of occupied building compliance by 2002.' (Presentation by Petrochemical Company, Ref. 96)

A very similar claim is made in a paper considering evacuation design for offshore platforms:

'It is in our opinion that the increasing application of both qualitative and quantitative hazard studies have resulted in significant platform safety improvements. Safety Cases as recommended ...[by the Cullen Piper Alpha Inquiry]...are likely to result in their increased use. This is likely to not only produce further safety improvements, but additional information relevant to evacuation decisions, equipment and procedures.' (Specialist Safety Consultant in Oil and Gas Sector, Ref. 107).

Similar sentiments are expressed from the rail sector:

'[The LUL Chairman...] considered that the safety case had added more rigour and structure to LUL's safety management systems'. (Ladbroke Grove Rail Inquiry, para 7.17, Ref. 38)

Other broadly positive comments in this category relate to implementing improvements. For example, some references suggest that engineering-related improvements are easier to develop from undertaking the Safety Case process, whereas the less tangible aspects such as management systems are more complicated. A HSE representative expresses this point thus:

'...it is usually easier to identify the specific technical improvements [made by undertaking a safety case] compared with the less tangible improvements to managerial systems or the safety culture, although there is evidence for all of this'. (Offshore Regulator, Ref. 148. Note there is an example given of engineered solution to support the first part of this quote.)



There are also quotes that suggest that the process of producing a Safety Case has helped in identifying the most appropriate prioritisation of risk control measures and improvement. For example:

'Other sites have used COMAH to re-order their capital programmes to ensure that the most significant risks are dealt with quickly.' (Speaker from Chemical Industry, Ref. 112)

The COMAH Regulations serve to encourage communications between specialist disciplines within an organisation and to ensure safety management issues concerning risk to people and environment are combined into a coherent safety report:

'The COMAH Risk Assessment process forced organisations to consider the environmental consequences of a large accident together with the consequences for people. In this way it has forced Health, Safety and Environment management closer together.' (Scottish Environment Protection Agency, Ref. 42)

On the more negative side, there was one source that suggested that Safety Case requirements may be used by some companies as a way of forcing through unpopular changes without requiring potentially lengthy consultation with staff. This may have negative implications and is illustrated in the following quote:

'Safety Case requirements may be used by companies to force through changes without adequate consultation with staff'. (Trades Union Representative, Ref. 90)

Such action is seen to '*contribute to mistrust and cynicism of both CA and the employer*'. (Trades Union Representative, Ref. 90)

6.1.3 Demonstrability

In the Ladbroke Grove rail crash enquiry, Lord Cullen reinforces his views on the SCR initially expressed during the Piper Alpha inquiry:

'I am satisfied that there is a need for the framework provided by the Safety Case Regulations, within which the duty holder demonstrates, and by reference to which it operates, its arrangements and procedures for the management of safety in a consistent and effective manner.' [Lord Cullen, Ladbroke Grove Rail Inquiry, Pt 2, para 1.18, Ref. 38)

Some papers touch on how the SCR facilitates the demonstration of management and control of risk. As the following quote illustrates, this may also be perceived to have additional benefits in terms of reduced legal liability:

'The next greatest benefit to the company is the reduction of legal liability in the event of an accident. Documented proof that safety is being managed has been demonstrably successful at reducing the litigation cost of an accident and keeping managers and directors out of court. This is a major driver for the senior management of any company to adopt safety management.' (Aviation Company associated with Oil and Gas Industry, Ref. 56)



6.2 Safety Culture/ Awareness

One of the potential benefits of SCRs identified in the literature is greater involvement of staff in the safety process. This is illustrated in the following quotes:

'The COMAH Report can be a useful tool for developing a common understanding of risk levels within a company if it is clearly written and people throughout the organisation are involved in preparing and understanding the report.' (Chemical Company, Ref. 12).

'If the COMAH Safety Report is well written, it should summarise a wide range of complex data about major accident hazards in a clear form. This will help staff throughout the organisation to have a better understanding of risk levels and how they adversely or positively affect these risks'. (Chemical Company, Ref. 11)

This in turn has benefits for staff awareness of hazards and controls (and in a broader sense communication of risk information). This is illustrated in the quotes below and is discussed in a number of papers, particularly those relating to the oil and gas industry.

'Personnel's *subjective* perceptions of the risks generally matched the QRA calculations for the platform Safety Cases, indicating that the workforce had good knowledge of these hazards, probably as a result of exposure to presentations of the platform Safety Cases...' (Offshore Industry Independent Survey, Section 6, Ref. 66)

'[The process of producing the Safety Case has]...improved dialogue.' (Onshore Petrochemical, Ref. 139)

'After such a short time in operation (7 months) results demonstrating improved safety performance are inconclusive, but heightened safety awareness throughout the company is clearly evident.' (Aviation Company associated with Oil and Gas Industry, Ref. 56)

It is however, important to realise that there were also some negative comments regarding communication and staff involvement and thus the view is mixed. Some companies saw ownership of the Safety Case by line management, and workforce awareness of its contents and importance as challenges facing the company rather than benefits already being achieved (e.g. Onshore Petrochemical Company, Ref. 96). There was also some debate about the level of explanation and involvement of staff currently taking place. This may to some degree reflect the stage of the SCR introduction, and maturity of regime. For example, the following quotes relate to the offshore industry from 1996.

'...nearly a fifth of safety representatives on offshore installations are unaware that they have a right to be consulted by management on the preparation of safety cases.' (Offshore Industry, Ref. 106)

'...a third of safety reps felt inadequately informed about the safety case.' (Offshore Industry, Ref. 106)



Workforce involvement was widely regarded as an area where the industry, although it had made considerable progress since 1995, still had considerable work to do to achieve meaningful results. While much had been achieved in enhancing communication on safety issues including those relating to the installation Safety Case and Safety Management Systems - there was evidence that achievements in encouraging active workforce participation in safety were more modest.' (Offshore Industry, Ref. 35)

These are echoed in a more recent quote in November 2000 following the introduction of COMAH:

'Anecdotally, feedback from members is that workers/safety reps are not usually involved. They are generally aware COMAH exists and is different from CIMAH, but rarely see any output from COMAH process.' (Trades Union Representative, Ref. 90)

These contrasting views on involvement and communication show that there are clear benefits to be gained but that not all companies are adequately involving their staff, particularly in the early days after legislation is introduced. The quotes also demonstrate that the process of realising the benefits is not always easy or straightforward. This position of recognising both benefits and challenge is reflected in the following quote from an onshore petrochemical company.

'Communication. The safety report is often seen as an excellent reference document. The challenge is to distil and communicate the findings of a long and complex document into a format which is easily digestible to all, so that it can be integrated into every day working practice.' (Onshore Petrochemical Company, Ref. 103)

'All workforce aware of contents and importance.' (A '*challenge*' from Offshore Company Presentation, Ref. 29)

There are warnings however as to how the Safety Case should be treated and produced. If the Safety Case is to be a useful briefing tool to staff then it must be accessible to all – not only the actual document but also the way it is written.

'Safety cases are just one method by which companies can show they have done all that is reasonably practicable (and hopefully prevent death and injury as well!). They do not, however, provide a defence on their own and the benefits of the information contained in the documentation must be widely disseminated and be easily accessible to all employees.

Gold plated safety cases costing thousands of pounds sitting in an operation's director's room gathering dust will not do any good to both the company and their employees, and will be of very little use in any defence of a subsequent alleged breach of safety'. (Barrister, Ref. 49)



6.3 Business & Security Issues

A number of papers, mostly very recent, raise issues relating to business and security plus concerns relating to the impact of regulation on the competitiveness of British Companies, specifically the COMAH Regulations.

In terms of security issues, companies are concerned about sensitive information becoming publicly available through inclusion within the COMAH safety report. This is illustrated in the following quote:

'It is...possible that the information [in COMAH report] could be used maliciously by arsonists or terrorist groups. The COMAH Report is likely to contain a lot of detailed information about the most vulnerable areas within chemical plants.'
(Chemical Company, Ref. 12)

The author goes on to point out that there is a balance between information that is within the public domain and withholding sensitive information:

'...confidence in the Safety Report may be undermined if sections of the report are unavailable or confidential. There may be a perception that the chemical industry has something to hide.'
(Chemical Company, Ref. 12)

As well as security issues, some papers also raised concerns relating to commercial confidentiality and the publication of sensitive information. This tended to be in relation to the more 'open' COMAH regime. For example:

'Under the CIMAH regime, the operating company could provide sensitive information to the Regulating Authorities with confidence because it would be treated confidentially. A large amount of information has to be presented in the COMAH Safety Report and operating companies may inadvertently disclose sensitive commercial information about their processes and operations.'
(Chemical Company, Ref. 12)

In contrast to these concerns, some papers do talk in more positive terms regarding availability of information to the public. For example, an offshore petrochemical company suggests:

'...there is a real opportunity for industry to take a more proactive role, engaging the public in debate and listening to and addressing their concerns' (Onshore Petrochemical, Ref. 103).

A further issue of concern raised within the literature relates to competition, and the potentially negative impact of the introduction of SCRs on the competitiveness of British business. With the regulations becoming increasingly applicable across the European Union, the translation and enforcement of these regulations into country specific regimes is raised as a commercial competitiveness issue. This is illustrated in the following quotes:

'[Seveso II-related] Regulations in different countries are very different, consistent approach difficult for global company.'
(Presentation by Onshore Petrochemical Company, Ref. 28)



'...no common European Standards, different levels of work needed in different countries, competition status may change' (Presentation by Chemical Storage Company, Ref. 94)

'There are real concerns that the competitiveness of the UK process and manufacturing industries is being eroded because:

- The legislation [Seveso II] has been enacted more quickly in the UK compared to some other European countries.
- The legislation is being implemented more thoroughly in the UK compared to some other European countries.'

(Chemical Company, Ref. 12)

The same author also comments on the possible impacts of COMAH on older process plants noting the following:

'[Older]...plants were often built when design, legislation and documentation standards were lower than they are today. It is often very difficult to make a coherent COMAH demonstration for this type of plant without doing lots of additional work. In some cases, companies may even choose to close down some plants as this additional work would make the plant's operations uneconomic.' (Chemical Company, Ref. 12)

A not too dissimilar view is reflected in the following:

'There is significant cost associated with...[employing additional staff to meet the COMAH demand]. Cost can never be ignored as it will directly affect the profitability of any business. However in this case, the increasing cost may cause operators to take action to prevent the need for this cost and scale down their business accordingly.' (Chemical Storage, Ref. 86)

Other business concerns raised within the literature relate to a loss in flexibility of operation, resulting from the need to define specific, formal procedures as a means of meeting SCR requirements. This is illustrated in the following quotes:

'The relevant strength for a SME is the flexibility of the decision-making process that represents an advantage in terms of the capacity to react quickly to production and process changes, so that the company can achieve competitive advantages. On the other hand, that flexibility may represent a weakness, as the implementation of a safety management policy [as required under SEVESO] aiming at the prevention of major accidents requires the definition of specific, formal and written norms, procedures, and operational instructions. This means 'stifling' the company's activities and procedures.' (Conference Paper on Process SMEs, European, Ref. 10)

'Organisations are dynamic and the operator needs flexibility to make frequent adjustments quickly in response to emerging problems. The acceptance requirements of a safety case regime can, if not managed appropriately, inhibit this flexibility and in themselves create risk.' (Rail Industry, Ref. 122)

Whilst these papers raise relevant concerns, there are other papers that are positive in relation to the impact of the regulations on business performance. These reflect the view that SCRs can improve overall business performance



through improved productivity and loss prevention. This is illustrated in the following quotes:

'The potential for conflict between business and safety was acknowledged by the majority of the respondents. One company saw it as fundamental that the relationship between safety critical and business critical issues be properly discussed and agreed, with a clear understanding and transparency of the relationship between business risk and safety risk. Another company, while recognising that cost pressures did have the potential to impact on safety, the new regulations had the effect of creating a number of "backstops" to prevent safety being degraded, with performance standards and QRA identified as two such factors.' (Offshore Industry, Ref. 35)

'Developing a consistent, robust and transparent approach to the regulations can be done. Sustaining a consistent approach can deliver huge benefits, not least in delivering on the COMAH objective of avoiding catastrophes. It can also deliver in a real business bottom line sense...Adopting an appropriate mindset is fundamental. However, once this has been achieved, continuing to look past the regulations toward the spirit of the regulations can lead to other benefits. An example of this, at one of our sites where the CIA guidance for Occupied Buildings is being discussed, the site safety engineer has been able to demonstrate to the site management how the safety benefits for taking the office, admin buildings and people off site, will also provide real cost savings'. (Onshore Petrochemical Company, Ref. 103)

Further quotes on cost are included in the Cost-Benefits Section (Section 6.5).

6.4 Process & Implementation

6.4.1 Development of a Safety Case

In developing the Safety Case submission, a number of authors suggest that there was a lack of clarity regarding what was actually required. This was particularly evident in the early stages after the introduction of the legislation, and was evident in a number of industries. This is illustrated in the following examples:

'From the industries perspective, it was not readily apparent what ALARP was and how it could be demonstrated. The guidance available was useful, but it was felt it could be better if it was clearer on the application of ALARP. (This refers to the Scottish whisky industry who were having to meet with COMAH, Ref. 42)

'Respondents expressed concern over the complexity of the legislation...suggesting a need to simplify the regulations'. (Independent Review of Offshore Regulations, Ref. 6)

'I think the level of detail required [in the submission is] not well defined' (Chemical Storage Company, Ref. 94)

Perhaps the most commonly raised example in relation to clarity of understanding was difficulties with the issue of 'demonstration'. This was most frequently raised in relation to the move from CIMAH to COMAH with



many papers raising this as both an issue and concern. Indeed, there are whole papers or articles addressing and discussing what is actually meant by 'demonstration', and what is required by the Regulator (see for example, Ref. 111). This is an issue experienced by all the regulated industry and summed up by an offshore quote:

'One of the problems HSE has faced with the use of safety cases has been getting the level of detail right. Initially there was a tendency for HSE to press for great detail. This was because HSE inspectors want to ensure there is sufficient detail in the case for them to be able to judge whether the case for safety has been made and to enable enforcement action to be taken, if the operator does not do what is said in the case. The more general the statement, the more difficult it can be to make this judgement and to use it for enforcement. However the more detail the case contains, the larger the documents become and they run the risk of being less useful to the operators' own staff. In the case of some of the older nuclear installations safety cases, there could be thousands of individual documents. Early offshore safety cases suffered from the same problem. Part of the problem stemmed from the need to produce a document, which was striving to meet the need of more than one "customer". In practice a balance has to be struck between the needs of the regulator and the operators own staff. Initially they have tended to be heavily orientated towards the need of ensuring acceptance by the regulator but latterly the needs of other audiences, including the operators' own staff, have received greater consideration. This has been achieved by developing "electronic" safety cases or by preparing high quality summary documents to help users "navigate" their way around the documents. And now there is the additional challenge of COMAH safety reports being public documents.' (Offshore Regulator, Ref. 147)

From VECTRA's own experience the levels of description and demonstration vary between and within industry (depending on the industry itself, the individual Regulators and the 'hot topics'). Within the papers a number of views are represented, but a common theme is uncertainty with regard to the level and nature of detail required for demonstration. For example, even when companies have undertaken significant analysis they remain uncertain on how best to present this, and whether it will then be considered sufficient. However, there is guidance available if you know where to find it, as illustrated in the following quote from a Chemical Storage Company.

'And then we came across the Safety Description Assessment Manual available on the Internet (www.hse.gov.uk). I say came across, my feeling was at the time, I still think it's true to a certain extent now, that it's not been very well publicised...I think it is probably amongst the best HSE guidance I have ever seen.' (Presentation by Chemical Storage Company, Ref. 94)

A second common theme in relation to the development of the Safety Case is the level of associated paperwork, and perceived bureaucracy. This is an interesting topic and one where it would appear that lessons have been learned as the SCR matures. In the early days of the SCR, there are commonly concerns about the resulting paperwork and its impact on other safety work. This is illustrated in the following quotes:

'...widespread concern in industry where implementation is often seen as a self-perpetuating paper chase. The feeling is that there has been a serious diversion of scarce trained resources away from SHE improvement into writing a document



much of which tells the regulators things that they already know.' (Chemical Company, Ref. 112)

'...the new era of COMAH and the bureaucratic burden imposed by COMAH may threaten the fabric of success.' (Ref. 86)

'The size of the safety case document should be limited – some sources are claiming the basic case cannot be made in less than 500 pages, although this is disputed elsewhere.' (Offshore Engineer, Ref. 105)

However, in contrast to these comments, there are others that recognise, and stress, that there are actually benefits to be gained from keeping the Safety Case simple and concise, though some debate on the extent to which this is feasible. This is illustrated in the following quotes relating to the offshore and rail industries respectively:

'Lessons learned by operators where improvements can be made in the size of the safety case – a balance is needed to achieve a clear safety case which is supported by adequate reference material...' (Offshore Engineer Article, Ref. 105)

'One of the most significant factors to emerge [from the experience of planning and submitting safety cases] is that the safety case need not be a complex document. To some extent complexity will reflect the internal complexity of the organisation that has prepared it. Since simplicity is one of the key factors in minimising communication errors within any organisation, it must also be true that simplicity is key to achieving safety. Above all else, the railway safety case must be shown to be clear, credible and consistent throughout'. (Rail Industry, Ref. 132)

Other interesting points made in the literature in relation to bureaucracy are the potential for an electronic Safety Case, to facilitate storage and access to information so reducing the associated paperwork.

A further theme that was frequently raised in relation to the development of the Safety Case was the concept of a 'living reference document'. Several papers touched upon this, and highlighted the following:

- The need for ongoing updating of the Safety Case,
- The importance of ensuring information is current and accurate
- The potential value of the Safety Case Report as a reference source.

Within the literature however, there were very few sources actually suggesting that the existing Safety Case was already being used in this way. A possible exception to this was in the nuclear industry, where BNFL described the process for updating of the Safety Case and as part of this addressed the review and updating of information (Ref. 20). Much more common however, was that companies were citing the use of the Safety Case in this way as a challenge. For example, an onshore chemical company cited '*Maintaining (the SC) up to date and integrated into the business*' as one of the challenges associated with implementing COMAH.



A final point in relation to the development of a Safety Case was raised in a paper that talked about the difficulties created by conflicting approaches in different sets of regulations, for example the differences between offshore and onshore approaches. This is illustrated in the following quote:

'The offshore and onshore approach to safety reports is substantially different, such that very different approaches often apply to equipment connected together by a single pipeline. In an ideal world the approach would be the same either end of the pipe.' (Onshore Petrochemical Company, Ref. 103)

6.4.2 Implementation and Enforcement

Regulatory Approach to Implementation and Enforcement:

There are a number of comments across industries relating to the regulatory approach to implementation and enforcement. For example, for some authors, the implementation of COMAH is reported as having an impact on the way the Regulator has conducted their assessments. One example of this is comments that reflect the focus on top-tier sites or areas of specific concern:

'What we are seeing is a large scale increase in HSE activity and inspection effort, directed at top tier sites, so that lower tier and non COMAH sites appear to be receiving very little attention.' (Chemical Storage, Ref. 86)

'...the number of topics being covered in a typical inspection has decreased – the reason being that the level of detail seemingly required on any given aspect of COMAH is much higher...[when compared to the CIMAH Regulations].' (Chemical Storage, Ref. 86)

Some of the comments relating to the Regulator are positive and in some instances refer to particular subject areas. For example, in one paper the Regulator is viewed as having a beneficial impact on companies, particularly with regard to safety management issues:

'The impact of the regulator...is measurable both broadly in terms of overall SHE performance and statistics at individual storage company sites, and also via periodic reviews by the regulator which will show areas of success, or perhaps areas where improvement is evolving.' (Ref. 86)

In other cases, papers raise concerns over the Regulator's approach and its effectiveness, for example the following quote, relating to consistency of approach in the oil and gas industry:

'The most frequently raised issue regarding the industry-regulator relationship was expression of concern relating to inconsistency in HSE's enforcement and assessment actions. In particular inconsistency varied from one inspector to another, and it differed between geographical locations, and between topic specialists and field inspectors'. (Independent Review of Offshore Regulations, Ref. 6).

Within the literature, it is clear that there are a number of notable critics of the SCR, particularly the offshore regime and the relationship between the



Regulator and the regulated. Amongst the most vociferous critics of the offshore SCR are Woolfson and his colleagues. They consider that the initial impetus of the regulations post-Piper Alpha has now relaxed and safety is being undermined. Quotes from Woolfson and his peers are not included here as they are described and assessed in the AUPEC report in depth (Ref. 6, Section 6 of the Overview, or Chapter 6 of the main report). The AUPEC report summarises the criticisms and are both positive and negative toward the SCR:

'Suggestions that there has been little significant reduction in accident rates since Piper Alpha occurred are contradictory to more recent data. Consideration of all accident characteristics and the more recent data suggest some progress has been made regarding personnel type accident'. (Independent Review of Offshore Regulations, Ref. 6).

'There is some evidence to support Woolfson et al ...argument that a 'Gradual Erosion Scenario' has occurred whereby HSE's initial enthusiastic approach to offshore safety is gradually being eroded and that the industry is gradually reasserting its hegemony. The picture is however far from clear'. (Independent Review of Offshore Regulations, Ref. 6).

Relationship with Regulator

Within the literature there are a number of quotes regarding the relationship between the Regulator and the regulated. Within this section, comments have also been included on some of the factors companies cite as affecting the relationship, and in particular the impact of the introduction of charging.

General Comments on the Relationship with the Regulator

Within the literature a number of disparate comments are made relating to the company Regulator relationship. For example, some companies cite changes to the relationship following the introduction of regulations, whilst others describe the nature of skills required for dealing with the Regulator. Others again, talk about the extent to which the regulations themselves promote or inhibit co-operation. Examples of these are presented below:

'Since the introduction of COMAH, many companies feel that Inspectors attitudes have undergone a marked change, away from the co-operative attitudes of the past to a more rule bound approach'. (Chemical Industry, Ref. 111)

'Discussions with a regulator require not only technical skills, but also strong negotiating skills in order to provide a constructive challenge to regulatory suggestions. In some cases a different suggestion can fully satisfy both sides in a more cost effective manner'. (Nuclear Industry, Ref. 20)

'The regulations provide the vehicle for both regulator and operator to work together, sharing best practice to prevent major hazards and limit their consequences to persons and the environment.' (Onshore Petrochemical Company, Ref. 114)



The relationship is not always seen as negative with the following quote from the nuclear industry clearly showing that a more interactive and positive relationship benefits both parties:

'During the mid nineteen nineties, BNFL in consultation with NII, began a wide ranging review to consider how best to improve its safety cases for both existing and new plants. A set of joint BNFL/ NII working groups were established to perform this study, which focused, in particular, on methodology developments, interactions with regulators and safety case formats. An important driver for BNFL was to improve the visibility of and documentary evidence for the safety of its plants. The interaction between BNFL and the NII was extremely valuable, as the NII were able to benchmark development proposals against industry best practice.' (Nuclear Company, Ref. 123)

Factors Affecting the Relationship

Within the literature a number of factors are discussed as having a potential impact on the relationship between the Regulator and the regulated. Examples of these include the number and nature of clarification questions that are asked following submission of the Safety Case, the clarity and consistency of information and guidance provided by the Regulator, and last but certainly not least the introduction of charging. Examples of these are described below:

Clarification Questions

Some papers and interviews suggested the amount of clarification questions returned from the Regulator can be onerous and commented that they generate significant demands on the time and resources of SHE department staff. Some interviewees described the ongoing cycle of questions and answers as 'unending'. This is to some degree reflected in the following quote:

'We're reasonably happy with the questions that are being asked. I say reasonably happy, I'm, perhaps getting less reasonably happy as time goes on. We've just had a second raft of questions on this first submission, now that's 8 months after the original submission and 4 months after the first set of questions came out. I think the regulators run the risk of turning it into a points scoring exercise where the regulator sets out to prove that he knows a little bit more than me all the time'. (Chemical Storage Company, Ref. 94)

The industry however must accept that variations in standards as well as operations and plants cause problems for the Regulator who inevitably has to ask a considerable number of questions:

'The assessment process has been made difficult by the understandably wide variety of approaches adopted by duty holders in making a case for safety, the diversity of installations and the different perception about how a proper case for safety should be made. Such variations were, of course inevitable in a goal setting regime. This has necessitated adoption of a selective approach to assessment.' (HSE experience in Offshore Industry Newsletter, Ref. 45)



Clarity and Consistency of Guidance from Regulators

There were a number of comments within the literature relating to the clarity and consistency of guidance provided by the regulatory bodies to companies. A selection of these are presented below:

'Q. It was mentioned that within the context of the COMAH Safety Report you dealt with around 20 inspectors. To what extent were you getting consistent advice?

A. There were misunderstandings and contradictions; one example is the issue of whether MAPP is required for top tier sites'. (Discussion Session, Ref. 46)

'[There were] Different perspectives between EA and HSE, with no central EA contact.' (Onshore Petrochemical Company, Ref. 28)

'No one stop shop for CA guidance' (Petrochemical Company, Ref. 28)

Charging

There were a number of comments within the literature and in interviews relating to charging. As would be expected these comments are negative in nature. A selection of examples are given below, with a useful summary quote at the end:

'The use [in the UK] of COMAH to introduce charging by the hour is felt to have fractured the relationship of mutual trust between the regulators and regulated.' (Chemical Company, Ref. 112)

'Charging – mechanisms restricts dialogue and creates friction.' (Onshore Petrochemical Company, Ref. 28)

'Industry's concerns about the practical effects of COMAH implementation have been increased by the introduction of charging. It is easy to uncover the belief that the regulators activities are now driven by what is chargeable. Charging has led to inspectors no longer being available to industry groups for discussion and has begun to dissuade industry's SHE professionals from ringing inspectors for advice, for fear of finding themselves charged. Charging was a political decision imposed upon the CA, but the timing was unfortunate, and has aggravated the inevitable problems of introducing the change to COMAH.' (Chemical Company, Ref. 112)

'Five particular issues cause concern to operating companies [about the introduction of charges]:

- The high hourly rate fee that will be charged for assessment, which is significantly higher than the rate that many top safety consultancies would charge for similar work.
- Fears that operating companies may have to pay these high rates for junior staff from the...[CA].
- Difficulties in budgeting for future assessment work by the CA due to the lack of a pre-agreed scope for the work to be carried out.
- Diverting management time to control the costs, which are being charged for assessment by the CA. This is particularly difficult when the invoices for such work are vague and do not clearly relate to specific activities.
- Fears that these additional costs will erode the international competitiveness of European chemical companies.' (Chemical Company, Ref. 12)



6.5 Cost-Benefits

Within the literature there are a number of papers, which discuss the costs and cost benefits associated with SCRs. Most papers simply identify how much it has cost for particular companies to prepare the Safety Case submission, a small number of others however, take the argument further and discuss the CBR of the process as they perceive them. Other issues raised within this section relate to the impact that diverting so many resources to the development of the Safety Case can have on other areas of safety.

The Cost of Preparing the Safety Case

It is clear from the literature that significant time and effort is spent in preparing a Safety Case, with of course associated costs.

'Four man years to prepare COMAH safety cases does not include time of non core team...more realistic figure may be six years.' (FABIG, Discussion Session, Ref. 46)

'Ah001 - Safety Case Development - 18 month programme to submission' (Offshore Oil and Gas Cost quoted in 1995 (Offshore Company, Ref. 84)

'Costs for preparing the document are said to be approaching £1 million for a fixed production platform.' (Offshore Engineer Article, Ref. 105)

'The report production process is likely to require intensive efforts from environmental and safety specialists in the company over a six month (straightforward report) to two year (complicated site report) time frame.' (Chemical Company, Ref. 12)

Whilst several papers talk about the initial cost of preparing the SCR for submission, one or two papers also raise the wider cost to a company of developing several Safety Cases, plus the ongoing cost of keeping the these 'live' and updated. This is illustrated in the following quote from the nuclear industry:

'There are now about 40 major safety cases covering facilities on the Sellafield site. BNFL has safety case production teams at each site. There are about 200 full-time people directly involved in safety case teams in BNFL, and an equivalent effort or greater is provided by the facility operators either in writing their parts of the safety case or in implementing its requirements, e.g. further improving operating procedures and updating maintenance regimes etc.' (Nuclear Industry, Ref. 20)

Within the same paper there is also some discussion of the costs of reviewing and updating Safety Cases which is undertaken every 5 years. In this discussion they suggest that:

'...a safety case reassessment (so far) has cost more than half the cost of the original safety case'. (Nuclear Industry, Ref. 20)



Meeting SCR Requirements in a Cost Effective Manner

A common issue that was raised in many sectors was the cost of implementing the SCR; in particular the Project Team felt that this is a major issue with smaller companies, especially within the COMAH Regulations. Whilst we accept that there are costs associated with compliance, these can be kept to a minimum as long as the SCR is integrated into the way the business operates and is used positively. The Project Team feels that excessive costs are more likely to be the result of one or more of the following:

- Poor understanding of the SCR requirements (often over estimating the requirements);
- Poor management of the production of the Safety Case;
- An attitude where the end result is not seen (or used) as a valuable tool to the business.

The Project Team believes that there is scope for developing further guidance both to ensure that the requirements of the SCR are clearly understood and that the importance of integration with wider business processes is appreciated.

Integrating Safety into Business Processes

The Project Team believes there is often still a gap between safety and business processes despite assurances to the contrary from the company itself. With few exceptions safety is still not an integral part of business planning and processes – and instead is still seen in many quarters as getting in the way. The Team believes that improved integration would have positive effects not only on safety but also company performance. Therefore the SCR should seek to encourage this and look for evidence as to how safety can be actively managed during business decision-making. This really needs to go beyond the statements often seen as implying that safety is taken into consideration during business discussions. So safety should not simply be an item on the agenda, rather it should be taken down to a further more detailed level. For example, during early phases of projects requirements, specifications and designs are sometimes drawn with very specific detail on engineering aspects of the system, but safety and final operational issues are often detailed at a more generic (higher) level. The challenge therefore is to persuade business that a more up-front consideration of safety at the right level of detail will:

- Increase the likelihood 'projects' will deliver it right first time and avoid expensive and lengthy retro-fitting (note that the safety assessment techniques and tools also help identify process improvements/vulnerabilities and so improve overall productivity).
- Reduce design costs by considering what is actually necessary and not what is 'flavour of the month'. VECTRA have experience of projects where alarms have been over specified, control rooms have redundant



'What does 'cost-effective' mean for a decommissioning safety case? It does not necessarily mean the cheapest safety case...more importantly, the safety case should be 'right first time' (and to programme) to minimise the approval process, to be fit and flexible enough to allow a project to develop optimum working methods'. (Nuclear Industry, Ref. 65)

Another position on the CBR of SCRs is put forward in a number of papers. These suggest that SCRs are always costly. However, where implemented well they suggest that they are in fact cost effective giving '*proven enhancement in safety performance*' (Ref. 109). However, where they are not fully implemented they are not considered to be cost-effective. Some of these papers also go on to describe what they believe are the characteristics that make regimes work (see Ref. 109) or the lessons that they as individual companies have learnt in making the regulations work for them (see for example, Ref. 103). One key topic that is raised repeatedly in such discussions is 'adopting the right mindset' or 'attitude' to the spirit of the regulations. This is seen as fundamental to realising the potential benefits associated with SCRs and is reflected in the following quotes:

'We're coming to the view that there are two ways you can do a safety report [to meet Seveso II]. You can do it because you have to do it; or you can do it because you want to improve your business and make your business run in a safer way...'. (Chemical Storage Company, Ref. 94).

'Depending on the attitude of operating companies and the Regulatory Authorities, the COMAH Safety Report will either be an expensive administrative burden or a useful tool which can improve corporate risk management'. (Chemical Company, Ref. 12)

Diverting SHE Resources

Within the literature a number of papers raised concerns regarding the impact of resource allocation to produce a Safety Case submission. In particular, there were concerns that SHE staff were unable to undertake their routine activities, that they were stressed and overworked through trying to meet strict deadlines, and that they had become isolated from their normal business roles. This is more likely to be an issue with smaller operations where they are unwilling, or unable, to afford to hire staff to help with the production of the Safety Case. The following quotes illustrate this view:

'The cost of COMAH is significant – and not just the financial costs, many SHE professionals have been working six (and more) days a week to try to get reports finished on time, and have been ignoring all 'normal' SHE work.' (Chemical Company, Ref. 112)

'The [COMAH] report production process is likely to require intensive efforts from environmental and safety specialists in the company over six months (straightforward report) to two year (complicated site report) time frame. There is a real risk that key staff will become isolated from their normal business roles and the quality of other activities (new projects, auditing, safety initiatives etc.) may suffer. A careful balance has to be struck in this area. Positive benefits can, however, flow from the COMAH safety report if it is high quality, making it easier to make decisions about major hazards in the site's future' (Chemical Company, Ref. 12)



'The number of safety professionals has had to increase dramatically, specifically in order to write or support the writing of COMAH safety reports. It is questionable whether this has made any contribution to practical day to day safety at the site concerned.' (Chemical Storage, Ref. 86).

6.6 Other Issues Raised in the Literature

This section presents information within the literature that did not fall within the classification system used for the analysis and includes summary opinions on the SCR.

Within the literature there are a number of papers that make useful comments or judgements on SCRs, or comment on how their effectiveness should be assessed. These do not specifically address cost effectiveness, or other classification issues discussed above. They are included here as an indication of the type of comments made. It is important to realise some of these comments have been made by regulatory staff, who have experience of the other side of managing SCRs. The section begins with quotes from the Regulators and continues with those from industry.

'COMAH has made a significant difference on some sites and there have been a number of changes that would not have been made without COMAH as a driver.' (Scottish Environment Protection Agency, Ref. 42).

'Experience suggests that the main benefits of a safety case comes from the process that the operator has to go through to prepare the case...[as]...the operator of the installation will always know it better than any regulator and the requirements to produce a safety case is intended to ensure that they know it even better'. (Offshore Regulator, Ref. 148)

'Safety cases have been in use in the UK now for some time, as a technique to help manage risks in the major hazard industries. There is enough experience to be able to form an overall judgement on their usefulness. They are not a panacea and they will not prevent all major accidents, nor less serious ones but they do seem to help us reduce the probability of a major event occurring and to mitigate the consequences of those that do occur. There are also problems in deciding the level of detail needed for the safety case. However all the evidence from across a wide range of industries and from the most senior manager to junior staff, as well as from independent evaluation points to their success and they have become the standard tool to manage major hazard industries'. (Offshore Regulator, Ref. 148)

'The ultimate success and failure of safety case systems is whether or not they reduce the frequency of major incidents. Fortunately they are relatively rare events anyway so it may be some time before we can definitely judge success or failure.' (Offshore Regulator, Ref. 148)

'The overwhelming majority of respondents felt that the regulations had improved their ability to manage safety, with the 'general improvement in the management of all risk' seen as the most important beneficial effect of the legislative regime as a whole.' (Offshore Industry, Ref. 35)



'The benefits of safety cases come in a number of areas. These include an improved understanding of the hazards and risks, an enhanced knowledge of the technical and managerial controls required to manage them, and better oversight by the regulator. Taken together these should lead to the principal goal of a reduction in the number and consequences of major accidents'. (Offshore Regulator, Ref. 147)

'...the overall trend of the new regime [the proactive safety approach encouraged by the SCR] cannot yet be judged with any confidence...'. (Chemical Industry, Ref. 34)

'Two objective measures of the success of the COMAH Regulations could, however, be used but will only be revealed in future years: 'have the normalised UK major accident safety and environmental accident statistics improved?' and 'have companies moved production facilities to other parts of the world where compliance costs are lower?' (Chemical Company, Ref. 12).



7.0 Interview Findings

The following discusses the findings from the interviews conducted with industry. Because of the request by the participants to remain anonymous the comments are summarised in this separate section and not individually detailed in the Findings section of this report. Table 3 summarises the number of interviews undertaken and the industrial sector.

Sector	Interviews
Chemical	4
Onshore Petrochemical	2
Offshore Petrochemical	2
Nuclear	3

Table 3 Interviews conducted by industrial sector

Information from the interviews was used as input in developing the classification system used in analysing the literature.

The findings showed mixed opinions with regard to the SCR. Most respondents gave two answers to each question, an official line, and a genuine personal opinion. The latter was only available in the event that anonymity was preserved.

The personal opinions are generally more sceptical of the regime and its effectiveness, although they often did not provide constructive comment as to how the regime could be improved.

Documented evidence of any of this is, understandably, unlikely to be found since it would amount to self-incrimination, however anecdotal.

The same categorisation as that used in Section 6.0 is used here to group the findings from the interviews.

7.1 Identification and Control of Hazards

- There are some potential problems where operators felt they 'knew it all before' and that the process has not added any value.
- Risk control has still not improved as much as it should have 'because there is too much reliance on compliance with standards (rail industry) without understanding the basis for the standards'.
- The fact that a good deal of attention is paid to the major hazards, and less is paid to behavioural and occupational hazards in the workforce and organisational management was seen as a concern. This seems to be a recurring theme. Respondents variously either raising it as a issue, or even stating that they believe that while improvements have been made in the identification and mitigation of major hazards, behavioural and occupational safety issues have not progressed since the introduction of the SCR. They acknowledge that this has an intrinsic effect on the validity and effectiveness of their Safety Case.



- Safety concerns in relation to major safety hazards are more systematically addressed in comparison to previous approaches resulting in better understanding of safety related risks, e.g. domino effects intra and inter plant on a site.
- Improving the adequacy of risk controls has been viewed by some as the principal benefit of the SCR, a 'proven conviction is a much more sound basis for safety assurance'.
- Some companies see as positive the requirement to have 'someone external to the company keeping you on your toes by regularly asking if you have done all you can', and that it 'forces you to convince yourself that you have covered all the risks.'

7.2 Process and Implementation

- The SCR is only as effective as the plant manager who has responsibility for implementing the SCR requirements. On these individuals depends the 'life' of the document. Regular review and revision depend on proactive management in order to preserve its effectiveness.
- The requirements placed on duty holders in relation to Safety Cases and supporting reports were not felt to be as clear as they need to be. This is based on the majority of returned comments, which appear to relate to early experiences with newer regimes as well as some more established ones. The nuclear industry appeared to be the exception, primarily due to the length of time it has had to justify its safety plans to external authorities.
- Comments on feedback seem to indicate that while companies understand where they are deficient, the returned feedback is not always clear on why they are deficient and what can be done to rectify the problem. It is noted that this appears to be in specialist areas such as Human Factors. It is noted that some respondents commented that they felt the weaknesses they have are mirrored to an extent by the HSE's weaker areas. There have been instances where 'Inspectors do not always follow what is in the Safety Case closely enough, rejecting aspects of a case where they feel there is something not right but they cannot put their finger on it, on a 'gut feeling'. This needs elaborating in order to be of any use to those compiling and implementing SCR.'
- One comment from the rail industry also noted that the reviewers do not always state their assumptions.
- There appears to be a perception among some safety personnel that it is possible to do 'too much' and that the HSE do not provide feedback where this has been done. This could be a genuine problem, or it could be, potentially more serious, a false positive in that they think they could do less. HSE would be in an awkward position with this perception as either reason presents problems.



- The nuclear industry is felt to have clear and unequivocal requirements on its duty holders, although this is also felt to be related to the fact that the industry has had a SCR far longer than any other.
- Having nuclear-trained inspectors is seen as having a positive effect on the feedback relating to nuclear Safety Cases and reports.

7.3 Cost Benefits

- The CBR is difficult to quantify, as having 'no accidents' is difficult to cost and prove to be as a result of complying with the SCR. Some businesses see it as cost-effective only because it keeps them in business rather than being shut down. There is also a perception in some quarters that there is little visible reward for the amount of work put in on a regular basis.

7.4 Other Issues

- It is noticeable from the responses received that there is a variation between generally positive and negative overall responses, with one or two being prepared to discuss both aspects. It is notable that in line with one of the more discursive responses, that those companies or individuals with more negative attitudes towards the regime in general are those that are experiencing problems and perceiving little benefit.

Those individuals who are more positive and 'pro Safety Cases' were prepared to state that the benefits are certainly there, even if they are not quantifiable in monetary terms. This again is a recurring theme. By the very nature of the regime, it is difficult to pin cost benefits down specifically to its use. Some companies see the benefits as only showing when they actually have an accident (more incident management focussed) others where they have a 'near miss' without a full-blown accident (more prevention focussed). A third group appears to perceive success to be judged by the lack of any form of incident, (prevention and planning focussed). This last group also appear to be those who take a more pro-active stance towards integration of the Safety Case into the culture and every day work of the plant. These are generalisations based on interview returns but do appear to be substantiated by the comments made.



8.0 Discussion

This section of the report discusses the findings presented in Sections 6.0 and 7.0 and comments on the nature of the information and data on which they are based. The section begins by raising a number of issues that should be borne in mind in reviewing the findings and continues with a short summary of the key findings.

8.1 Issues to Consider in Interpreting the Findings

Nature of Papers Identified In the Literature Search

1. Within the literature the vast majority of papers recognised that SCRs have both positive and negative implications. Thus, there were very few, if any, papers that were either entirely supportive or critical of SCRs. This was important in that it influenced the way in which the literature was analysed and the manner in which the findings are presented. A further point that relates to this is the fact that some authors tended to focus on the negative issues. This does not necessarily mean that they perceived the regulations negatively, rather they perceived a greater need to discuss the negative implications of the regulations with a view to promoting and facilitating change and improvement. Indeed some authors commented at the beginning of their paper that the positives were essentially taken as read, but that discussion of the negatives was necessary to promote change. This is illustrated in the following quote:

[This paper] deliberately concentrates on the controversial aspects of the regulations, in the interests of stimulating constructive discussion' (Ref. 112)

This is an important issue to bear in mind in reviewing the findings, which can initially seem rather negative at times. Indeed it is the belief of the Project Team that broadly speaking most papers were, by and large, positive.

Objectivity and Content of Information in the Literature

2. There is a virtual absence of objective evidence on the impact on the SCRs. The vast majority of papers were opinion based with little or no evidence to substantiate the claims. The obvious exception to this is the AUPEC report that has attempted to objectively review the impact of the Offshore Regulations (Ref. 6). It is recognised however, that an objective study of the impacts of introducing a SCR would be complicated, as there are numerous other conflicting variables to be controlled.
3. In considering the results of the literature review it is important to note that one should not necessarily extrapolate from the views expressed within the papers and interviews as representative of the views of



industry as a whole. Rather they represent the views of a relatively small group of people.

4. The literature review generated a relatively large number of potentially valuable references (around 2,500). Unfortunately, upon further review, the vast majority of these were found to be peripheral to the issues being considered. Most commonly papers relating to SCRs fell into one of the following categories:
 - Preparation and development of Safety Case submissions, covering topics such as planning, construction, submittal and maintenance. See for example Ref. 20 for nuclear, Ref. 132 for Rail, Ref. 51 for mining.
 - Descriptions of how the current approach to major hazards have evolved and developed within particular industries (covering topics such as the background, history, regulatory changes etc.), see for example Ref. 130.
 - Descriptions of how to address particular elements of the regulations, for example what is meant by the terms 'demonstrate' or 'ALARP'. See for example Ref. 111.

Following the filtering process, around 160 papers were considered to have information that could contribute to this research topic. The Project Team would estimate that this is around 90% of published works (certainly the team believes that there is coverage of around 95% of the topics related to the effectiveness of the SCR). The Team believe that further gathering of reference material would not benefit the coverage already identified and detailed in this report.

5. It should be noted that there might be a number of papers published at industry specific conferences, which have not been identified as part of the literature search. This reflects the fact that the conference proceedings for these events are not formal publications and, as such, usually have no ISBN references. This makes identifying papers of this type difficult and time consuming. In addition, even when the Project Team has been aware of particular events, it can still be difficult to access copies of proceedings (if indeed formal proceedings are produced).

Longevity of SCR

6. The documents reviewed cover a lengthy period (c.1993-2002) during which time the various SCRs have bedded in or evolved. In extracting material effort has been made to identify the more recent comments or ones where the issue is unlikely to have been resolved. One of the issues that the Project Team had hoped to examine within this study was the changing impact of the regulations as the regimes reached maturity. Whilst some discussion of this has been made with regard to the gradual erosion argument in the offshore industry, and the changing nature of the Safety Case (COSR) in the nuclear industry, the team were generally disappointed with the number and breadth of



papers addressing this issue. There is scope for further research to examine the development of SCRs over time, which could perhaps compare industries such as nuclear, offshore, rail and onshore process, which have progressively introduced regimes more recently.

8.2 Summary of Key Findings

Identification and Control of Hazards

The identification and subsequent control of hazards in the regulated industries would appear to have benefited from the SCR approach through:

- Improving systematic hazard identification;
- Enforcing a process for undertaking hazard review and identifying controls;
- Enabling prioritisation of improvement works/capital investments.

In some cases this is the first time some operators have reviewed their systems and in these instances the improvements are likely to be substantial.

However, there are some individuals that believe that the SCR does not improve their existing systems for risk control, and to them the SCR adds additional cost and effort to their business. This was particularly evident from the interviews where strong views were more commonly expressed.

Project Team View

The Project Team believes that in general terms the introduction of SCRs has helped in improving the identification and control of hazards. In the main this has been through requiring a systematic and comprehensive approach to the process. In particular, this has helped to improve hazard identification in companies who were previously very poor, and has helped to ensure that all companies are striving to attain a reasonable standard of hazard identification and control. Where companies already had comprehensive systems in place, there is more debate as to the value that the development of Safety Cases has added.

The development of a Safety Case submission appears to have particular value in the early days of application in a sector. This, to some extent, reflects the fact that the process can lead to significant re-examination of the way in which things are done; almost a questioning of why a company operates in a particular way. This can have a number of powerful benefits and as part of this can improve the understanding of hazards and the mechanisms in place to control them.

Whilst this is essentially a benefit, it also raises an important issue in relation to the management of the regime as it matures. The hope is that the Safety Case remains a living document and supports the systematic management of safety within a company. One potential concern is that once the initial review has been undertaken, there is a risk that the benefits may reduce, and in



extreme cases that the exercise becomes something akin to "jumping through hoops". This is important to avoid, and in this area, there are possibly lessons to learn from the more mature regimes such as the Nuclear Industry and Offshore Oil and Gas.

Safety Culture/ Awareness

There is generally a positive picture regarding the impact of SCRs on safety culture and awareness. Claims are made that during the process of producing a Safety Case, staff involvement in the risk assessments and implementation of risk control measures enhances staff awareness of safety. In several cases papers suggest that preparation of Safety Case reports ensure staff are more aware of the relative risks from various operations or activities at work.

The SCR is also viewed as improving dialogue between management and staff as often the technical knowledge to undertake the detailed risk assessments resides with these people.

Against this relatively positive backdrop, there are however, a number of concerns expressed. In particular, the picture is less clear with reports that in certain industrial sectors (e.g. offshore), safety representatives are often unaware of the Safety Case content, and remain uninvolved in the preparation of the case. There is also the expressed concern that the SCRs maybe used as a reason for pushing through change with limited staff consultation.

A final point is that the Safety Case is also viewed as a vehicle that can facilitate the communication of safety information. Achieving this communication is however seen as a substantial *challenge*. Often the Safety Cases are technical documents that are not easily assimilated by the workforce.

Project Team View

The Project Team believes that the SCR can have a potentially significant impact on the safety culture, communication and awareness of staff within an organisation. The impact however would seem to be very variable, and is critically affected by the 'spirit' and manner in which the regulations are implemented. For example, in instances where companies rely heavily on external consultants and see undertaking the QRA almost as a driver for the process, rather than one of a number of relevant tools, there may be little or relatively superficial involvement of the workforce. However, where staff are more closely involved in identifying and assessing hazards, there are clearly a number of benefits such as improved understanding, communication and management of risk.

The Project Team believes that one of the key challenges for companies is linking the hazard identification to the control of hazards through procedures, safe practices and sound engineering judgement. Making and demonstrating this linkage would have a number of benefits, but importantly is one way in



which staff can see and understand how what they do contributes to and underpins the control of hazards.

A final point in relation to communication is the language and format that is used in the Safety Case. Here it is clear that there are lessons to be learnt from some of the more mature regimes. Clearly the documentation associated with the Safety Case needs to be written in such a way that it is meaningful to staff, and easily accessible to all. It is also important that staff understand what a Safety Case is, why it is developed and how it relates to the way in which they undertake their work. Without this, there is a real risk that the Safety Case simply becomes an abstract concept, or something seen as being undertaken by a group remote from day to day operation of plant. This takes away much of the potential for improvements in communication and awareness that developing a Safety Case can provide.

The Team is aware of efforts undertaken by various companies to develop more accessible information from Safety Cases. This includes simplified workforce guides to the Safety Case and use of web technology to provide access to relevant information. It is clear that more can be done to exploit and disseminate the information collected during the development of a Safety Case. The costs to an individual company, however, can be prohibitive. The HSE should perhaps consider whether it could assist in some way in facilitating the development of approaches and technologies to make best use of Safety Case information.

Business and Security Issues

There were a number of areas of concern expressed about business and security. The SCR is seen as adding to the operational costs of businesses, with sometimes little tangible business return. This is particularly true of older sites where significant improvements may be required to reach an acceptable standard.

The issue of the SCR undermining competitiveness was raised several times, especially with respect to COMAH/Seveso II. The authors saw the UK as having some of the toughest regulations, thereby adding costs and reducing their ability to compete within the European Market. In some cases, this burden is viewed as potentially leading to plant closures, or relocation to a less regulatory-onerous country.

The need to publicly document details about plant and processes is raised as a concern both in relation to commercial confidentiality and in relation to the risk of terrorism or sabotage.

There is also concern that perhaps the need to document processes may restrict the ability of an organisation to make changes to keep up with competition and technological advances.

However, whilst it is apparent that complying with the SCR will add to costs, the process of producing a Safety Case can potentially produce business benefits. These may be through improved operations or loss prevention. In some cases, there seems to be an attitude difference between authors, some



taking a positive view of using the SCR to help with the business as well as meeting with statutory requirements.

Project Team View

The Project Team believe that meeting the requirements of the SCR can potentially save companies significant sums of money in terms of improved loss prevention. This will, of course, depend upon the scope for safety improvements that can be made and how much risk is inherent within an operation. As before, the Project Team also believes that the manner in which the SCRs are implemented is an important influence and this may to some extent explain the differences in views reported in the literature. Of the various sectors reported in the literature, only in the oil and gas industry are figures for estimated savings presented and discussed. These seem to draw in the main on HSE data (either survey or the AUPEC study) and there is therefore a need for further research in other industries to provide data of this type.

An interesting issue that has been discussed by the Project Team is the business flexibility that adopting the principles of ALARP provides. This can have benefits for business in that the ALARP principle helps to prevent over engineering of less critical systems. This reflects the fact that the reliability of the design is prioritised according to the safety significance of the system. It should be noted that within interviews there was some debate as to the veracity of this argument. This reflects the fact that interviewees were sceptical regarding whether Inspectors would actually accept this as a valid argument for not implementing improvements, if it led to a perceived lowering of safety standards.

A final point in relation to this section relates to the move towards greater openness (through COMAH) and the associated concerns in relation to commercial confidentiality and security concerns. The Project Team believe that careful thought is required with regard to the value of greater openness, as it raises genuine concerns for a number of companies, particularly in the post September 11th era. Certainly, with some railway Safety Cases, there are some assessments and volumes relating to security matters that are not openly declared, but retained in a secure manner.

Process and Implementation

Whilst there is considerable material relating to definition of concepts such as ALARP, detail about hazard assessment etc., there would still appear to be an apparent lack of clarity in the minds of several authors regarding what exactly is required. This is an inherent problem with goal-setting regimes in that defining exactly what is adequate to demonstrate the Safety Case is not as easy a concept as with prescriptive legislation.

This is compounded it seems in some cases by questions from the Regulator, which companies do not apparently understand or appreciate why they are being asked. Sometimes the questions can be seen as a 'points scoring exercise' rather than being constructive. The interviews yielded particularly



strong views on this topic. For example, there was the attitude that the more detail and effort an organisation went to in producing their Safety Case, the more questions they were likely to be asked. Therefore, information was sometimes left out, requiring Inspectors to have detailed knowledge of the industry.

Where charging for Inspectors' time has been introduced, there is strong criticism. Not only are the charges seen as very high, it is seen to undermine the relationship between the Regulated and Regulator.

Project Team View

It is clear from the review that it is the process of developing the Safety Case that produces most benefit. This is particularly true where the company has not previously undertaken an overall and systematic review of their operations. The very act of collating and analysing information about one's organisation often identifies gaps, risks and possible improvements. The main benefits therefore of the SCR in this area is that it requires a much wider view of the organisation than say a targeted assessment of a particular aspect of operations (e.g. a safety review of a new piece of equipment being installed).

The Project Team believes that the greatest potential for identifying improvements is generally realised in the early days of seeking compliance with the SCR. During this time there is perhaps the greatest potential to make a step change in reducing or removing risks and to make improvements in management and process. As time passes there is likely to some extent to be a diminishing of returns in terms of changing the risk or operational profile through an insight via compliance with the SCR. However, the SCR can be used as a framework in which continuous reviews of performance ensure safety standards are maintained.

Given the reduced potential for identifying improvements, it is important to carefully think through how the SCR process should be managed and, if appropriate, modified through its lifecycle. For example, it may be desirable to move the focus from QRA and engineering modifications to softer issues and addressing more minor occupational safety losses. Here there are perhaps lessons to learn from the more mature regimes such as the nuclear industry and offshore oil and gas. In the nuclear industry, for example, there are examples where the SCR is changing such that it is becoming more closely owned by operational staff and with closer linkage of hazards to the day-to-day operations, processes, and engineering judgements that control hazards within the operational plant. Here the development and changing nature of the Safety Case report has followed close collaboration and discussion between companies and the Regulator.

Within the process and implementation of the SCR the HSE clearly play a major part. The process and effectiveness of implementation is not only dependent upon their knowledge and experience but on their attitude and ability to 'manage' the regulated. There are issues related to the exact role of the HSE as Regulator and the degree to which they advise and guide versus enforce. With the regimes maturing then a change in focus increasingly



toward the 'softer' aspect of organisation and human factors is likely to lead to more debate between HSE and organisations as these subjects introduce more qualitative arguments – many of which have no obvious right or wrong answer.

Cost Benefits

There are several papers that discuss the relatively high cost and effort involved in producing and maintaining a Safety Case. With the exception of the nuclear industry, little is said on the ongoing costs (e.g. of making changes, periodic reviews).

As for the CBR there are mixed feelings with some particularly negative views being expressed in interviews. However, the one systematic review (the AUPEC report) suggests that there are benefits in producing a Safety Case to meet the demands of the SCR.

An important factor raised as being influential with regard to CBR is the attitude toward SCR suggesting that 'adopting the right mindset' is significant in determining the benefits derived from its production and existence.

One further concern raised with regard to preparing Safety Case reports was that precious SHE resources are side-tracked from day-to-day safety work. It is perhaps worth noting that onshore petrochemical companies subject to COMAH most often express this. Larger operators (e.g. offshore oil and gas) tend to have dedicated departments of risk assessment and Safety Case specialists, whereas other smaller companies may not have these organisational resources or arrangement.

Project Team View

The Project Team in general believes that the SCR produces benefits over cost. However, this very much depends on the scope for safety improvements within an organisation (they may already be doing thorough safety studies and management) and the costs incurred in meeting the demands of the SCR.

Like any project, time, materials and people effect the production costs. The Project Team would suggest that there is sometimes significant wastage of resources through poor management of the Safety Case development process. This may stem from a limited understanding of what is required (in some cases it is in overestimating requirements) and of the ability to manage resources during production. This commonly involves external parties with particular expertise and perhaps higher costs. Whilst it may be an advantage to bring in external resources who provide particular expertise, it should also be recognised that this creates management and co-ordination tasks, which are not always easy to undertake at a time when there are many competing demands on the time of company staff.

Other issues, which are worth mentioning in relation to CBR, relate to the format and nature of the Safety Case itself. Where documentation is



extensive and technical, produced primarily for the Regulator, they are often to a large extent ignored or little used by company staff. Approaches of this type fail to capitalise on the potential benefits of the SCR in terms of safety culture, communication, risk awareness etc. Where Safety Cases are of most benefit, it tends to be where their development is an integral part of the business processes, with documentation being produced that is both understandable and usable by staff.

Overall Benefits of the SCR

A number of papers specifically comment on the impact of the SCR with a number categorically stating that the regime is of benefit in reducing the occurrence of major hazards. There are however also a number that comment that it is unclear or in some cases too early to comment on the impact SCRs have had in particular industries.

Project Team View

The Project Team supports the view that the SCR has had a beneficial impact upon safety within the regulated industries. There is increased use of systematic risk assessment and safety management techniques and subsequent increased awareness by decision-makers in organisations of the safety implication of actions and operations.



9.0 Sector Discussion

Despite the differences in SCR regulated industrial sectors, there was a great deal of commonality between the papers across different industries. Issues such as hazard identification, communication, risk awareness and management of the SCR were all raised. This is not surprising as in effect each industry have gone through the same learning curve in having to implement regulations based around a goal-setting philosophy.

Whilst recognising the commonality across industries, a number of sector specific comments were noted. Where appropriate, these are detailed in the following sections. Note that these sections provide an overview of the differences between the sectors, quotes relating to each sector are given throughout Section 6.0.

9.1 Offshore Oil and Gas

Within oil and gas, there were many papers written early in the regime that tended to focus on methods and details of design. There were also discussions about the management of the Safety Case as a living document, and the consultation (or not) of safety representatives as part of the development process. As the regulations have been in force for many years now, the more recent papers tend to focus on the long-term management of the Safety Case and how to make the Safety Cases more user-friendly. Attention turns from major hazards (now believed to be well understood) to matters such as safety culture and day-to-day working practices.

The offshore, oil and gas industry tended to yield more papers than most on the cost of developing Safety Cases and the potential monetary savings associated with loss prevention. Offshore was the only industry where actual figures for cost savings were presented (based generally on HSE survey data, and, or the AUPEC study). The AUPEC study was also the most significant attempt to really evaluate and objectively analyse the impact of the SCR on an industry.

9.2 Nuclear

The nuclear industry has been subject to regulations since the Windscale fire in the late 1950's. The industry has a great deal of experience, with the requirements of the legislation and with the tools and methods to produce adequate Safety Case documentation. Many of the tools used within other industrial sectors were originally developed from the nuclear Safety Case requirements.

Whilst the nuclear industry addressed many of the common topics discussed in Section 8.0, it was unusual in discussing how the SCR might change and develop as it becomes more mature. As part of this there is some discussion of streamlining the Safety Case, tailoring its use to an operating plant, and improving its relevance and accessibility to staff. This reflects an increasing focus on staff related issues (i.e. away from the engineering aspects to the



organisational and motivational aspects). The Project Team sees this as a result of diminishing potential to identify engineering improvements and an increasing awareness of the potential improvements to be made on 'softer' issues. There is also a greater recognition of the need to observe and evaluate the way in which the plant is actually operating, as opposed to the idealised way in which it was perhaps intended to work.

9.3 Onshore Process Industries

There were a large number of relevant quotes identified that relate to COMAH, and this to some degree reflects its relatively recent introduction. A key aspect, which is repeatedly raised within these papers, is the 'pain' caused by the new regulations and the coming to grips with 'demonstration', ALARP etc. There is also concern about security and commercial sensitivity of the information required for the more 'open' nature of the regime. A third common point that is raised in the COMAH literature relates to charging. This has generated criticism regarding the level and nature of charging and there is concern about the role of the Regulator and the relationship between them and the company.

There are however several positive aspects too, these generally supporting the regime and suggesting there to be benefits. Here perhaps more so than in other sectors, there is a tendency to recognise the benefits of the regime, but to focus on the negatives as a means of promoting change.

9.4 Rail

Rail as a sector generated relatively few quotes or relevant papers. This is disappointing, as the sector is different from the others in many respects, including:

- The regime was established because of privatisation not because of accidents,
- It is applied to a distributed system and not to a limited number of specific sites, and
- It tends to focus on management systems as opposed to technical systems.

The Project Team had hoped to be able to focus on some of these differences and to discuss the relative benefits of the SCR in these rather different circumstances. This was not however possible as there was simply not enough relevant material in the public domain to enable the team to do this.

Note: Most discussions relating to rail appear to occur in industry journals and are not necessarily published at conferences. This has made searching for relevant papers difficult and labour intensive as such journals are often inaccessible to search engines.



10.0 Conclusions & The Way Ahead

This study's overall objective to collate quotes concerning the benefits and disadvantages of the UK Safety Case Regimes has been met. Whilst the majority of the literature on Safety Cases was found to be peripheral to the issues being considered in this study, there were a number of sources that addressed the effectiveness of the SCR and its overall value. These cover quite differing views within and across a range of industries.

Much of the criticism identified in these sources seems to stem from the effort required and associated costs, a degree of uncertainty on requirements and questioning of the CBR of this type of approach. However, these negatives are generally outweighed by positive assertions that the SCR has (and will) reduce major incidents, does help in understanding options for improvement and acts to better inform staff.

There are disappointingly few objective attempts to determine the impact of SCRs and this is therefore something that would benefit from further study. This is particularly important given that serious criticisms were identified within the interview material but that comments of this nature are likely to remain unpublished. The majority of this criticism tends to be related to how the regulations are implemented, rather than the nature of the regulations themselves.

10.1 Some Specific Observations Relating to the Way Ahead

Developing A Shared Understanding of Key Terms

Little in the literature raised fundamental questions about the underlying philosophy of the SCRs, i.e. the goal-setting style seems to have high acceptance. The Project Team would tend to agree with this sentiment as it allows organisations the opportunity to develop their own Safety Case in the context of their business and management style. This regulatory approach however has problems associated with definition of terms (e.g. what is 'demonstration?') and in the workload on the Regulator, as they will be required to review differing styles and approaches within the Safety Case submissions.

The Project Team believe that there would be benefit in developing further guidance in collaboration with industry to help develop a shared understanding relating to key terms such as 'demonstration' and 'ALARP'. Specifically, how can the balance between what a company considers to be an adequate demonstration of safety and that of the Regulator be achieved? Furthermore, how much say should the company have in this argument? Where safety issues are moving toward the 'softer' topics such as human performance and management styles then there is likely to be an increase of subjective arguments and potentially very different views on what is deemed 'acceptable'. This will increase the need for a shared understanding of best practice and what is necessary to meet the requirements of the regulations.



Meeting SCR Requirements in a Cost Effective Manner

A common issue that was raised in many sectors was the cost of implementing the SCR in particular the Project Team felt that this is a major issue with smaller companies, especially within the COMAH Regulations. Whilst we accept that there are costs associated with compliance, these can be kept to a minimum as long as the SCR is integrated into the way the business operates and is used positively. The Project Team feels that excessive costs are more likely to be the result of one or more of the following:

- Poor understanding of the SCR requirements (often over estimating the requirements);
- Poor management of the production of the Safety Case;
- An attitude where the end result is not seen (or used) as a valuable tool to the business.

The Project Team believes that there is scope for developing further guidance both to ensure that the requirements of the SCR are clearly understood and that the importance of integration with wider business processes is appreciated.

Integrating Safety Into Business Processes

The Project Team believes there is often still a gap between safety and business processes despite assurances to the contrary from the company itself. With few exceptions safety is still not an integral part of business planning and processes – and instead is still seen in many quarters as getting in the way. The Team believes that improved integration would have positive effects not only on safety but also company performance. Therefore the SCR should seek to encourage this and look for evidence as to how safety can be actively managed during business decision-making. This really needs to go beyond the statements often seen as implying that safety is taken into consideration during business discussions. So safety should not simply be an item on the agenda, rather it should be taken down to a further more detailed level. For example, during early phases of projects requirements, specifications and designs are sometimes drawn with very specific detail on engineering aspects of the system, but safety and final operational issues are often detailed at a more generic (higher) level. The challenge therefore is to persuade business that a more up-front consideration of safety at the right level of detail will:

- Increase the likelihood 'projects' will deliver it right first time and avoid expensive and lengthy retro-fitting (note that the safety assessment techniques and tools also help identify process improvements/vulnerabilities and so improve overall productivity).
- Reduce design costs by considering what is actually necessary and not what is 'flavour of the month'. VECTRA have experience of projects where alarms have been over specified, control rooms have redundant



instrumentation etc., all of which add cost and make operations/maintenance more complex.

- Reduce the process of approval (where required) by the Regulator.

Improving the Interface between the Regulator and the Regulated

A further key issue which has arisen many times within the study is the interface between the Regulator and the regulated. Here the Project Team believes that the relationship between the two should be reviewed with a view to identifying ways of promoting a positive relationship and ensuring an effective interface. This might address a number of facets of the relationship, and should include the extent to which the Regulator provides advice/guidance/assistance to companies. This is particularly important at the 'Inspector' level, where review of Safety Cases and compliance checking is carried out. The balance between a goal of improving safety and enforcing the regulations is a problematic area as there may be questions about the Regulator compromising their responsibilities. The literature identifies some quite different relationships - from co-operative to confrontational and these might be evaluated and investigated further as part of the process of reviewing the interface.

Developing Guidance on How to Maintain a Live Safety Case as the Regime Matures.

Maintaining the Safety Case over time following the initial production is likely to produce diminishing returns in terms of identifying improvements that lead to a step change in risk control (the first few passes of the Safety Case should identify the major factors). In addition, the initial momentum of producing the Safety Case may become stagnated. Therefore, further work should focus on how to ensure the Safety Case remains a 'live' document and provides the maximum ongoing benefit. This should include consideration of how Safety Cases can be made more readily understandable and accessible to the general workforce.



11.0 Bibliography

Note: For some publications it has not been possible to provide page numbers. This reflects the fact that page numbers are not provided on some publications, for example those accessed via the web, some conference proceedings, or on papers published as part of a Technical Meeting Review.

1. Abramson J (2000), *Can a Safety Case Protect the Company in Court?* Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000
2. Abramson J (2002), *The Company on Trial : Can a Safety Case Help or Hurt?* Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
3. Ahern J, HSE (2000), *Lessons Learnt So Far – UK Regulator.* Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000
4. Allinson J (1997), *Survey of the Safety Case Process/Crime* In: Risk 2000: Acceptability to Core Technology, IBC UK Conference Limited, 1997
5. Arnold K E (1994), *Safety cases: are they appropriate for most offshore platforms?* In: Journal of Petroleum Technology, Vol 1994, Vol 46, no 11, p954
6. AUPEC Ltd, for HSE (1999), *Evaluation of the Offshore Safety Legislative Regime.* Ref 8938/3714, Final Report June 1999
7. Bainbridge D (1993), *ALARP in Practice.* In: Offshore Safety Cases Conference, Aberdeen, April 1993, p85-89, HSE
8. Barker S, Kendall I, Darlison A (1997), *Safety Cases for Software-Intensive Systems: An Industrial Experience Report.* In: Computer Safety, Reliability and Security (SAFECOMP) 16th International Conference, York, Sept 1997, p332-344. Publisher: Springer, London, c1997
9. Barrel T, Watson K (1993), *Objective Setting and Performance Standards in Offshore Safety Cases.* In: Offshore Safety Cases Conference, Aberdeen, April 1993, p61-70, HSE
10. Batchelor J R (1997), *The LUL Safety Case – a Train Maintainer's View.* In: Third International Conference on Train Maintenance Tomorrow...And Beyond, IMechE conference transactions, 1997, Vol 1, p 49-56
11. Beale C (2000), *Safety Cases: Regulatory Requirements.* Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000
12. Beale C (2001), *Positive and Negative Experience with the New COMAH Regime in the Speciality Chemicals Industry.* Presented at: Hazards XVI – Analysing the Past, Planning the Future, Manchester, UK 6-8 Nov 2001



13. Beale C (2002), *Assessing and Managing Environmental Risks Within the Comah Safety Case Regime - Chemical Industry Experience*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
14. Beaumont J, BP Exploration (1995), *Clyde (Existing Installation)*. Presented at: Safety Case Preparation – The Industry Responds, FABIG Technical Meeting, Jun 1995. Published as Technical Meeting Review
15. Beaumont J, BP Exploration (1995), *Seillean Floating Production Storage and Offloading*. Presented at: Safety Case Preparation – The Industry Responds, FABIG Technical Meeting, Jun 1995. Published as Technical Meeting Review
16. Beredsin R (2000), *The Electronic Live Safety Case?* Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000
17. Bibbings R (1993), *Workforce Involvement – A Trades Union View*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p135-140, HSE
18. Bishop P G, Bloomfield R E (1995), *The Ship Safety Case Approach: A Combination Of System And Software Methods*. In: Centre for Software Reliability (1995), *Safety and Reliability of Software Based Systems 12th Annual CSR Workshop – Bruges*, p107-121, Publisher Springer, 1997
19. Blackburn R (2000), *Periodic Safety Reviews of Nuclear Power Plants – A Regulatory View*. Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27-28 March 2000
20. Bounds A (1995), *BNFL Experience in Construction and Implementation of Safety Cases*. In: *Safety on the Railways*, London, June 1995, 11pp
21. Boyce T, Hamilton V (1999), *Retrospective Collection of Safety Case Evidence – Experiences from an Air Traffic Control System Safety Case*. In: 7th Conference on Safety-Critical Systems: Towards System Safety, Huntingdon, 1999, p 48-49. Publisher, Springer, London, 1999
22. Brown M (2002), *Railway Safety Cases: Theory and Acceptance*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
23. Bruyninckx E (1994), *A Review of Safety Cases and Applied Risk Analysis in the Offshore Industry*. In: *Explosion Safety and Related Risk Control*, Ghent, 1994, p 143-154, Antwerp, Koninklijke Vlaamse Ingenieursvereniging
24. Burgoyne Dr J H (Chair) (1980), *Offshore Safety, Report of the Committee*. Report presented to Parliament, March 1980



25. Chevalier J (1993), *Workforce Involvement, An Industry View (2)*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p151-154, HSE
26. Coghlan P W (1994), *The Impact of the Safety Case Regime in Offshore Western Australia*. In: Papers Society of Petroleum Engineers of AIME, 2nd International Conference, Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, Jan 1994, Vol 1, p 175-182. Publisher: SPE, 1994
27. Considine M (2001), *Safety Reports – An Operators View*. Presented at IBC 3rd Annual Conference on Safety Cases, International Cross Industry Comparisons of Best Practice, London UK, 26-27 April 2001
28. Considine M, BP (2000), *Experiences of COMAH*. Presented at: International Conference on the Control of Major Accident Hazards, 6-8 November 2000
29. Considine M, BP (2002), *Demonstration in COMAH Safety Reports*. Presented at: Fire and Blast Aspects for the COMAH Safety Case, 26th FABIG Technical Meeting, 17 April 2002. Published as Technical Meeting Review
30. Corrie J (1999), *The Consultant's View*. In: Safety Cases: Getting There Together p11.15. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
31. Cox T (1999), *Challenges and Opportunities for Regulators and Industries in Risk Based Decision Making*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26-27 April 1999
32. Cox T (2001), *Railway Safety Cases as Tools of Safety Regulation and Risk Management*. Presented at IBC 3rd Annual Conference on Safety Cases, International Cross Industry Comparisons of Best Practice, London UK, 26-27 April 2001
33. Coxson B A, Brand V P (1993), *Benefits Arising from Audits of Operational Experience: Method and Case Study from the Sizewell 'B' Safety Case*. In: Safety and reliability assessment: an integral approach, Munich, Germany, May 1993, p 729-740, Amsterdam, London, Elsevier, 1993
34. Crawley F K, Department of Chemical and Process Engineering, University of Strathclyde (1999), *The Change in Safety Management for Offshore Oil and Gas Production Systems*. In: Institute of Chemical Engineers, Trans IChemE, Vol 77 Part B May 1999, pp143-148
35. Cresecent J (2000), *Evaluation of the Offshore Safety Legislative Regime*. Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000



36. Crowther M and Stansfield R (2002), *Generating Real Safety Benefits from a Web Based Approach*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
37. Cullen (1990), *The Public Inquiry into the Piper Alpha Disaster*, Volumes 1&2, London, HMSO
38. Cullen (2001), *The Ladbroke Grove Rail Enquiry*, Parts 1 & 2, HSE Books
39. Dietzold A (2002), *Risk Assessment – An Operators View*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
40. Duerden S L, Smith R E, Sumerling T J, Yearsley R A (1998), *Regulatory Assessment of an Applicant's Long-Term Safety Case in the UK*. In: High Level Radioactive Waste Management, 8th International Conference, Las Vegas, NV, May 1998, p503-506. Publisher: La Grange Park, American Nuclear Society, 1998
41. Edwards C (1995), *Railway Safety Cases*. In: Centre for Software Reliability (1995), *Safety and Reliability of Software Based Systems 12th Annual CSR Workshop – Bruges*, p317-322, Publisher Springer, 1997 ISBN 3540760342
42. Elam J, Process Engineering Specialist, Scottish Environment Protection Agency (2002), *Scotch Whisky: The Impact of COMAH*. Paper received by email from HSE, 04/12/2002.
43. Evans A & Horbury A (1999), *An Assessment of the Railway Safety Case System in Great Britain*, Presented at ESRC Risk and Human Behaviour Programme Conference, London 17th September 1999
44. Evans A (1995), *Rail Safety Cases and Railway Risk Assessment in Britain*. In: 4th International Conference on Competition and Ownership in Land Passenger Transport, Rotorua, July 1995, p 170-188, publisher Transit New Zealand 1995
45. FABIG (1995), *Offshore Safety Cases – HSE Experience*. In: FABIG Newsletter Article R201, Issue No 13, June 1995
46. FABIG (2002), *Discussion Session*. Presented at: Fire and Blast Aspects for the COMAH Safety Case, 26th FABIG Technical Meeting, 17 April 2002. Published as Technical Meeting Review
47. Fitzpatrick M, BHP Petroleum Ltd (1995), *Liverpool Bay Development Design Safety Case*. Presented at: Safety Case Preparation – The Industry Responds, FABIG Technical Meeting, Jun 1995. Publisher: Technical Meeting Review
48. Ford R (1999), *A History of Safety Cases*. In: *Safety Cases: Getting There Together* p13.35. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999



49. Forlin G (2001), *Safety Cases and the Legal System*. Presented at IBC 3rd Annual Conference on Safety Cases, International Cross Industry Comparisons of Best Practice, London UK, 26-27 April 2001
50. Forrest J, Tuck K (1993), *Workforce Involvement, An Industry View (1)*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p141-150 HSE
51. Foster P J (1996), *Safety Cases in United Kingdom Coal-Lining Operations*. In: Health and Safety in Mining and Metallurgy, London, May 1996, p59-70, Publisher: London, Institution of Mining and Metallurgy, 1996
52. Fox C, Redd E (1993), *Industry's Experience of Voluntary Safety Cases*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p13-24, HSE
53. Franklin S J (2000), *Experience with Periodic Safety Case Review and Waste Management Planning at the Imperial College Reactor*. In: Nuclear Energy (London – British Nuclear Energy Society), Vol 39, pt 1, 2000, p33-40
54. Garner J (1998), *How the Development of a Safety Case Can Effect the Safety Culture of a Fleet*. In: Transactions – Institute of Marine Engineers – Series C, Vol 110, number 3, number 1 (sic) 1998, p33-44
55. Glasspool T (2002), *Developing and Maintaining an Aviation Safety Case*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
56. Glasspool T, Bristow (2001), *Developing and Maintaining an Aviation Safety Case*. Presented at: IBC Effective Safety Management Conference, Cambridge, 17-20 Sept 2001
57. Grieve A, Dolphin Drilling (1995), *Flotel*. Presented at: Safety Case Preparation – The Industry Responds, FABIG Technical Meeting, Jun 1995. Published as Technical Meeting Review
58. Grieve A, Dolphin Drilling (1995), *Semi Submersible Mobile Offshore Drilling Unit*. Presented at: Safety Case Preparation – The Industry Responds, FABIG Technical Meeting, June 1995. Published as Technical Meeting Review
59. Groombridge J C (2001), *A Coal-Mine 'Safety Case': Suggestions from the Petroleum Industry Following the Piper Alpha Disaster*. In: Transactions – Institution of Mining and Metallurgy, Vol 110, Jan/Apr, Part A, 2001, pA18-A26
60. Grose M, HSE (2002), *CIMAH to COMAH – From Information to Demonstration*. Presented at: Fire and Blast Aspects for the COMAH Safety Case, 26th FABIG Technical Meeting, 17 April 2002. Published as Technical Meeting Review



61. Hall C (1999), *The Acceptance Programme*. In: *Safety Cases: Getting There Together* p10.35. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
62. Harrison A, Duggan P (1999), *ISA – Is It Adding Value? Audit and Assessment ISA*. In: *Safety Cases: Getting There Together*, p14.15. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
63. Hart P M I, Smith D W, Thomas E J (1995), *Preparation OF Combined Operations Safety Case: Experience and Lessons Learnt*. In: *Offshore Europe 95*, Aberdeen, Sept 1995, p267-276, Papers – Society of Petroleum Engineers
64. Hawksley J (1999), *Operator Viewpoint the Wider Picture*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26- 27 April 1999
65. Herbert A, Wright E M, Goodhill D R (1995), *Cost-Effective Safety Cases*. In: *Nuclear Decommissioning: the Strategic, Practical and Environmental Considerations*, No 1995, IMechE Conference Transactions, Vol 7, 1995, p149-158, Mechanical Engineering Publications, 1995
66. HSE (1994), *Risk Perception and Safety in the Offshore Oil and Gas Industry*. Research Paper OTH 94 454, prepared by The Robert Gordon University for the HSE
67. Hudson J, Caldwell S (1993), *HSE's Systems for Safety Case Handling and Assessment*. In: *Offshore Safety Cases Conference*, Aberdeen, April 1993, p51-60, HSE
68. Hunns D W, *Computer-Based Safety Systems – The Elements of an Acceptable Safety Case*. In: Centre for Software Reliability (1995), *Safety and Reliability of Software Based Systems 12th Annual CSR Workshop – Bruges*, p176-182, Publisher Springer, 1997
69. IBC Technical Services Ltd (1994), *Practically Implementing Safety Case Regulations in the Transport Industry*. London, Mar 1994
70. IMO (1995), *IMO Backs Safety Case Approach*. In: *Safety at Sea International Issue 315*, 1995, p12
71. Jupp A (2000), *Living Safety Cases*. Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27– 28 March 2000
72. Jupp A, AWE plc (2001), *Safety Risk Management*. Presented at: IBC Effective Safety Management Conference, Cambridge, 17-20 Sept 2001



73. Kelly T P (1999), *Arguing Safety – A Systematic Approach to Managing Safety Cases*. In: University of York Department of Computer Science – Publications – YCST Issue 5, 1999 (whole issue)
74. Kelly T, McDermid J (1998), *Safety Case Patterns – Reusing Successfully Arguments*. In: Understanding Patterns and Their Application to Systems Engineering, Apr 1998. Publisher: Colloquium Digest – IEE, Issue 308, 1998
75. Kennedy D (1993), *ALARP in Practice – An Industry View*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p91-105, HSE
76. Kenney G (2001), *Safety Cases – Are they Meeting their Original Objective*. Presented at IBC 3rd Annual Conference on Safety Cases, International Cross Industry Comparisons of Best Practice, London UK, 26-27 April 2001
77. King J (1993), *SMS Interfaces*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p211-216, HSE
78. Kletz T () *Flixborough – 20 Years After*. Paper presented at 2nd Biennial Canadian Conference on Process Safety and Loss Prevention (source from www.dyadem.com/support/techpapers/flixboro)
79. Knapp J (1995), *RMT: The Importance of Information Provision in Safety Cases*. In: Safety on the Railways, London, June 1999, London, AIC, 1995, Pagination 11.40A
80. Kuo C (1994), *Application of the Safety Case Approach to RoRo Ships*. In: RORO 97 – 12th International Conference on Marine Transport Using Roll-On/Roll-Off Methods, Gothenburg, Sweden, Apr 1994, Vol 12, p13.4, Publisher Rickmansworth,
81. Kuo C (1997), *Application of the Safety Case Concept to High Speed Craft*. In: 4th International Conference on Fast Sea Transportation, Sydney, Australia, July 1997, Vol 1, p381-386. Publisher: Baird Publications, 1997,
82. Lawton A (1999), *the Rolling Stock Owner's View*. In: Safety Cases: Getting There Together, p15.35. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
83. Leiser H (1993), *ALARP Philosophy, ALARP and the Safety Case Regulations*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p77-83, HSE
84. Lewis S, Amerada Hess/EQE (1995), *AH001 Semi Submersible Production Vessel*. Presented at: Safety Case Preparation – The Industry Responds, FABIG Technical Meeting, June 1995. Published as Technical Meeting Review



85. Loss Prevention Bulletin (1995), *Procedures for Plant Safety Cases in the Nuclear Industry*. Publisher: Institution of Chemical Engineers, no 123, 1995, 19pp
86. Lyons M, Operations Director, Simon Storage (2001), *The Effectiveness of HSE at Controlling Major Hazards*. Paper presented on behalf of the Tank Storage Association, at HSE Specialist Inspector Conference, 15 February 2001
87. Maddison T, HSE (2002), *Demonstration and ALARP*. Presented at: Fire and Blast Aspects for the COMAH Safety Case, 26th FABIG Technical Meeting, 17 Apr 2002. Published as Technical Meeting Review
88. Maidment D (1995), *From Clapham to Safety Cases*. In: Rail International Vol 26, number 3, 1995
89. Malmén Y, VTT Automation, Risk Management (2001), *Is EU's Seveso II Directive Leading to More Systematic Use of Risk Assessment Methods? – A Finnish Case Study*. Presented at ESREL 2001, Torino
90. Marsden S, Transport and General Workers Union (2000), *A Trade Union Perspective – Concerns and Opportunities*. Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000
91. Mavin R M, Grainger C E (1993), *Impact of the Safety Case Legislation on Subsea Activities*. In: Subtech '93 Advances in Underwater Technology of Ocean Science and Offshore Engineering, Aberdeen, No 1993, Vol 31, p129-138, Publisher: Kluwer Academic 1993
92. Mayer L (1996), *Navigation & Safe Operation of Very Fast Craft – The Need for a Safety Case?* In: Ekranoplans and Very Fast Craft International Workshop, Sydney Australia, Dec 1996, p194-212. Publisher: Sydney, University of New South Wales, 1996
93. Mee D, Barker C (1999), *ISA – The Key Areas: Perspectives of an Auditor's Victim*. In: Safety Cases: Getting There Together, p14.15. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
94. Mercer D, Vopak (2000), *Seveso I to Seveso II – From Describe to Demonstrate*. Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000
95. Morgan J (1993), *An Operators View*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p167-186, HSE
96. Mudie A (2002), *Occupational Buildings – An Operators Experience*. Presented at: Fire and Blast Aspects for the COMAH Safety Case, 26th FABIG Technical Meeting, 17 April 2002. Publisher: Technical Meeting Review



97. Mullins J R, Patel V K (2001), *Demonstration of ALARP Within COMAH Safety Reports*. Presented at: Hazards XVI – Analysing the Past, Planning the Future, Manchester, UK 6-8 Nov 2001
98. Murray J, HSE (2000), *CIMAH to COMAH Transition in the UK*. Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000
99. Naval Architect (1996) *Defining the Safety Case Concept*. In: Naval Architect, No 4, 1996, p59-61
100. Naval Architect (1997) *Promoting the Safety Case Philosophy*. In: Naval Architect, Oct 1997, p8-10
101. Neilan P (1999), *Air Traffic Service Provider Experience*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26-27 April 1999
102. Nordland O (2001), *Assessment Criteria and Safety Case Fundamentals*. In: Control in Transportation Systems, IFAC Symposium, 9th Braunschweig, Germany. Publisher: Pergamon, 2001, Vol 2, p499-504
103. O'Leary D, BP (2001), *Implementing COMAH Effectively in an International-Multisite Organisation*. Presented at: IBC Effective Safety Management Conference, Cambridge, 17-20 Sept 2001
104. Odling D (1993), *A Contractor's View (1)*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p199-206, HSE
105. Offshore Engineer (1993), *Safety Case Lessons*. In: Offshore Engineer, Jun 1993, p23-24
106. Other, A N, (1996) *How are the Safety Case Regulations Shaping Up?* In: Safety Management – London, Vol 12, Number 1, 1996, pp5, Article with no author.
107. Owens M J, Technical (1991), *The Effect of Improved Platform Design on Emergency Evacuation Requirements*. Presented at Safety Developments in the Offshore Oil and Gas Industry, Proceedings of the Institute of Mechanical Engineers
108. Pape D (1993), *ALARP QRA and Temporary Refuges*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p107-120, HSE
109. Pape E, DNV Consulting (2001), *Comparison of Safety Case Approaches*. Presented at: IBC Effective Safety Management Conference, Cambridge, 17-20 Sept 2001
110. Pascoe S K, Wilson J D (1995), *Methods of Risk Assessment and Benefits from Application to Pressure Vessel Components within PowerGen*. In: IMechE Conference Transactions, Vol 4, p77-86



111. Patterson K, Berentzen N (2001), *Demonstration Under COMAH – Problems and Partnership*. Presented at: Hazards XVI – Analysing the Past, Planning the Future, Manchester, UK 6-8 Nov 2001
112. Patterson K, Hickson and Welch Ltd (2000), *COMAH – An Industry View*. Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000
113. Pavard M (1999), *The Signalling Supplier's View*. In: *Safety Cases: Getting There Together* p11.55. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
114. Pinder C, BP (2000), *COMAH – Progress to Date*. Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000
115. Pitblado R (2000), *Chairman's Opening Address* Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000
116. Pitblado R (2002), *Chairman's Opening Address – Highlights from the previous conferences and major accident lessons for safety cases*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
117. Pollard S (1999), *Safety Cases in Context: Lessons for and From Environmental Risk Assessment*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26-27 April 1999
118. Powell T (1993), *HSE's Experience of Voluntary Safety Cases*. In: *Offshore Safety Cases Conference*, Aberdeen, April 1993, p25-50, HSE
119. Pudduck R (1999), *The Naval Ship Safety Case*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26-27 April 1999
120. Raknes J, Directorate for Fire and Electrical Safety (2002), *Seveso II – A Norwegian Perspective*.
121. Rawlinson G A (1997), *'Living' Safety, Cases – A Team Approach I*. In: *International Conference Safety and Reliability*, Lisbon, June 1997, p497-506, Publisher: Oxford, Pergamon, 1997
122. Reid R (1999), *Railways Safety Case Experience*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26-27 April 1999
123. Rice S (2000), *A New Approach to Preparing Safety Cases for Existing Nuclear Plants*. Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000



124. Riva M & Zani F, Syreco Srl (2001), *Strengths and Weaknesses of the Implementation of Safety Management Systems in Major Accident Hazards in Small and Medium Enterprises*. Paper presented at ESREL, 2001, Torino
125. Ross J S (1994), *The Management of Safety – The Role of Safety Cases and Risk Assessment*. In: Fire Safety on Ships: Developments into the 21st Century, London, May 1994, Transactions – Institute of Marine Engineers, Series C, Vol 106, No 2, 1994, p225-230
126. Salter M (1993), *A Contractor's View (2)*. In: Offshore Safety Cases Conference, Aberdeen, April 1993, p207-210, HSE
127. Scott P (2001), *Moving Forward from Assessment to Inspection – How Good is COMAH?* Presented at: Hazards XVI – Analysing the Past, Planning the Future, Manchester, UK 6-8 Nov 2001
128. Sefton A (1993), *Inspection Programmes and the Safety Case* In: Offshore Safety Cases Conference, Aberdeen, April 1993, p187-197, HSE
129. Sefton A D (1994), *The Development of the UK Safety Case Regime: A Shift in Responsibility from Government to Industry*. In: Annual Offshore Technology Conference, 26th Offshore Technology, Houston, Texas, May 1994, Vol 1, p135-142
130. Shaw R (1995), *Safety Cases – How We Get There?* In: Centre for Software Reliability (1995), *Safety and Reliability of Software Based Systems 12th Annual CSR Workshop – Bruges*, p43-95, Publisher Springer, 1997
131. Simister D (1995), *The UK Regulatory Approach to Deterministic and Probabilistic Safety Analysis in Criticality Safety Cases*. In: Proceedings of the 5th International Conference on Nuclear Criticality Safety, Albuquerque, NM, Sept 1995, Vol 2, p7.7-7.10
132. Stead J P (1996), *Building Your Railway Safety Case – Feedback from the Front Line*. In: Railtech: Railway engineering, systems and safety, selected papers from Railtech 96, Publisher: IMechE Seminar Publication Number 16, 1996, p45-56
133. Stephens S (1999), *Consultant's Offshore Experience*. Presented at IBC 1st Annual Conference on Safety Cases, Successes and Concerns, London UK, 26-27 April 1999
134. Stephens S (2002), *Business Benefits of Offshore Safety Cases*. Presented at IBC 4th Annual Conference on Safety Cases, Cross Industry Comparisons, London UK, 15th-16th May 2002
135. Stokoe T Y (1997), *Safety Case Reviews at Magnox Electric Nuclear Power Plants*. In: Reviewing the Safety of Existing Power Plants, International Symposium, Vienna, Oct 1996. Publisher: International Atomic Energy Agency, Publications, STI PUB, p289-294



136. Thomas M (1995), *Safety Cases for Software-Based Systems*. In: Centre for Software Reliability (1995), *Safety and Reliability of Software Based Systems 12th Annual CSR Workshop – Bruges*, P328-337, Publisher Springer, 1997
137. Thomson et al I, HSE (1995), *Comments on Safety Cases*. Presented at: *Safety Case Preparation – The Industry Responds*, FABIG Technical Meeting, Jun 1995. Published as Technical Meeting Review
138. Tomkins B (2000), *Developments in the Philosophy of Safety Cases*. In: *Risk, Economy and Safety, Failure Minimisation and Analysis*, 4th International Symposium, Umhlanga Rocks, South Africa, July 2000, p3-14. Publisher: EMAS, 2000,
139. Turner S, Shell UK (2002), *COMAH – An Operators Perspective*. Presented at: *Fire and Blast Aspects for the COMAH Safety Case*, 26th FABIG Technical Meeting, 17 April 2002. Publisher: Technical Meeting Review
140. Van Der Borden J (1996), *Well-Service Vessel Record Proves Safety Case*. In: *Health, Safety and Environmental in Oil and Gas Exploration and Product*, 3rd International Conference, New Orleans, LA, Jun 1996, Vol 2, p591-598. Publisher: Papers, Society of Petroleum Engineers
141. Van Steen et al J, DCMR Environmental Protection Agency (2000), *The First Year of Experiences with Seveso II in the Rotterdam-Rijnmond Region*. Presented at: *Implementing Seveso II Conference*, London, 6-8 Nov 2000
142. Vaughan G (2000), *Nuclear Safety Cases: Regulatory Requirements*. Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2002
143. Waldram I (2000), *Lessons Learned from 2,000 Onshore and Offshore Safety Cases*. In: *Journal – Institution of Occupational Safety and Health Vol 4, part 2 21-36 2000*
144. Wang J, Sing Sii H, Pillay A & Lee J A, Liverpool John Moores University and CorrOcean Ltd (2002), *Formal Safety Assessment and Novel Supporting Techniques – Maritime Applications*. Presented at Formal Safety Assessment Conference, Rina, 18-19 September 2002
145. Wendes M J (1993), *One Company's Experience of Formal Safety Assessment and Preparation of Offshore Safety Cases*. In: *Major Hazards Onshore and Offshore*, Institution of Chemical Engineers Symposium Series, Vol 130, 1993, pp49
146. Whitfield A (2001), *COMAH and the Environment – Lessons Learned from Major Accidents 1999-2000*. Presented at: *Hazards XVI – Analysing the Past, Planning the Future*, Manchester, UK 6-8 Nov 2001



147. Wilkinson P (2000), *The Case for Safety Cases?* Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27th – 28th March 2000
148. Wilkinson P, Manager Review Implementation Team, Offshore Safety Section, Department of Industry, Tourism & Resources (2002), *Safety Cases: Success or Failure?* Seminar Paper 2, Australian National University National Research Centre for OHS
149. Willcox B (2000), *A Case for Safety Cases*. In: Explosives Engineering Year 2000, Part/Issue/Part No SEAS SUM pagination 4-7
150. Williams D (1999), *Safety Management in the Swedish Air Traffic*. In: Safety Cases: Getting There Together, p16.15. Publisher: Colloquium Digest – IEE, Institution of Electrical Engineers Issue 114, 1999
151. Williams D, Neilan P (1995), *The Role of Safety Cases in Risk Management: European Convention Security and Detection*. In: Brighton, May 1995, IEE Conference, Issue 408, 1995, p40-42
152. Wilson D (2000), *The Electronic 'Live' Safety Case*. Presented at IBC 2nd Annual Conference on Safety Cases, Cross Industry Comparison of Best Practice, London UK, 27-28 March 2000
153. Wilson S P, Kelly T P, McDermid J A (1995), *Safety Case Development: Current Practice, Future Prospects*. In: Centre for Software Reliability (1995), Safety and Reliability of Software Based Systems 12th Annual CSR Workshop – Bruges, p135-136, Publisher Springer, 1997
154. Wood J (1996), *Railway Safety Cases – Friend or Foe?* In: 1st Railway Infrastructure and Management Course, RIA, 1996, page E36
155. Woollam P B, Cameron H M, Davies A R, Hiscox A W (1995), *Comprehensive Safety Cases for Radioactive Waste Management Facilities*. In: 5th International Conference, Radioactive Waste Management and Environmental Remediation, Berlin, Sept 1995, Vol 2, p1177-1182. Publisher: ASME, 1995
156. Zandvoort B, dow Terneuzen (2000), *Implementation of the Seveso II Guidelines at Large Chemical Site in the Netherlands*. Presented at: Implementing Seveso II Conference, London, 6-8 Nov 2000