Beyond Longford: The Impact of Major Hazard Facilities Regulation on Safety Management Systems in Victoria

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Acronyms & Abbreviations

ACMH  Advisory Committee on Major Hazards (UK)
ADG   Australian Dangerous Goods
AFR   Assessment Findings Report
AI    Annual Inspection
AIChE American Institute of Chemical Engineers
AS    Australian Standard
AS/NZS Australian and New Zealand Standard
AWU   Australian Workers’ Union
BHP   Broken Hill Proprietary Company Limited (BHP Billiton Limited since 2001)
BLEVE Boiling Liquid Expanding Vapour Explosion
BMS   Business Management System
BS    British Standard
CAAA  Clean Air Act Amendments (USA)
CAER  Community Awareness & Emergency Response (USA)
CCPS  Centre for Chemical Process Safety
CEO   Chief Executive Officer
CEPP  Chemical Emergency Preparedness Program (USA)
CFT   Critical Function Testing
CI    Correspondence In (VWA)
CIMAH Control of Industrial Major Accident Hazards (UK)
CO    Correspondence Out (VWA)
COMAH Control of Major Accident Hazards (UK)
CPSU  Community & Public Sector Union
CSA   Canadian Standards Association
CSB   Chemical Safety and Hazard Investigation Board (USA)
CSP   Crude Stabilisation Plant
Cwth  Commonwealth (of Australia)
DCS   Distributed Control System
DLI   Department of Labor and Industries
DNV   Det Norske Veritas
DNV/Aon Det Norske Veritas/Aon Pacific Risk Consultants
DOA   Demonstration of Adequacy
DPP   Director of Public Prosecutions
EAL   Esso Australia Limited
EC    European Community
ECI   Exxon Company International
EEC   European Economic Community
EIA   Economic Impact Analysis
EP    Emergency Plan
EPA   Environment Protection Agency
EPCRA Emergency Planning and Community Right-to-Know Act
ESD   Emergency Shut Down
FR    Focus Rule
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<td>GP</td>
<td>Gas Plant</td>
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<tr>
<td>HAZCHEM</td>
<td>Hazardous Chemical (labelling system)</td>
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<td>HAZID</td>
<td>Hazard Identification</td>
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<td>HAZOP</td>
<td>Hazard &amp; Operability Study</td>
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<td>Hazard Management Division</td>
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<td>Human Resources</td>
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<td>ILO</td>
<td>International Labour Organisation</td>
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<td>ISO</td>
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<td>LA</td>
<td>Lead Assessor</td>
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<td>LPG</td>
<td>Liquefied petroleum gas</td>
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<td>Managing Director</td>
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<td>PACIA</td>
<td>Plastics &amp; Chemicals Industry Association</td>
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<td>PRA</td>
<td>Periodic Risk Assessment</td>
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<td>PRV</td>
<td>Pressure Relief Valve</td>
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<td>Warehouse Management System</td>
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Summary

In the aftermath of the Longford gas plant major incident, new legislation was introduced requiring all Victorian Major Hazard Facilities (MHFs) to be licensed, based on the regulator’s assessment of their Safety Case and Safety Management System (SMS). This thesis examines how well Victoria’s 47 MHFs performed in attempting to achieve compliance with these strict new regulations; whether SMS development was fully achieved; and what factors affected MHF performance in meeting these regulatory requirements.

An SMS Development Model was established to capture the SMS requirements of the MHF Regulations, allowing MHF performance to be assessed over time. Due to the population size of 47 sites, a multi-method research approach was taken by first examining the entire population in four industry sectors to gain a general overview of SMS development and licensing outcomes. Then seven case studies were undertaken to gain insight into the deeper social dynamics at work as MHFs adapted to the new regulations.

Of the initial 47 MHFs, 39 continued through to the licensing process. Thirty-seven licences were granted (32 full-term and 5 reduced-term) and two were refused. One refusal was reversed on appeal following improvement. These licence outcomes show the process was not automatic and that the regulator was prepared to refuse licences.

This thesis shows that licensing of Victorian MHFs had value in that it fast-tracked change, particularly in SMS development. But licensing also had weaknesses. Some MHFs were granted licences when their SMS was still in an early development stage. Annual Inspections, examining SMS elements and specific control measures, were an essential companion tool to licensing and to the learning process around SMS development and MHF compliance. Annual Inspection results suggest that MHFs may not be capable of self-regulation due to undetected SMS decay.

Analysis of management in the case studies suggests 13 factors which appear to assist their ability to adjust to the regulations. Of the 13 factors identified, the following five appear to matter most:

- Senior management engagement with MHF compliance,
- Positive relationship with the regulator,
- Employee involvement in SMS development,
- Understanding the present stage of SMS development, and
- Effective internal auditing.
Statement of Authorship

Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis submitted for the award of any other degree or diploma.

No other person’s work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

________________________  ______________
Sarah E. Sinclair  Date
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To my children, Laura and Hannah, who have only ever known life with ‘mummy is working on her thesis’ and ‘mummy is going to a meeting with Malcolm’. In hindsight, writing a thesis with two small children is probably the most difficult way, however I hope
some of my persistence, tenacity and dedication to the task has rubbed off on them. Their unconditional love and smiles kept me going.

To my parents, without their love, support and encouragement, this thesis would not have been possible.

I have enjoyed the journey – to Malcolm, Clare and Mike, WorkSafe Victoria Inspectors and Analysts and MHF site personnel – thanks for your contributions.

A major incident is the result of a sequence of events which, each in themselves, is unlikely. Equally no single individual or small group can be said to be responsible for the disaster. Perhaps the most important lesson of all that can be drawn is that the sum and quality of our individual contributions to the management of safety determines whether the colleagues we work with live or die.

Kletz (2001:206)

This study is part of my on-going contribution to the management of safety.

Sarah Sinclair
December 2012
CHAPTER 1

THE LONGFORD DISASTER AND MAJOR HAZARD FACILITIES REGULATION IN VICTORIA: AN INTRODUCTION

1.1 Longford: Events and Lessons

The Longford gas plant explosion and fire on 25 September 1998 killed two people, injured eight and cut gas supplies to most of Victoria for 20 days (RLRC 1999:1.3 and 1.9). This major incident, with an estimated cost of A$1.3 billion (The Australian Financial Review 27 Apr. 1999), triggered the introduction of legislation regulating the safe operation of Major Hazard Facilities (MHF) in Victoria, aiming to prevent the occurrence of similar events. This MHF legislation was recommended by the Longford Royal Commission (RLRC 1999:15.26) established by the Victorian Government in response to significant political and public pressure. The almost total cessation of gas supply to consumers and industry following the Longford explosion had created a social climate of almost ‘wartime solidarity’ (Hopkins 2000:2). In this context the government had to act, and act it did by introducing the Occupational Health and Safety (Major Hazard Facilities) Regulations 2000 (MHF Regulations).

The occurrence of such a disaster at an MHF followed by a regulatory response is not new. A chemical plant explosion at Flixborough in the UK in 1974 led to a similar sequence of events. Flixborough, while not the first major incident to occur (Lees et al. 1996:A1/26), was the first which generated a policy focus on preventing major incidents. Kletz (2001:83) describes Flixborough as a ‘milestone in the history of the chemical industry…[showing] that the hazards of the chemical industry were greater than had been generally believed by the public’.

Following the inquiry into Flixborough (Parker 1975), an Advisory Committee on Major Hazards (ACMH) was established (Withers 1988:51) and some ten years later, the Control of Industrial Major Accident Hazards (CIMAH) Regulations were introduced in 1999.

\[1\] Replaced by the Control of Major Accident Hazards (COMAH) Regulations in 1999.

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the UK in an attempt to prevent further catastrophes (Kletz 2001:95). A number of other major incidents and subsequent government responses are examined in this thesis, showing the growth of MHF legislation in various jurisdictions around the world. A common thread exists in the rationale for public intervention.

*Until the explosion at Flixborough in 1974 little thought was given to ways of reducing inventories of hazardous materials...Flixborough weakened our own [industry's] and the public's confidence [in industry's ability to control chemical processes] and ten years later Bhopal almost destroyed it.* (Kletz 1998:368)

Both the UK and Europe have since revised their initial MHF legislation. In Europe, the Seveso directive\(^2\) was revised in 1996\(^3\), becoming the Seveso II directive, and in the UK, CIMA\(^4\) was replaced with the Control of Major Accident Hazards (COMAH) Regulations in 1999. Despite these overseas examples, Victoria made no attempt to regulate MHFs prior to the Longford incident. The Victorian health and safety regulator, Victorian WorkCover Authority (VWA), did not have any specific focus on major incidents or upon MHFs, despite the explosion and fire at the Coode Island\(^4\) chemical storage facility in 1991 (O’Meara 2001:51). At the time of the Longford incident, the VWA administered a regulatory regime which ‘drew no distinction between regulation of a petrochemical facility and a dry-cleaning shop’ with inspectors who ‘did not have the expertise to identify hazards in technically complex plants’ (Hopkins 2000:93).

The Longford incident occurred in one such technically complex plant operated by Esso\(^5\), a subsidiary of the Exxon Corporation\(^6\), a major international petro-chemical company. Esso had extensive world-wide operational experience and a Safety Management System (SMS)\(^7\) which was widely regarded ‘as a model system and one which company audits suggested was operating at peak level’ (Gallagher *et al.* 2001:15). So what went wrong on 25 September 1998?


\(^3\)Effective February 1997.

\(^4\)Located approximately 4km west of the Melbourne central business district.

\(^5\)Esso Australia Resources Ltd.

\(^6\)Incorporated in the United States of America (RLRC 1999:1.2).

\(^7\)This thesis uses the term ‘SMS’ rather than ‘OHSMS’ to be consistent with the Victorian MHF Regulations.
The Longford Royal Commission’s findings showed that a good SMS (known as the Operations Integrity Management System (OIMS)) was in existence at Esso Longford, but had been neglected or ignored for some time due to a number of factors (RLRC 1999:13.38).

The Commission cited many implementation and operational deficiencies with the SMS, as well as design and maintenance deficiencies, concluding:

Reliance placed by Esso on its OIMS for the safe operation of the plant was misplaced. The accident on 25 September 1998 demonstrated in itself, that important components of Esso’s system of management were either defective or not implemented. (RLRC 1999:13.42)

The failure of this SMS raised serious concerns within industry and the wider community. What can be learnt from this failed SMS? Major incident investigations now focus on the failures of the organisation, through the management system, rather than of the individuals involved (Wreathall & Reason 1992:448). Kletz (2001:267) acknowledges this shift in focus, reporting that the Longford Royal Commission Report ‘describes the operator failings that led to the explosion but does not blame the operators, as reports in earlier time might have done, but shows how the operators’ failings were the result of inadequate training and other management failures’.

Public concern generated by the Longford explosion placed pressure on the Victorian state government to determine the events which culminated in this major incident, the extent of loss and possible culpability by the operators of the plant, and the identification of measures which might prevent or mitigate similar incidents in the future (The Age 28 September 1998:1 and 8 October 1998:20). The major lessons from Longford showed a failed SMS and a regulator with no focus on major incident prevention. Under significant pressure to act, the government responded as described below.

1.2 The Response

The Longford Royal Commission was appointed to investigate and report on all aspects of the disaster, and make recommendations for any means of preventing or mitigating any similar occurrence in the future (Victorian Government Gazette 1998:1). In its report, the Royal Commission made a number of highly critical findings and a number of major recommendations. One major recommendation called for new legislation to create an
MHF regime that mandated the creation of a Safety Case in every declared MHF\(^8\) (RLRC 1999:15.26), together with a licensing regime that was a prerequisite for the operation of any MHF site (RLRC 1999:15.19). A Safety Case is described as:

a written presentation of the technical, management and operational information covering the hazards and risks of the facility and their control, and provide justification of the adequacy of the measures taken to ensure the safe operation of the facility (RLRC 1999:14.29).

The Royal Commission concluded:

Had Esso been required to submit a safety case with respect to its facilities at Longford before 25 September 1998, it is likely that it would have identified the very hazards which were in evidence on that day, hazards which a proper HAZOP\(^9\) [Hazard and Operability] study of GP1 [Gas Plant 1] would also have identified (RLRC 1999:14.33).

A major element in the Safety Case was to be the SMS which addressed a number of matters considered essential to the safe operation of the specific MHF. Frick et al. (2000:1) report the increased acceptance of systematic occupational health and safety management amongst regulators, employers, workers and other parties in advanced industrialised countries, and state that ‘safety management has evolved internationally as the major strategy to reduce the serious social and economic problem of ill-health\(^{10}\) at work’ (Frick et al. 2000:2). The International Labour Organisation (ILO) (2001:i) reports that governments, employers and employees recognise the positive impact of introducing an SMS, on both the reduction of hazards and risks, and on increased productivity. However no SMS is fool proof. Failures of the management system were shown to have contributed to the cause of over 85% of incidents reported in Europe since the implementation of the Seveso directive (Mitchison & Porter 1998:i). So how can an SMS be improved or SMS failures be prevented?

The Victorian Government’s response to the failed SMS at Longford was to legislate the requirements for an SMS within an MHF Safety Case regime – safety case being a well-developed concept (Rasche 2001:2), ‘recognised as one of the most effective means of risk management’ (RLRC 1999:14.30), particularly for major risks (Rasche 2001:2). A

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\(^8\) A site producing, consuming, storing or handling specific chemicals in certain quantities (see Appendix A for detailed information).

\(^9\) Hazard and Operability Study (HAZOP) is the most widely used hazard identification process (Pitblado & Turney 1996:14).

\(^{10}\) ‘ill health’ encompasses the occurrence of disease, psycho-social and physical injury in the workplace.
MHF Safety Case regime goes beyond an SMS by requiring the operator to demonstrate to the regulator that major incident risks have been reduced so far as is practicable. To enact the principles of an MHF Safety Case regime, the Victorian Parliament approved new subordinate legislation, the *Occupational Health and Safety (Major Hazard Facilities) Regulations 2000* (MHF Regulations), under the *Occupational Health and Safety Act 1985* (Vic) and appointed the VWA as the statutory regulator of MHFs.

The MHF Regulations required the SMS to be the ‘primary means of ensuring the safe operation of the facility’ (MHF Reg 301(1) & (2)), placing a clear focus on the SMS, which had not previously been a requirement under Victorian occupational health and safety (OHS) legislation. The new regulations did not give technical guidance on how to actually achieve an effective SMS, and minimise the possibility of the repetition of SMS failings observed at Longford. SMS design was substantially left to each MHF. The regulations are primarily performance oriented. As Hopkins (2000:99) states ‘safety case regulation is performance or outcome oriented: the ultimate legal requirement is a safe workplace and how this is achieved is to some extent up to the employer’.

However, not everything was left up to employers in the Safety Case requirements of the regulations. To ensure Victorian MHFs became outcome-focused on providing a safe workplace in a timely manner, the Victorian Government legislated a tight timeline, requiring all operating MHFs in Victoria to achieve compliance with certain provisions within two years (Regulation 802(3)). Without satisfactory demonstration of compliance, the Victorian health and safety regulator could refuse to grant a licence to operate, thereby requiring the closure of an MHF. In addition, the regulator went on to require each MHF to undergo Annual Inspections after licensing to ensure the SMS remained fully implemented. This sent a clear message to both industry and the public that the Victorian Government was serious about preventing major incidents.

To administer the new MHF Regulations and respond to criticism regarding a lack of inspector skills in technically complex facilities, the VWA established a Major Hazards Unit (MHU)\(^\text{11}\) with authority and staff to regulate all declared MHFs in Victoria. Recruitment of staff focused on creating a multi-disciplinary group of experienced professionals in the fields of chemical engineering, risk management, auditing and technical safety, human factors and emergency planning (VWA 1999a:6).

\(^{11}\) The VWA Major Hazards Unit was later included in the broader Hazard Management Division (HMD).

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Thus the new Victorian MHF Regulations placed both industry and the OHS regulator in uncharted waters, without prescriptive regulatory direction, but with a tight timeline for industry to achieve compliance or face the prospect of forced site closure. Within the same timeline the newly formed MHU needed to establish and implement a compliance assessment and licensing process. This led to a very steep learning curve for all parties in a largely unknown and evolving process (WorkSafe 2004:1).

1.3 Research Questions

The questions this thesis asks is how well did Victoria’s 47 MHFs perform in attempting to achieve compliance within two years with these strict new regulations requiring a Safety Case and prescribing an SMS; whether SMS development was fully achieved; and what factors affected MHF performance in meeting these regulatory requirements? The scale of this challenge is shown in the previous section which outlined both the requirement to develop and demonstrate a Safety Case (incorporating an SMS), and to do so within two years in order to gain a licence to continue operation as an MHF. For those (like Esso, Longford) that had implemented an SMS on a voluntary basis, this requirement could prove demanding if there was a significant gap between the paper-based system and its practice. For others with no prior SMS experience the demands would be even greater.

The questions explored in this thesis are policy-oriented. They are important for two reasons. First, there has been little significant previous research upon how businesses managed compliance with MHF regulations. While similar regimes exist elsewhere in the world, there is a shortage of adequate primary research to investigate what impact these regimes have upon industry, and whether regulatory requirements are adhered to. In other words, a research gap exists in the applied field of research into the impact of MHF regulations.

Second, policy compliance is inherently important if the purpose of the regulations is to be achieved and the risk of incidents minimised in MHFs. Such regulations serve no purpose if they are ignored, and it is a matter of public interest for research to throw light upon this subject.
In Victoria, a formal measure of policy compliance with the new regulations exists. Did MHFs achieve a licence to operate? This can be answered succinctly by counting the number of firms that achieved a full-term licence, those who received short-term licences (usually with additional requirements to be met), those who were refused a licence, and those MHFs who dropped out of the process and ceased to operate as an MHF.

Beneath these simple outcomes, more complex processes are at work. These obviously involve MHF management (who are responsible for developing a Safety Case and SMS), the regulator (who may assist, but who also inspects and assesses regulatory compliance at each site), and the interaction between the two as they became more familiar with the challenge of meeting the new regulatory requirements. But management and the regulator are not the only participants in this evolving process. Also important may be the workforce, whose daily routines put into practice the ‘paper’ SMS, and consultants who advise or assist management.

While the thesis addresses the three questions: how well did Victoria’s 47 MHFs perform in attempting to achieve compliance within two years with strict regulations requiring a Safety Case prescribing an SMS; whether SMS development was fully achieved; and what factors affected MHF performance; its concerns lie with management, their relationship with the regulator, and their capacity to involve their workforce. As the thesis will show, these relationships were rarely stable and could not be captured easily at a fixed point in time. Rather they were dynamic, evolving in response to a wide range of factors. The thesis aims to throw light on those factors – especially those that seem most significant.

1.4 Plan of this Thesis

The body of the thesis falls into four main parts. First, Chapters 2 and 3 are concerned primarily with reviewing literature upon the nature and origins of MHF regulation and the influences on Victoria’s MHF Regulations. Second is a section on key concepts and research methodology (Chapter 4) which develops a model of SMS development and describes a multi-method approach to data collection and analysis to both capture the performance of the whole population of 47 MHFs (divided into four industry sectors) and also investigate in detail the process of SMS development and overall compliance in seven case studies. The third part (Chapter 5) reports and analyses the data gathered in the sectoral analysis, looking at both licensing outcomes and also SMS development.
The fourth part of the thesis consists of three chapters (Chapters 6, 7 and 8) which describe and analyse case study findings upon the deeper processes and relationships underlying regulatory compliance. Finally a concluding chapter reviews findings in the thesis and considers the research questions in the light of them.

Chapter 2 begins by defining ‘a major incident’- the focus of this thesis – as an ‘uncontrolled incident including an emission, loss of containment, escape, fire, explosion or release of energy that (a) involves Schedule 1 materials, and (b) poses a serious and immediate risk to health and safety’. Most analysis attributes major incidents to failures of the management system. It follows that the best prevention is now traced to Occupational Health and Safety Management Systems (referred to as ‘SMS’ in this thesis to align with the specific terminology of the Victorian Regulations). Chapter 2 goes on to examine the definition, evolution, and elements of an SMS. Parallels are drawn with quality assurance frameworks – which ultimately may be linked to Deming’s Plan, Do, Check, Act cycle. Chapter 2 then explores the idea of ‘system failure’ by describing the causes, impact and investigation findings of six major incidents. Chapter 2 then tracks the pattern of ‘cause’ (usually a major incident) leading to ‘effect’ (subsequent state regulation) in the evolution of MHF regulation. This pattern was emulated in Victoria (the Longford incident leading to the Victorian MHF Regulations) but well behind the other cases, which positioned Victoria to learn from them. The idea of ‘system failure’ is taken further in the conclusions which note SMS degradation over time.

Chapter 3 describes another set of influences upon the Victorian MHF Regulations by reviewing the local political context after the Longford explosion. A detailed case study describes the causes of the fire, the escalating political pressure upon the Victorian state government, the subsequent Royal Commission, and its findings and recommendations. The Royal Commission exposed the failure (due to a multitude of causes) of what should have been a world-class sophisticated SMS at Longford. Chapter 3 then discusses the government policy and legislative responses in the aftermath of the Longford disaster. These included the creation of a Major Hazards Unit within the statutory OHS regulator, and the formulation of policies that would shape the Victorian MHF Regulations in 2000. A description of the resulting MHF Regulations is given and their distinguishing features are outlined in comparison with other regulatory regimes.

Chapter 4 describes the conceptual framework and research methods used in the empirical research for the thesis. It begins by modifying Deming’s Plan, Do, Check, Act
cycle into the Safety Management System Development Model, which reflects the SMS regulatory requirements of the Victorian MHF Regulations. The SMS Development Model serves as a framework to record and analyse empirical data upon regulatory compliance. It also introduces a ‘time dimension’ into the concept of an SMS which can both capture how well an MHF learns to operate an SMS, and also how well it is maintained over time instead of slipping into degradation. In the policy context of this thesis, this chronological dimension is crucial. The aim of the thesis is to trace compliance with MHF Regulations in 47 sites. This population size is sufficiently small to allow some data collection for every site. However the number is too large to allow an ‘in-depth’ analysis of the social dynamics underpinning the process of pursuing regulatory compliance. A multi-method approach is therefore adopted, designed to provide both an overview of compliance outcomes and processes in all 47 MHFs as well as in-depth analysis of social dynamics in a smaller set of seven case studies. The total population was analysed through a sectoral analysis, dividing the sites into four industry sectors. The seven case studies were divided into ‘laggers’ (with licensing problems) and ‘leaders’ (with full-term licences). The sectoral analysis seeks to record licensing outcomes and to track sectoral differences in performance using the SMS Development Model. The case studies aim to use inductive analysis to bring out factors that influenced compliance outcomes.

Chapter 5 reports the sector level analysis of the 47 MHFs. The opening section reports raw licensing outcomes. However the aim is to probe behind these simple data to expose the deeper dynamics of regulatory compliance. Preliminary analysis is then undertaken of voluntary SMS adoption (sites who had a head start) before the regulations came into force, and of some possible influences upon this (complexity, age, size and corporate support). The main part of the chapter tracks sectoral differences in relation to the four stages in the SMS Development Model (design, implementation, operation and maintenance). The following section then takes an overview of which ‘stages’ of the model tended to be strongest and weakest, and seeks to reconcile these synoptic findings with the initial licensing outcomes. Finally, sectoral analysis data is used to support the selection of the seven case study sites.

Chapters 6 and 7 describe respectively four ‘lagger’ case studies and three ‘leader’ case studies, chosen because of their licensing outcomes. Each case study follows a narrative structure, beginning with an assessment of SMS readiness prior to the regulations coming into force, tracking Safety Case development and assessment.
leading up to the first licence decision, and then recounting developments (where possible) for up to seven years after that first decision. Each chapter concludes with a summary of the case studies drawing out major points for further analysis.

Chapter 8 brings together the findings from Chapters 6 and 7 by means of a comparative (or cross-case) analysis. Data in this chapter are reported under 13 general headings or categories suggested by inductive analysis of the case study evidence. These categories are designed to identify factors that affect the process of gaining compliance with the MHF Regulations. They include initial preparedness factors, management and employee variables, attitudes towards the regulator, coherent planning, effective use of consultants, quality of the relationship with the regulator, auditing ability, and external influences (especially destabilising ones). Performance of the seven cases is then plotted – *ex ante* and *ex post* – against the SMS Development Model. Further analysis of SMS deficiencies and licensing outcomes is followed by the identification of 13 factors that assisted progression towards compliance. Several of these are selected for special emphasis because of their particular importance.

The final chapter (Chapter 9) summarises findings from the previous eight chapters. It highlights briefly some contrasts in the findings between formal licensing success and the evidence of different progression rates in the SMS Development Model including the quality of SMS operation and maintenance. Are the best MHFs genuinely trouble-free, or is regulator inspection necessary to spot problems even in those cases? These and other policy issues are explored in the conclusion.
CHAPTER 2

MAJOR INCIDENTS, SAFETY MANAGEMENT SYSTEMS AND THE REGULATORY RESPONSE TO SYSTEM FAILURE

2.1 Introduction

This thesis asks how well 47 Victorian MHFs performed in attempting to achieve compliance with strict regulations requiring a Safety Case and prescribing an SMS, whether SMS development was fully achieved and what factors influenced their performance. To consider these questions, it is necessary to understand how MHF Regulations work. This chapter will examine this issue by dissecting the nature of ‘major incidents’, exploring how effective SMSs are meant to prevent them, how SMS failures cause them, and looking at the pattern of international development in which major incidents were succeeded by MHF regulation.


*industrial accidents are the end-results of long chains of events that start with decisions at management level. Often these decisions create latent failures, which may remain hidden for a long time.* (Wagnaar, Hudson & Reason 1990:273)

A link between these major incidents and regulatory responses will be demonstrated, looking at MHF regulatory regimes in the UK, Europe, USA, India and Australia. Central to these regimes is the notion of breaking the chain of causation in the sequence of events that tends to characterise system failure (Reason 1997).
The chapter concludes by drawing together several major themes. One dominant theme in this chapter concerns SMS failure and degradation over time due to management inattention.

## 2.2 Major Incidents Defined

The public, professions and government are likely to react more strongly to a single catastrophic event which kills a number of people, than to the same number of fatalities in separate events, such as car crashes (Hopkins 2005:125 and Lees et al. 2005:4/3). Catastrophic events include:

- natural disasters, such as tsunamis (UNFPA 2005:5), bush fires (VicPol 2009), and floods (Carafano 2005);
- man-made disasters, such as train collisions (Hidden 1989), aircraft crashes (Weick 1990), maritime incidents (Department of Transport 1987 and United States Senate 1912), chemical releases (Shrivastava 1992) and radioactive releases (IAEA 2006), and
- ‘social hazards’ (Wells 1997:1) including terrorism (Kean & Hamilton 2004).

In this thesis ‘major incidents’ can be considered a sub-set of catastrophic events, defined by the involvement of specific dangerous chemicals and significant consequences, including fatalities, injuries, damage or destruction of property, and harm to the environment both on- and off-site. Other effects on the community include disruption to normal activities such as evacuation, road blocks, loss of services such as electricity and gas, and loss of material being produced at the site. Major incident effects may be short- or long-term. But in all instances the event has major consequences. As a result, some companies may not recover from a significant major incident, resulting in site closure and permanent job losses. Reason (1997:239) reports 80% of organisations suffering a major incident, without recovery procedures, never reopen for business.

While the community may view major incidents as random events (Wells 1997:iii), analysis of major incidents later in this chapter will indicate that their occurrence is not random, but rather they are foreseeable events with many contributing causes (Wagnaar, Hudson & Reason 1990, Lees et al. 1996). This was described at the Longford Royal Commission as an ‘interactive, multiple failure scenario’ (Hopkins 2000:29).
Major incidents can be further described by a risk-management approach. ‘Risk\(^{12}\)' is considered to be the combination of how often something happens (the likelihood) and the outcome (the consequence) (Wintle \textit{et al.} 2001:F4 and Tweeddale 2003:67). Hence, a major incident can be described as a low-likelihood, high-consequence event. Preventing major incidents through a focused ‘blend of engineering and management skills’ is termed ‘Process Safety’ (AIChE 2011). Process safety can also be referred to as Asset or Operational Integrity (Hackitt 2012) as it provides a ‘framework for managing the integrity of operating systems and processes handling hazardous substances. It is achieved by applying good design principles, engineering, and operating and maintenance practices. It deals with the prevention and control of events that have the potential to release hazardous materials and energy’ (IAOGP 2011:1).

Major incidents can be contrasted to higher likelihood and lower consequence events, sometimes referred to as ‘personal safety’, such as slips, trips and falls (Hopkins 2011:9). Nicols (2001:24) reports how a focus on personal safety, rather than process safety, has ‘resulted in risk management being aimed at reducing high-frequency, low-consequence personal injuries’. Personal safety was a focus of the BP Senior Executives visiting the Deepwater Horizon oil rig just hours before the explosion of 20 April 2010\(^{13}\) (Hopkins 2011:10). Both ends of the risk spectrum require attention, as noted by Nicols (2001:24) and Hopkins & Wilkinson:

\begin{quote}
Major accidents in Australia, such as the Moura coal mine explosion in Queensland and the Esso gas plant explosion in Victoria, have demonstrated the need for safety management systems to pay particular attention to the most serious hazards, while not neglecting other OHS risks. (Hopkins & Wilkinson 2005:5)
\end{quote}

A risk-management definition of a major incident would include aviation, maritime, road and rail disasters as well as acts of terrorism. Following the MHF Regulations, ‘major incidents’ will be defined as high consequence industrial incidents involving highly hazardous chemicals. Hence aviation, shipping, mining, road and rail disasters and acts of terrorism will be excluded from this study. Table 2.1 provides a range of major incident definitions extracted from legislation in the UK, Europe, the USA and Australia.

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\(^{12}\) The Institution of Chemical Engineers (IChemE 1985) define risk as ‘the likelihood of a specified undesirable event occurring within a specified period or in specified circumstances’.

\(^{13}\) The explosion killed 11 crew and ignited a fire which could not be extinguished, with the rig sinking two days later. The well continued to discharge oil and gas into the ocean resulting in America’s largest offshore environmental disaster (USA Today 2010).
### Table 2.1: Comparison of Major Incident Definitions

<table>
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<th>Terminology</th>
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<td>USA</td>
<td>1992</td>
<td>Process Safety Management of Highly Hazardous Chemicals 29 CFR 1910.119</td>
<td>Catastrophic Release</td>
<td>Catastrophic Release - a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals, that presents serious danger to employees in the workplace.</td>
</tr>
<tr>
<td>Europe</td>
<td>1996</td>
<td>Seveso II (96/82/EC)</td>
<td>Major Accident</td>
<td>Major Accident – an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this Directive, and leading to serious danger to human health and/or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.</td>
</tr>
<tr>
<td>Australia (Cwth)</td>
<td>1996</td>
<td>National Standard NOHSC:1014(1996)</td>
<td>Major Accident</td>
<td>Major Accident - a sudden occurrence (including, in particular, a major emission, loss of containment, fire, explosion or release of energy) leading to serious danger or harm to people, property or the built or natural environment, whether immediate or delayed.</td>
</tr>
<tr>
<td>Australia (Cwth)</td>
<td>1996</td>
<td>Petroleum (Submerged Lands) (Management of Safety on Offshore Facilities) Regulations (1996)</td>
<td>Major Accident Event</td>
<td>Major Accident Event - an event connected (whether immediately or after delay) with work activities that, should it occur, would cause, or pose a significant risk of causing, multiple fatalities (for example, by reason of hydrocarbon releases). Revised in 2005 to be Major accident event - an event connected with a facility, including a natural event, having the potential to cause multiple fatalities of persons at or near the facility.</td>
</tr>
<tr>
<td>Australia (Vic)</td>
<td>1999</td>
<td>Gas Safety (Safety Case) Regulations 1999/Gas Safety Act (1997)</td>
<td>Gas Incident</td>
<td>Gas Incident - any incident or event relating to the conveyance, supply or use of gas which causes or has the potential to cause (a) the death of or injury to a person; or (b) significant damage to property; or (c) an explosion.</td>
</tr>
<tr>
<td>UK</td>
<td>1999</td>
<td>COMAH (Statutory Instruments 1999 No. 743)</td>
<td>Major Accident</td>
<td>Major Accident - an occurrence (including in particular, a major emission, fire or explosion) resulting from uncontrolled developments in the course of the operation of any establishment and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances.</td>
</tr>
<tr>
<td>Australia (Vic)</td>
<td>2000</td>
<td>Occupational Health &amp; Safety (MHF) Regulations 2000 (Vic)</td>
<td>Major Incident</td>
<td>Major Incident - an uncontrolled incident, including an emission, loss of containment, escape, fire, explosion or release of energy, that (a) involves Schedule 1 materials, and (b) poses a serious and immediate risk to health and safety.</td>
</tr>
<tr>
<td>Australia (Qld)</td>
<td>2001</td>
<td>QLD - Dangerous Goods Safety Management Act 2001</td>
<td>Major Accident</td>
<td>Major Accident - a sudden occurrence (including, in particular, a major emission, loss of containment, fire, explosion or release of energy) leading to serious danger or serious harm to persons, property or the environment, whether immediate or delayed.</td>
</tr>
</tbody>
</table>

---

14 As listed in Annex 1 of Seveso II
15 Listed in Schedule 1 of COMAH
16 A list of hazardous chemicals by UN number, types, classes and categories that are contained in Schedule 1 of the *Occupational Health and Safety (Major Hazard Facilities) Regulations* 2000.
All jurisdictions use the term ‘accident’ except Victoria (Gas Safety Regulations & MHF Regulations) and USA (OSHA 29 CFR 1910.119) which use ‘incident’ and ‘catastrophic release’ respectively. The term ‘incident’, rather than ‘accident’ is adopted in this thesis, building on Cantelli’s (1965:44) observations that ‘‘accidents’…should perhaps better be called ‘incidents’, [as] all [are] ascribable to some causative factor’. This is reinforced by Bill Shorten, when secretary of the Australian Workers Union (AWU), commenting on the coroner’s findings into the deaths of two workers at the Esso Longford Gas Plant:

“These findings are a powerful reminder that the word ‘accident’ has no place in describing the Longford explosion. An accident implies that it was unavoidable. Clearly the Longford explosion was a terrible incident for which corporate hands are to blame.” (Shorten 2002)

Although slightly different wording is used, such as ‘dangerous substances’, ‘highly hazardous chemicals’, and ‘Schedule 1 materials’, the definitions of major incidents are similar throughout the various regions, particularly with regard to ‘emission, fire or explosion’. The scope of some definitions is broader than others, including harm to people, property and the environment, with time-frames of ‘immediate’ and some also including ‘delayed’.

For the purposes of this study, a major incident is defined as an uncontrolled incident, including an emission, loss of containment, escape, fire, explosion or release of energy, that (a) involves Schedule 1 materials, and (b) poses a serious and immediate risk to health and safety. This is the major incident definition from the Victorian MHF Regulations. Schedule 1 materials are listed in Appendix B.

An industrial site producing, consuming, storing or handling Schedule 1 materials is referred to as a ‘Major Hazard Facility’ (MHF). Examples of MHFs include oil refineries, chemical plants and dangerous goods warehouses. States or countries where legislation regarding major incidents has been introduced can be described as having a ‘MHF regulatory regime’ or a ‘MHF regime’.

Major incidents have been occurring since hazardous materials have been processed (Tweeddale 2003:1). Lees et al. (1996:A1/26) document an explosion at a munitions factory in Silvertown, London, in 1917 where 69 people were killed and 98 seriously injured. A further 551 major incidents are listed in Lees et al. (1996:A1/9) from 1911 to
1995, accounting for an estimated 14,615 fatalities and 35,30217 injured. Table 2.2 summarises seven major incidents which will be examined further in this chapter, with Longford the focus of Chapter 3.

Major incidents have now been defined and differentiated from catastrophic events. But what causes major incidents? Mitchison & Porter (1998:i) found that the cause of over 85% of the incidents reported to the European Commission since the introduction of Seveso I18 were failures of the management system. Perrow's (1984) study of technological disasters concluded that 80 - 90% of the failures were attributable to management and system failures. However before the specific causes of the major incidents in Table 2.2 are further analysed, it is important to clarify what is meant by an Occupational Health and Safety Management System (OHSMS), or – in the context of the Victorian MHFs – a Safety Management System (SMS). This modification arises when discussing Victorian MHF Regulation because they specifically apply to safety and not to occupational health which is dealt with by other regulations. For consistency with the Victorian MHF Regulations the term 'SMS' will be generally used in this thesis rather than 'OHSMS'.

17 This does not include injuries from Bhopal.
18 European MHF legislation to be discussed later in this chapter.
## Table 2.2: Major Incidents

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Company</th>
<th>Process</th>
<th>Major Incident</th>
<th>Fatalities</th>
<th>Injuries</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flixborough, UK</td>
<td>1/6/74</td>
<td>Nypro (UK) Ltd</td>
<td>Production of caprolactam</td>
<td>Explosion in oxidation of cyclohexane process</td>
<td>28 workers</td>
<td>36 on-site 53 off-site</td>
<td>Death toll likely to have been higher if it occurred during a weekday&lt;sup&gt;19&lt;/sup&gt;.</td>
</tr>
<tr>
<td>Seveso, Italy</td>
<td>10/7/76</td>
<td>Industrie Chimiche Medica Societa Azionara (ICMESA)</td>
<td>Batch production of 2,4,5-trichlorophenol (TCP)</td>
<td>Toxic release of TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin)</td>
<td>0</td>
<td>477 people reported skin injuries (burns &amp; chloracne)</td>
<td>Environmental damage. 78,000 small animals and 700 large animals were slaughtered to prevent dioxin entering the food chain (Marshall 1987:365).</td>
</tr>
<tr>
<td>Bhopal, India</td>
<td>2-3/12/84</td>
<td>Union Carbide India Ltd</td>
<td>Production of Sevin isocyanate (MIC)</td>
<td>Toxic release of methyl isocyanate (MIC)</td>
<td>3,787+ workers and near-by residents&lt;sup&gt;20&lt;/sup&gt;</td>
<td>8</td>
<td>77 people reported skin injuries (burns &amp; chloracne)</td>
</tr>
<tr>
<td>Piper Alpha, UK</td>
<td>6/7/88</td>
<td>Occidental Petroleum (Caledonia) Ltd</td>
<td>Offshore oil and gas processing</td>
<td>Oil platform explosion and fire</td>
<td>167 workers&lt;sup&gt;21&lt;/sup&gt;</td>
<td>130 to 300</td>
<td>Oil platform destroyed and UK hydrocarbon production decreased by 11% (Wells 1997:220).</td>
</tr>
<tr>
<td>Pasadena, USA</td>
<td>23/10/89</td>
<td>Phillips 66</td>
<td>Polyethylene production</td>
<td>Polyethylene plant explosion and fire</td>
<td>23 workers</td>
<td>130 to 300</td>
<td>Nearly US$750 million in property damage - the costliest single owner property damage loss in the petrochemical industry (at that time) (Sanders 2005:98).</td>
</tr>
<tr>
<td>Longford, Australia</td>
<td>25/9/98</td>
<td>Esso Australia Resources Ltd</td>
<td>Gas and crude oil processing</td>
<td>Gas plant explosion and fire</td>
<td>2 workers</td>
<td>8</td>
<td>Gas supply from the plant ceased for several weeks.</td>
</tr>
<tr>
<td>Texas City, USA</td>
<td>23/3/05</td>
<td>BP</td>
<td>Oil refinery</td>
<td>Isomerisation unit explosion</td>
<td>15 workers</td>
<td>180</td>
<td>All fatalities were contractors, located in portables (Visscher 2008:41).</td>
</tr>
</tbody>
</table>

<sup>19</sup> Parker (1975:para 1). The potential death toll estimated at 128 if the explosion had occurred during the week with the offices occupied (Kletz 2001:86).

<sup>20</sup> The exact death toll was never clearly determined (Marshall 1987:373). Lees et al. (1996:A5/9) estimates the death toll at 2,000, Willey et al. states the official documented death toll as 3,787 with an estimated undocumented death toll of over 10,000 (Willey et al. 2006:1), while Lapiere & Moro (2001:366) estimate the death toll between 16,000 and 30,000 people.

<sup>21</sup> including 2 rescue crewmen from a support vessel.
2.3 Safety Management Systems - A Systematic Approach to OHS

When organisations seek to comply with OHS legislation, that requires both a safe and healthy working environment for all workers and reduced risk, there are increasing demands to adopt a systematic approach to health and safety. Regulators, employers, workers and other parties in advanced industrialised countries are increasingly accepting systematic occupational health and safety management (OHSMS) (Frick et al. 2000:1).

In recent decades, regulatory frameworks have moved from a prescriptive ‘command-and-control’ model to a more ‘self-regulating’ model aligned with process-based performance standards (Gunningham and Johnstone 1999). This approach allows some discretion on how prevention responsibilities can be met (Gallagher and Underhill 2012:228) with the overall aim of ‘improved management of health and safety’ (Walters et al. 2011:6). These regulatory changes have increased the focus on systematic OHSMS and OHSMS (Gallagher and Underhill 2012:231), although OHSMS are not new, being widely introduced into the high-risk process industries following significant incidents such as Bhopal, India in 1984 (Sweeney 1992:89). Concurrent developments in general systems theory and quality management also influenced OHSMS (Gallagher 1997 and Nielsen 2000). In 1989, the European Commission introduced a directive on ‘the introduction of measures to encourage improvements in the safety and health of workers at work’, mandating systematic OHSM (European Commission 1989). The United States introduced government program initiatives (Needleman 2000) and other countries such as the UK, Canada, Australia and New Zealand introduced risk management-based regulations requiring the identification of hazards, the assessment of risks, the adoption of control measures and their review over time (Gunningham and Johnstone 2000). Gunningham and Johnstone (2000) note such systematic OHSM regulatory initiatives do not require OHSM systems to be introduced, but contain parts of an OHSM system. Bluff (2003:5) reviewed OHS legislative requirements in Europe, America, Asia and Australia, concluding that they ‘generally fall short of a fully-fledged OHSM system’. A formalised OHSM system is required by only a few OHS legislative regimes such as ‘Internal control’ in Norway and Sweden, MHF regimes in Europe and Australia (Gunningham & Johnstone 2000, Gallagher & Underhill 2012:231) and mine safety legislation in some states of Australia (Department of Labour 2012:29-30).

While a universal definition of OHSMS has not been adopted to date, there exists substantial international alignment around their key elements which include: OHS policy;
management commitment; planning and resourcing of OHSM; OHSM being integrated into broader business systems and operations; roles of responsibility and mechanisms of accountability; risk management; worker participation; reporting, investigation and correction of deficiencies; policy, procedures and documentation; development of OHS competency; monitoring, auditing and reviewing of OHS performance (Gallagher and Underhill 2012:231, Walters et al. 2011:37, Robson et al. 2007; Bluff 2003 and Gallagher 2000:37). For the purposes of this study, the Australian and New Zealand Standard definition (AS/NZS 4801:2001, 4) will be used. An OHSMS is:

\[
\text{that part of the overall management system which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the OHS policy, and so managing the risks associated with the business of the organisation. (AS/NZS 4801:2001, 4)}
\]


National standards have been developed in many countries such as Australia and New Zealand (AS/NZS 4801:2001), the UK (BS 8800:2004) and Canada (CSA Z1000-06). It should be noted that these standards are non-prescriptive or process-based, that is, they detail what should be done, but do not specify how it should be done. Individual organisations must then develop, implement, operate and maintain internal systems, processes, and procedures that provide more detail on how the general requirements of the standards are met within their unique operating environment (Kausek 2006:4).

As noted before, this study acknowledges the important role of occupational health aspects in an OHSMS. However for consistency with the terminology and major incident focus of the Victorian MHF legislation, the legislative terminology of a ‘Safety Management System’ will be adopted in this thesis. While this does not exclude occupational health aspects, it does not specifically require them, unless they have a role
in preventing or mitigating a potential major incident. The full SMS requirements of the Victorian MHF Regulations will be presented in Chapter 3.

Key Elements of an SMS

While the specific parts of SMSs may differ, along with terminology, they do share common high-level elements or a framework, as shown in Figure 2.1 (based on AS/NZS 4801:2001, vi).

Figure 2.1: SMS Framework (based on AS/NZS 4801:2001, vi)

This SMS framework is similar to that for ISO 9000 and ISO 14000 and is based on the Deming continuous improvement cycle (Figure 2.2) principles of Plan, Do, Check, Act (Bottomley 1999b:2 and IOSH 2003:9). Deming’s cycle was chosen for this study due to
its general applicability to all systems, as noted by the Canadian Standards Association (CSA 2006) and the Institution of Occupational Safety & Health (IOSH 2003:9). If OHS performance is expected to improve over time with an effective continuous improvement loop (OECD 2005:16), can the continuous improvement cycle be used as a basis for better understanding the development of the SMS and its role in preventing major incidents?

In Chapter 4, Deming’s continuous improvement cycle will be modified to create an SMS Development Model, encompassing the four stages of SMS development required by the Victorian MHF Regulations, to provide a framework for analysis of SMSs in Victorian MHFs. This Development Model has a chronological dimension to enable measurement of both learning how to apply an SMS and its maintenance as a real rather than paper-based system.

Figure 2.1 showed an SMS as a structured group of inter-related elements. A brief description of each element is presented below. For a more detailed description see AS/NZS 4801:2001 or OHSAS 18001:1999.

**Policy**

An SMS begins by stating the organisation’s occupational health and safety policy and objectives, indicating the organisation’s direction and commitment. Developed in
consultation with employees, it creates a framework for accountability that is adopted and led by senior management (IOSH 2003:9).

**Planning**

Planning facilitates the implementation of interdependent activities. Planning consists of establishing methodologies (e.g. how to conduct hazard identification, risk assessments etc.), and identifying requirements that impact decision-making on OHS matters, such as regulations, codes and practices. Planning also considers how objectives will be met and demonstrated. These will all be established in consultation with employees. Planning also incorporates prioritising activities and tracking progress through a health and safety management plan.

**Implementation**

Implementation requires, among other things, responsibility and accountability for all personnel involved in the SMS to be defined. Implementation requires on-going consultation with employees as well as communication; essential components of systematic health and safety (Walters & Frick 2000:43). In Victoria, as in many jurisdictions, employees may elect fellow employees as Health and Safety Representatives (HSRs) to represent them in OHS matters. To achieve full implementation, planned activities need to be realised, which requires management to provide appropriate resources and training in both OHS aspects and performing work activities competently. For example, the planned methodologies for hazard identification, etc., should be performed and reviewed (or repeated) at appropriate intervals and may require specialist facilitators and key personnel to be made available. Support functions such as document control, reporting and feedback loops from performance measurement and evaluation, assist implementation.

**Measurement and Evaluation**

Implemented activities, the SMS, and control measures put in place to reduce risk, should be monitored and the results evaluated to determine their effectiveness. Auditing the system provides information on the level of system implementation and operation, and the system’s effectiveness in helping to achieve the organisation’s objectives. Incident investigation evaluates system performance under demand and often results in changes to the system. Detected deficiencies should be rectified through an action-tracking process. All of these activities facilitate the maintenance of the SMS.
Management Review

At regular intervals, senior management (with input and appraisal by others) should review the SMS with regard to the suitability, adequacy and effectiveness of all the elements to the organisation’s changing operational and regulatory environment.

Continuous Improvement

The five elements outlined above are supposed to interact in a continuous improvement cycle - an on-going process that applies to all elements of the SMS. The ILO reports that organisations should ‘tackle occupational safety and health challenges continuously and to build effective responses into dynamic management strategies’ (ILO 2001:i).

To summarise this section, an SMS has been defined as ‘the part of the overall management system...managing the risks associated with the business of the organisation’ (AS/NZS 4801:4) and a framework has been described with its various elements. An advantage of the SMS framework is that it can be adapted to the specific needs of a particular facility, resulting in a wide variety of form and content of SMSs (Frick et al. 2000:2 and IOSH 2003:7). Managing business risks includes preventing major incidents which were described in risk management terms as low-likelihood, high-consequence industrial events involving hazardous chemicals. The SMS provides a framework to co-ordinate the independent activities needed to minimise risks, thereby preventing major incidents. In the next section, contributing factors and the role of the SMS in the major incidents listed in Table 2.2 will be examined to identify specific instances of system failure.

2.4 Major Incidents – System Failures?

Some understanding of major incidents is helpful for the analysis in this thesis. The major incidents listed in Table 2.2 will be described in terms of the production process and events leading up to the incident, its consequences and key investigation findings. The major incidents will also be analysed (results presented in Tables 2.3 – 2.8) to identify SMS failures which contributed to the incident, making reference to the SMS framework (Figure 2.1). It should be noted that the deficiencies identified in these tables are not intended to be an exhaustive list22. The Longford incident is discussed in Chapter 3.

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22 For further information refer to the specific major incident investigation report.
Flixborough, UK

Caprolactam is a raw material for the production of Nylon 6. Nypro’s capacity to produce caprolactam from cyclohexane was increased in 1972 (Parker 1975:para 13). This required storage of cyclohexane and its circulation through a train of six reactors (Parker 1975:para 14).

On 27 March 1974 Reactor 5 was leaking cyclohexane and the plant was shutdown (Parker 1975:para 55). A temporary dog-leg bypass was constructed from the 28-inch Reactor 4 outlet to the 28-inch Reactor 6 inlet using 20-inch pipe that was readily available (Lees et al. 1996:A2/5). The three-piece bypass was necessary as the reactors were at different heights (Kletz 1998:56). Bellows were left at each end of the bypass. The bypass piping rested on purpose-built scaffolding (Kletz 1998:57). The plant was started up and operated without incident.

On 29 May the plant was again shutdown as a sight glass was leaking (Wells 1997:5). Start-up began on 1 June and the explosion occurred that afternoon. The exact cause is unknown, however the inquiry concluded the most likely scenario was rupture of the bypass line and the release of cyclohexane, resulting in a vapour cloud explosion (Parker 1975:para 6).

The explosion killed all 18 people in the control room, flattened the main office buildings and started several fires (HSEa, Lees et al. 1996:A2/7). The Flixborough Inquiry concluded:

> The disaster was caused by the introduction into a well designed and constructed plant of a modification which destroyed its integrity. The immediate lesson to be learned is that measures must be taken to ensure that the technical integrity of plant is not violated. (Parker 1975: para 209)

Design and manufacturing deficiencies of the bypass were identified (Parker 1975: para 61-63, 68, 72). ‘There was no overall control or planning of the design, construction, testing or fitting of the assembly nor was any check made that the operations had been properly carried out’ (Parker 1975: para 71). The investigation showed a clear failure of the change management process. Other factors contributed to the number of fatalities, including plant congestion\(^{23}\) and vulnerability of the control room (Parker 1975:para 218).

\(^{23}\) Which increased explosion pressures.
Table 2.3 contains Nypro’s SMS deficiencies as identified by the Flixborough Inquiry (Parker 1975: paras 207-224) with cross reference to the SMS Framework described in Figure 2.1.
## Table 2.3: Possible SMS Deficiencies Identified in the Flixborough Incident

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1)</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient number of qualified and experienced people</td>
<td>Did not sufficiently plan for the required resources.</td>
<td>Did not implement the required resources.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management of change procedure for controlling plant modifications</td>
<td>Did not understand the importance of management of change.</td>
<td></td>
<td></td>
<td></td>
<td>Did not review and reinforce the importance of management of change.</td>
</tr>
<tr>
<td>Poor definition of safety officer role</td>
<td>Did not sufficiently define requirements.</td>
<td>Did not sufficiently measure and evaluate the understanding and requirements of the role.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modification not built to standards and codes</td>
<td>Required standard and code not identified.</td>
<td>Designer did not implement the identified standard or code.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large inventory contributed to the event</td>
<td>Major Incident potential not recognised.</td>
<td>HAZID and Safety Assessment methodology did not examine major incident potential events.</td>
<td>HAZID and Safety Assessment did not identify the hazard of the large inventory.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design and location of buildings (people) and access to hazardous areas</td>
<td>HAZID and Safety Assessment methodology did not examine major incident potential events.</td>
<td>Designer was not informed of the potential consequences of an event from the safety assessment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Too many critical management decisions to be made in an emergency</td>
<td>Emergency preparedness was not implemented fully.</td>
<td></td>
<td>Had not tested the effectiveness of the emergency preparedness and identified the inappropriate number of critical decisions to be made.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency response plan not appropriate for major incidents</td>
<td>The emergency response plan was in development and was not informed of the potential consequences of an event from the safety assessment.</td>
<td></td>
<td>Had not tested the effectiveness of the emergency response against major consequences.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Seveso, Italy

2,4,5-trichlorophenol (TCP) is used for herbicides and antiseptics (Lees et al. 1996:A3/3). TCP is made in batches from reacting 1,2,4,5-tetrachlorobenzene and caustic soda, in the presence of ethylene glycol (Kletz 2001:103). TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), the most toxic chemical in the dioxin family (NPI 2005), is an undesirable by-product, which is minimised (1ppm of TCP) by maintaining the temperature below 180°C (Lees et al. 1996:A3/3). Prolonged heating of the reactor at 230-260°C can increase TCDD production a thousand-fold (Lees et al. 1996:A3/3).

On 9 July at 4pm a TCP batch was begun (Lees et al. 1996:A3/6). Normally 50% of the ethylene glycol is removed, however only 15% was removed, and the process interrupted (Lees et al. 1996:A3/7). Heating stopped, however water was not added to cool the batch to the specified 50-60°C and the temperature recorder and agitator were turned off (Lees et al. 1996:A3/7). The plant was then closed for the weekend as required by Italian law, with the batch left in the reactor (Kletz 2001:104). The steam turbine was on reduced load, superheating the steam in the reactor jacket to about 300°C (Kletz 2001:104). The bursting disc on the reactor ruptured, sending a dense cloud of toxic chemicals directly into the atmosphere for some 20 minutes, travelling several kilometres from the plant (Kletz 2001:103).

The investigation concluded the Seveso incident was the result of design and operational failures. Plant activities were contrary to operating procedures24 (Wells 1997:6). The design allowed toxic liquid to be discharged direct to the atmosphere and the reactor had an unnecessarily hot heating medium (300°C steam) with a runaway reaction possible at 230°C (later revised to 185°C) (Kletz 1998:376). Fundamentally these design deficiencies can be traced back to a lack of understanding or identification of the hazards. Kletz (1998:217) reports that:

*a catchpot after the relief device would have prevented the reactor contents from reaching the atmosphere. No catchpot was installed as the designers did not foresee that a runaway [reaction] might occur, although similar runaways had occurred on other plants.*

Table 2.4 contains SMS deficiencies identified from the Seveso incident.

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24 15% rather than 50% of the ethylene was distilled, water was not added, and personnel did not remain with the reactor until the target cooling temperature was reached.
### Table 2.4: Possible SMS Deficiencies Identified in the Seveso Incident

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1) Implementation</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazards not fully understood</td>
<td>Major incident potential not recognised.</td>
<td>Hazards of ultratoxic TCDD, undetected exotherms and prolonged holding of reaction mass not fully understood.</td>
<td>Hazard not identified.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design features compromised</td>
<td>HAZID, safety assessment and control measures not broad enough.</td>
<td>Control measures not appropriately implemented e.g. bursting disc not sized for reactor venting, reactor not designed to withstand runaway reaction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control system too simplistic</td>
<td>No plans to improve control and protection on the reactor.</td>
<td></td>
<td></td>
<td>Primitive control system not identified as inadequate.</td>
<td></td>
</tr>
<tr>
<td>Failure to follow operating procedures</td>
<td>HAZID and control measures methodology did not identify the importance of operating procedures.</td>
<td>Lack of training in the importance of following operating procedures.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency response plan inadequate</td>
<td>Emergency response plan not informed by the safety assessment.</td>
<td>Emergency response plan not implemented in a timely manner.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor consultation and communication</td>
<td>No acknowledgement of the need to inform emergency services/ community of appropriate emergency response actions.</td>
<td>Emergency services and community did not respond appropriately.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Major Incidents, Safety Management Systems and the Regulatory Response to System Failure

Bhopal, India

Methyl isocyanate (MIC) was an intermediate product in the production of Carbaryl, the active ingredient in the pesticide Sevin (Wells 1997:204). MIC is unstable, requiring storage at low temperatures (Bowonder & Miyake 1988:240). At Union Carbide India Ltd’s Bhopal facility, there were three refrigerated underground MIC tanks (Wells 1997:204). The plant was not originally designed for MIC (Wells 1997:204), with on-site production of MIC commencing in 1979 (Lees et al. 1996:A5/2).

By 1983, decreasing profits coupled with the departure of experienced engineers, saw the plant’s level of safety decline (Bowonder & Miyake 1988:240). Manning levels and the maintenance crews were cut (Marshall 1987:378). The MIC refrigeration unit was shutdown in May 1984 and its refrigerant removed, despite the storage tanks still containing MIC (Chouhan 2005:206). The vent gas scrubber, on the vents of the MIC tanks, was also inoperable due to maintenance and reportedly low levels of caustic soda (Ayres & Rohatgi 1987:24). The flare tower was under maintenance, however it was not completed due to staff shortages (Chouhan 2005:207).

On the night of the incident, pipework in the MIC plant was flushed with water, without the necessary isolations (Chouhan 2005:207). Isolations were previously performed by the maintenance department which had suffered heavy redundancies several days prior (Wells 1997:205). It is hypothesised that flushing water entered a MIC storage tank, resulting in a runaway reaction, causing discharge of MIC to the atmosphere (Bowonder & Miyake 1988:244, Chouhan 2005:205 and Kletz 1998:368). Forty-one tonnes of MIC discharged through the tank’s relief valve in two hours (Willey et al. 2006:1).

Management decisions had disabled many control measures, which would have prevented or reduced the consequences of this incident (Chouhan 2005:206 and Wells 1997:205). Mitigation controls were also ineffective (Chouhan 2005:206, Marshall 1987:378 and Wells 1997:205).

The local community was warned of the toxic gas when an alarm sounded; however it was turned off some minutes later in accordance with company procedures (Ayres & Rohatgi 1987:30). This confused residents who were seeking to assist in extinguishing a

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25 An employee of Union Carbide, India.
26 Marshall (1987:377) reports there is controversy regarding the operational status of the scrubber.
27 Water sprays only reached a height of 15m – the MIC was released at 33m.

Sarah Sinclair 29

MIC was an intermediate product in the production of Sevin and the storage of such large quantities was unnecessary. The most important lesson from Bhopal being ‘What you don’t have, can’t leak’ (Kletz 2001:111), which is now a key concept in inherent safety.

Table 2.5 contains SMS deficiencies identified from the Bhopal incident.
### Table 2.5: Possible SMS Deficiencies Identified in the Bhopal Incident

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1)</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient number of qualified and experienced people</td>
<td></td>
<td>Did not close plant prior to de-manning. Did not identify hazards posed by reduced manning levels.</td>
<td>Did not have sufficient personnel for critical activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazards not fully understood</td>
<td></td>
<td>Hazards of toxic MIC and runaway reaction in a storage tank not fully understood.</td>
<td></td>
<td>Hazards not identified.</td>
<td></td>
</tr>
<tr>
<td>Cost cutting a higher priority than safety</td>
<td>Policy should place importance on safety.</td>
<td></td>
<td></td>
<td>Cost cutting actions taken by management were not evaluated for safety impact.</td>
<td></td>
</tr>
<tr>
<td>Large inventory of intermediate product contributed to the event</td>
<td></td>
<td>HAZID and Safety Assessment methodology did not identify the unnecessary storage of MIC.</td>
<td>HAZID and Safety Assessment did not identify the hazard of the large inventory.</td>
<td></td>
<td>Management chose to operate the modified plant with large intermediate storage despite being warned that it was ‘undesirable’ (Lees et al. 1996:A5/10).</td>
</tr>
<tr>
<td>Protective systems disabled</td>
<td></td>
<td></td>
<td>Cost-cutting and poor maintenance practices had led to the disabling of several protective systems without alternative controls being put in place.</td>
<td>Monitoring and measurement of controls was not occurring due to limited resources.</td>
<td>Management had not identified (or perhaps understood) the gross inadequacies of the plant’s protective systems.</td>
</tr>
<tr>
<td>No effective emergency response plan</td>
<td>Emergency response planning (if any) not effectively conducted.</td>
<td></td>
<td>Employees, emergency services and community did not have appropriate emergency response information or training.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor consultation and communication</td>
<td>No acknowledgement of the need to fully inform others of appropriate emergency response actions.</td>
<td></td>
<td>Emergency services and community did not respond appropriately.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Piper Alpha, UK, North Sea

Piper Alpha was an oil and gas platform in the North Sea operated by Occidental Petroleum (Caledonia) Limited (Kletz 2001:196). Three other platforms pumped hydrocarbons to Piper Alpha for distribution to Flotta, Scotland (Wells 1997:220). At the time of the incident, the platform was undergoing maintenance (Lees et al. 1996:A19/7). A decision to completely shutdown the platform for maintenance was overturned, continuing limited production (Cullen 1990:235).

One of two condensate pumps, Pump A, had its relief valve removed for maintenance (Wells 1997:221). At shift hand-over, the night shift was incorrectly informed that Pump A was operational (Wells 1997:221). Pump B was fully operational. Around 9.45pm Pump B tripped and could not be restarted (Cullen 1990:71-72). Pump A was re-instated, requiring electrical de-isolation28 (Lees et al. 1996:A19/7). Three low level gas alarms sounded, followed by a high level alarm at 10pm (Cullen 1990:74). An explosion in the pump area killed several workers (less than 10) and destroyed the platform’s firefighting system (Wells 1997:221). The resulting fire engulfed the control room, damaging the platform’s communication systems (Lees et al. 1996:A19/8).

The other three platforms continued to feed hydrocarbons to Piper Alpha for over an hour (Wells 1997:221). This led to further explosions and a large number of fatalities (Cullen 1990:138-145). The helicopter evacuation drill was followed by some, however smoke and flames prevented the helicopter’s approach (Cullen 1990:2).

The platform was destroyed within two hours (SIA 2008). One hundred and sixty-seven personnel died – 62 people survived (Lees et al. 1996:A19/2). Most fatalities were caused by smoke inhalation in the galley29 and accommodation areas (Kletz 2001:197 and Wells 1997:221).

A series of procedural non-conformances had occurred during maintenance activities on Pump A. The supervisor, who was a contractor, had not received training in the permit to work (PTW) system. Furthermore the shift hand-over did not adequately cover the maintenance work on Pump A. The design of the platform and its emergency protective systems did not provide protection against major incidents. The lack of emergency planning for such a scenario, and communication problems resulted in the continued

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28 Equipment is electrically isolated during maintenance to prevent accidental re-start.
29 The galley was a muster point.
supply of hydrocarbons to Piper Alpha. The cessation of hydrocarbon supply would have reduced the consequences of the incident.

This incident occurred during simultaneous operations of maintenance and production. The Inquiry was critical of this management decision. The pressure on personnel to continue production was also considered a contributing factor to the incident.

The deficiencies on Piper Alpha were failures in systems. Either there was a system but it was inadequately designed and executed, the PTW system, or there was no system where one should have existed, for example, the lack of a systematic method for assessing major hazards or the lack of a system for training in inter-platform emergencies. (Kletz 2001:205)

Table 2.6 contains SMS deficiencies identified from the Piper Alpha incident.
Table 2.6: Possible SMS Deficiencies Identified in the Piper Alpha Incident

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1) Implementation</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor quality of safety management</td>
<td>Did not strive for improvements or challenge the status quo.</td>
<td>Quality of safety activities not reviewed.</td>
<td>Lack of staff qualified in safety and lack of quality safety training for existing staff resulting in poor practices being tolerated.</td>
<td>Audits were not critical of poor practices.</td>
<td>Management did not seek feedback on safety matters.</td>
</tr>
<tr>
<td>Poor practices tolerated in PTW system</td>
<td></td>
<td>PTW system not implemented according to procedure. Inadequate training provided.</td>
<td></td>
<td>Audits were not critical of poor practices in PTW system.</td>
<td>Management did not seek feedback on audits.</td>
</tr>
<tr>
<td>No positive isolation of plant for maintenance</td>
<td></td>
<td>Isolations not conducted according to procedure.</td>
<td></td>
<td>Audits were not critical of poor practices in preparation for maintenance activities.</td>
<td>Management did not seek feedback on audits.</td>
</tr>
<tr>
<td>Contractors not trained in critical systems</td>
<td>Training needs of all personnel not recognised as being equal.</td>
<td>Did not identify hazards of inadequately trained contractors.</td>
<td>Training in the company’s operating and emergency systems and procedures not provided to all contractors.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor shift hand-over</td>
<td>Importance of communication between shifts not recognised.</td>
<td>Shift hand-over not performed adequately.</td>
<td></td>
<td>Auditing of handover procedures not being performed.</td>
<td>Lack of management follow-up after earlier prosecution for failure in handover procedures.</td>
</tr>
<tr>
<td>Disabling of emergency protective systems</td>
<td></td>
<td>Hazards of disablement of emergency protective systems not identified.</td>
<td>Design of emergency protective systems did not allow for damage by fire/explosion.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design did not address major incident potential</td>
<td>Major incident potential not acknowledged.</td>
<td>Hazard identification and safety assessment did not identify major incident scenarios.</td>
<td>Design did not allow for control of the total pressure system, minimisation of hydrocarbon inventory, automated emergency isolation or fire and explosion protection.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency plan did not consider major incident scenarios</td>
<td>Major incident potential not acknowledged.</td>
<td>Emergency response plan not informed by a safety assessment.</td>
<td>Emergency response plan not implemented to allow for major incidents.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of emergency planning between connected facilities</td>
<td>Hazard identification did not identify connections with other platforms.</td>
<td></td>
<td>Connected platforms did not respond appropriately during the emergency.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrepancies in plant documentation</td>
<td></td>
<td>Document control process of revising documents when changes to plant are made, was not being followed.</td>
<td>Documents not audited to ensure currency.</td>
<td>Management did not seek feedback on document control process.</td>
<td></td>
</tr>
</tbody>
</table>
Pasadena, USA

Phillips 66 produced high-density polyethylene in the Houston Chemical Complex in Pasadena (OSHA 1990:vii-viii). Polyethylene is formed via the polymerisation of ethylene in isobutene at high pressure (41 bar g) and high temperature (107°C) (Wells 1997:9). Polyethylene particles settle out and are removed from the tall vertical reactor in settling legs (Lees 1996:A6/2). The plant produced 1.5 billion pounds of polyethylene per annum, employing 905 direct employees and 600 contractors (OSHA 1990:viii).

Maintenance work began on Reactor 6’s settling legs (HSEb). To isolate the settling leg from the reactor, maintenance procedures required isolation of a valve and removal of compressed air hoses30 (Sanders 2005:99). Settling leg Number 4 was isolated and partially disassembled, however a plug of polyethylene was unable to be dislodged (Lees 1996:A6/2). Assistance was sought from the control room and shortly thereafter the release of hydrocarbon occurred (HSEb).

Approximately 85,000 lb of ethylene, isobutene, hexane and hydrogen were released (OSHA 1990:viii). The vapour cloud ignited and exploded, registering 3.5 on the Richter Scale (Sanders 2005:98) and destroyed the sprinkler system (Yates 1990:5). The incident command centre was damaged, disrupting telecommunications and fire systems were severely compromised (Tweeddale 2003:402).

The incident investigation concluded the release occurred because of reliance on isolation by a single air-operated ball valve, which was then inadvertently opened as the valve’s air hoses had been cross-connected31 due to poor ergonomics (Tweeddale 2003:402 and Welch 1993:243). The isolation used was against company written procedures and standard industry practice (HSEb), which required a double block32 system or a blind flange (Lees et al. 1996:A6/2).

Contributing factors to the scale of the incident included (HSEb):

- poor audibility of the initial alarm,
- vulnerability of fire-fighting systems,
- inadequate escape routes,
- vulnerability of the control room, and

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30 Compressed air provides motive power to operate the valve.
31 The cross-connection meant the valve was open when the control panel indicated it was closed and vice versa.
32 Two valves in a row.
• damage to the intended command centre.

The Occupational Safety and Health Administration (OSHA) (1990:70) concluded ‘the primary causes of the accident were failures of the management of safety systems.’ Table 2.7 contains SMS deficiencies identified from the Pasadena incident. The Phillips 66 Company was fined US$4 million by OSHA and was required to institute process safety management procedures at Pasadena, and three other facilities, as well as train Phillips employees and on-site contractor employees about potential hazards (OSHA 1991). OSHA also fined the contractor, Fish Engineering, US$100,000 and required a corporate health and safety program to be implemented (OSHA 1992b).

Above all, the actions proposed in this report underscore the urgent need for increased attention to established principles of process safety management (OSHA 1990:72).
Table 2.7: Possible SMS Deficiencies Identified in the Pasadena Incident

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1) Implementation</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazards not identified</td>
<td>Major hazards not addressed.</td>
<td>Hazard identification and assessment processes not required to be undertaken.</td>
<td></td>
<td></td>
<td>Management did not monitor or require hazard identification.</td>
</tr>
<tr>
<td>Plant separation distances did not meet standards</td>
<td>Review of plant and practices against standards-of-the-day not planned for.</td>
<td></td>
<td>No review of current standards occurred.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to minimise exposure to personnel</td>
<td>Hazard identification (not performed, as noted above) did not include exposure to personnel.</td>
<td></td>
<td>Consideration not given to location of people and measures to protect them.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escape routes not adequate</td>
<td>Requirements of emergency planning not broad enough to include escape route adequacy.</td>
<td>Adequacy of escape routes not considered in emergency planning.</td>
<td>Evaluation of emergency response plan effectiveness did not include escape routes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No fixed flammable gas detection system</td>
<td>As no hazard identification or assessment conducted, similarly no control measure adequacy review conducted.</td>
<td>Poor design and lack of standards review.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor control of ignition sources</td>
<td>Ignition sources control not fully implemented.</td>
<td></td>
<td>Monitoring of compliance and action close-out not undertaken.</td>
<td></td>
<td>Management did not actively review compliance.</td>
</tr>
<tr>
<td>Permit to work system was not enforced for maintenance</td>
<td>Hazard identification not undertaken and hence hazards of maintenance activities not appreciated.</td>
<td>Permit to work system not implemented for all plant activities.</td>
<td>Monitoring of permit to work effectiveness not undertaken.</td>
<td></td>
<td>Management did not actively review compliance.</td>
</tr>
<tr>
<td>Isolation procedure not followed</td>
<td>Corporate isolation procedure not correctly implemented.</td>
<td></td>
<td>Effectiveness of isolation practices not reviewed.</td>
<td></td>
<td>Management not reviewing compliance with corporate requirements.</td>
</tr>
<tr>
<td>Poor integrity of fire fighting system</td>
<td>No plan to review design standards for currency and control measure effectiveness.</td>
<td>Design standards not reviewed.</td>
<td></td>
<td></td>
<td>Management did not review asset integrity.</td>
</tr>
<tr>
<td>Failure to act on audit results</td>
<td>Audit program did not include active close-out of action items.</td>
<td></td>
<td></td>
<td></td>
<td>Management did not monitor or support audit action close-out.</td>
</tr>
<tr>
<td>Major incidents not included in emergency response plan</td>
<td>Major incident potential not acknowledged.</td>
<td>Emergency response plan not informed by a safety assessment.</td>
<td>Emergency response plan not implemented to allow for major incidents.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Texas City, USA

The BP Texas City facility was the third-largest oil refinery in the United States, producing 10 million gallons of gasoline per day and other fuels (CSB 2007:17 and 31). The refinery had approximately 1,800 employees, and at the time of the incident, approximately 800 contractors were on-site (CSB 2007:31).

On 23 March 2005, the raffinate splitter tower was being restarted after maintenance. During the start-up, liquid hydrocarbons were pumped into the 52m tower without any liquid being removed (CSB 2007:21). The tower was overfilled, causing liquid to enter the overhead piping, which was protected by pressure relief valves (PRV) located 45m below the top of the tower (Visscher 2008:40). As pressure increased, the PRVs opened, discharging a large amount of hydrocarbon to a collection vessel that was open to the atmosphere via a 34 m vent stack (CSB 2007:21). The result was a ‘geyser-like release’ from the vent stack (CSB 2007:21). The hydrocarbon vapour cloud ignited33 and exploded, killing 15 people. These victims were contractors working in temporary offices (portables) located 37 m from the collection vessel (CSB 2007:22).

The U.S. Chemical Safety and Hazard Investigation Board (CSB) revealed that start-up procedures had been violated (CSB 2007:18). Procedures had become ‘outdated documents to be used as guidance’ (CSB 2007:73). Critical alarms and instrumentation were inaccurate and ineffective (CSB 2007:18). The absent34 Day Supervisor was not substituted by personnel with relevant experience (CSB 2007:86-87). The blowdown system, installed in the 1950s, was an unsafe design; having never been connected to a flare system to safely collect liquids and combust flammable vapours released from the process (CSB 2007:18). Miscommunications occurred among management, supervisors and operations personnel including whether or not the unit was going to be started, how liquid raffinate was to be sent to storage, and the liquid raffinate level in the unit at shift change (CSB 2007:79).

The CSB investigation concluded ‘The Texas City disaster was caused by organizational and safety deficiencies at all levels of the BP Corporation’ (CSB 2007:18) with ‘serious management safety system deficiencies that allowed the operators and supervisors to fail’ (CSB 2007:71). ‘While most attention was focused on the injury rate, the overall

33 Ignition source believed to be an idling vehicle about 8 m from the collection vessel.
34 Due to a family emergency (CSB 2007:54).
safety culture and process safety management (PSM) program had serious deficiencies’ (CSB 2007:19).

Baker’s independent review, concluded BP’s corporate SMS did ‘not effectively measure and monitor process safety performance’ for its U.S. refineries and BP’s over-reliance on personal injury rates impaired its perception of process safety risks (Baker 2007:xiv & 72, CSB 2007:28, HSE 2007:1). Furthermore, BP’s Board of Directors had not ensured that management had ‘implemented an integrated, comprehensive, and effective process safety management system for BP’s five US refineries’ (Baker 2007:234, CSB 2007:28, HSE 2007:1).

Ten recommendations were made for improving BP’s process safety leadership, systems, expertise and oversight of process safety performance, including establishing and implementing:

- an integrated and comprehensive management system that systematically and continuously identifies, reduces and manages process safety risks (Baker 2007:xvi), and
- an effective system to audit process safety performance (Baker 2007:xvii).

Table 2.8 contains SMS deficiencies identified from the Texas City incident.
**Table 2.8: Possible SMS Deficiencies Identified in the Texas City Incident**

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1)</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>No focus on major incidents</td>
<td>No reporting requirement of major incident prevention indicators.</td>
<td>Major incident prevention activities not included.</td>
<td>Personal safety focus was implemented but not major incident prevention.</td>
<td>Measurement and evaluation of major incident prevention indicators did not occur.</td>
<td>Major incident focus (learnt from Grangemouth UK incident) not implemented across the business.</td>
</tr>
<tr>
<td>Procedure deviation and lack of management of change (MOC)</td>
<td>Procedures to be certified annually as being current and accurate following review of operating practices in accordance with MOC policy.</td>
<td>No planning for policy to be implemented.</td>
<td>Policy not implemented. Procedures did not reflect actual practice or include specific start-up requirements or critical events previously experienced during start-ups. MOC not recognised.</td>
<td>Policy implementation not measured or evaluated. Start-up procedure not updated over time despite modifications to the equipment design and purpose.</td>
<td>Management review did not enforce procedures meeting practice and allowed procedural changes to occur in an ad-hoc manner without MOC requirement.</td>
</tr>
<tr>
<td>No effective communication for shift change and hazardous operations</td>
<td>No policy for effective shift communication.</td>
<td>No planning had occurred for shift communication.</td>
<td>Shift handover and use of log books not enforced.</td>
<td>Communication methods not measured or evaluated.</td>
<td>Importance of effective communication not emphasised or monitored by management.</td>
</tr>
<tr>
<td>Malfunctioning instrumentation/ineffective mechanical integrity program</td>
<td>No planning to ensure mechanical integrity program tools and training implemented.</td>
<td>Mechanical integrity program tools and training not implemented. Instrumentation maintenance not effectively implemented. No testing and maintenance procedures existed for items identified.</td>
<td>Malfunctioning instrumentation not identified or rectified. Necessary tools, training and oversight of mechanical integrity program not measured or evaluated.</td>
<td>Mechanical integrity program and instrumentation maintenance not effectively monitored or reviewed.</td>
<td></td>
</tr>
<tr>
<td>No technical assistance during start-up</td>
<td>Policy provided for provision of experienced technical personnel during start-up.</td>
<td>Policy not planned for during start-up.</td>
<td>Policy not implemented.</td>
<td>Policy implementation not measured or evaluated.</td>
<td>Management did not ensure policy was implemented.</td>
</tr>
<tr>
<td>Insufficient staffing during start-up</td>
<td>No policy identifying need for extra staff during start-up.</td>
<td>No planning to provide extra staff during start-up.</td>
<td>Recommendation for additional staffing(^{35}) not implemented.</td>
<td>Management review did not act on MOC recommendation for additional staffing at critical times.</td>
<td></td>
</tr>
<tr>
<td>No human fatigue prevention policy</td>
<td>No fatigue prevention policy.</td>
<td>No planning of shift arrangements to prevent fatigue.</td>
<td></td>
<td>Management did not identify fatigue as an issue to address.</td>
<td></td>
</tr>
</tbody>
</table>

\(^{35}\) Raised by MOC in 2001 (CSB 2007:87).
Table 2.8: Possible SMS Deficiencies Identified in Texas City Incident (continued)

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>Implementation</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate operator training for abnormal and start-up conditions</td>
<td></td>
<td></td>
<td>Training did not address abnormal situation management.</td>
<td>Operator knowledge and qualifications not effectively verified.</td>
<td>Management did not ensure performance appraisals and development plans were conducted. Cost cutting to training budget.</td>
</tr>
<tr>
<td>Ineffective incident investigation process</td>
<td></td>
<td>No planning to incorporate incident investigation outcomes into other processes such as hazard analysis.</td>
<td>Incident investigation process not fully implemented as learnings and changes were not being made.</td>
<td>Auditing was occurring, however no actions/recommendations were implemented.</td>
<td>Management did not respond to poor audit results regarding incident investigations.</td>
</tr>
<tr>
<td>Industry practices (design and hazards) not monitored and maintained</td>
<td>No policy to remain up-to-date with industry practices and design standards.</td>
<td>No planning to review industry practices and design for application to site.</td>
<td>Industry knowledge of distillation column hazards not applied to site. Company design requirements not implemented.</td>
<td>No measurement or evaluation of current practices and design versus current industry practices and design standards.</td>
<td>Information regarding adherence to company design standards, industry practices and application to this site not sought. Management did not act on proposals for design changes.</td>
</tr>
<tr>
<td>Auditing recommendations not acted upon</td>
<td></td>
<td></td>
<td>Audits were implemented, but full audit process of reviewing recommendations and closing-out actions were not implemented.</td>
<td>Auditing was occurring. Evaluation and measurement of actions/recommendations close-out were not implemented.</td>
<td>Management did not systematically act on audit recommendations or ensure timely close-out of actions.</td>
</tr>
</tbody>
</table>

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36 Hazards of overfilling a distillation column not understood and design not according to company standards.
37 CSB (2007:114) report this decision was driven by the belief that regulations were not going to require these modifications in the foreseeable future.
Systems Approach to Safety Failed

The preceding analysis of major incidents identified failings in the operators’ SMS. This section will examine the nature of these SMS failings and how they have changed over time. This will include the shift from investigations blaming the person, to blaming the system the person interacts with. People often forget the valuable lessons from major incidents and systems can deteriorate.

Many of the SMS failings identified in the preceding analysis of major incidents were latent, that is, they existed but were hidden. Examples of latent failures include emergency response procedures and equipment being inadequate to deal with a significant consequence; the location of buildings close to hazardous process areas unnecessarily exposing people to risk; or the proximity of storage areas to other hazardous areas which make them vulnerable.

In all the major incidents examined in this chapter, it was not just a single event that led to the catastrophe, but a series of failings coming together simultaneously. It was often a single trigger event, such as a maintenance or operating task being incorrectly performed\(^{38}\) that started the incident and exposed a number of latent failings.

> Although actions or errors by operations personnel at the BP Texas City site... were immediate causes of the March 23 accident, numerous latent conditions and safety system deficiencies at the refinery influenced their actions and contributed to the accident. (CSB 2007:71)

That this finding is not restricted to the chemical industry was shown in the Columbia disaster:

> It is our view that complex systems almost always fail in complex ways, and we believe it would be wrong to reduce the complexities and weaknesses associated with these systems to some simple explanation. Too often, accident investigations blame a failure only on the last step in a complex process, when a more comprehensive understanding of that process could reveal that earlier steps might be equally or even more culpable. (Columbia\(^{39}\) Accident Investigation Board 2003:6)

\(^{38}\) Hopkins (2008:7) reports ‘most but not all major accidents are triggered by operator errors’.

\(^{39}\) Space Shuttle Columbia disintegrated on re-entry into the Earth’s atmosphere on 1 February 2003 (Columbia Accident Investigation Board 2003).
Reason (1997:9) demonstrates this knock-on effect leading to major incidents with the Swiss Cheese model (Figure 2.3). Reason describes barriers of defence between the hazards and the major incident. In an ideal world the barriers are solid and intact. However in reality, the barriers have weaknesses, which are depicted as small holes in the barrier. Such a barrier looks like a piece of Swiss Cheese. When a direct line occurs from the hazard to the major incident by particular holes in the different barriers lining up, then a major incident occurs. The alignment of holes in successive defences is rare (Reason 1997:11). Reason (1997:2) states:

…there is nothing accidental about the existence of these precursors, nor in the conditions that created them…

**Figure 2.3: Swiss Cheese Model** (after Reason 1997:9)

These barriers need to be understood by the organisation and effectively managed in the SMS (Hale 2003:185). Based on the SMS framework, the SMS spans all aspects of operation and maintenance activities at a site. It should prevent both latent failures and major incident triggers.

Major incident investigations have shown a change in SMS failures over time. SMS deficiencies identified from major incidents at Flixborough (1974 – Table 2.3) and Seveso (1976 – Table 2.4) indicate that the necessary control measures were not in place –

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40 See Qureshi (2007) for a discussion of accident modelling, going beyond ‘Swiss Cheese’ to include the complex and dynamic nature of modern socio-technical systems.

41 through analysis of ‘what can attack, weaken, or remove the barrier and under what circumstances’ (Hale 2003:185).
Major Incidents, Safety Management Systems and the Regulatory Response to System Failure

often due to a lack of management and technical foresight and knowledge. The possibility of a major incident had not been considered and hence the SMS did not drive hazard identification, safety assessment or control measure activities to prevent or mitigate major incidents.

*He [Mr Brenner, the Safety & Training Manager at Nypro Ltd, Flixboro] had created a proper system for dealing with normal hazards and was in the course of preparing and putting in hand a disaster plan...it was not designed to deal with an instantaneous catastrophic disaster such as occurred.* (Parker 1975: para 194)

As the hazard of large, or unnecessary, inventories of chemicals had not been recognised prior to Flixborough, ‘little thought’ was given to ways of reducing these inventories (Kletz 1998:368). This was also the case at Bhopal.

While there were design deficiencies at Bhopal (1984 – Table 2.5), such as the unnecessarily large storage of an intermediate chemical (Kletz 2001:111), the control measures (both preventative and mitigative) were in place such as refrigerated storage tanks, scrubber, flare, etc. (Bowonder & Miyake 1988:240 and Chouhan 2005:206), indicating an understanding of the potential hazards. However, none of these control measures were effective. In fact some had been knowingly disabled such as the refrigeration system and flare (Ayres & Rohatgi 1987:24). Even if the controls had been active, there is considerable doubt as to their ability to cope with the extent of the major incident scenario, which had not been considered in their design (Marshall 1987:378).

Since Bhopal, investigations into the cause of major incidents have shown that control measures were often in place (suggesting an increase in the knowledge and understanding of hazards), however these control measures were ineffective due to deficiencies in the implementation, operation and/or maintenance of the SMS, including a lack of consideration for major incident potential. An example of this is the erosion of procedural requirements such as the permit to work and shift handover on Piper Alpha (1988 – Table 2.6) and at Pasadena (1989 – Table 2.7).

*…the Phillips 1989 explosion...demonstrates the need to adhere to operating procedures and implementing appropriate management systems for contract workers.* (Anthony & McKetta 2001:169)

As Tables 2.3 to 2.8 show, in all cases there was a weakness in ‘Measurement and Evaluation’ and ‘Management Review’ to critically identify deficiencies and rectify them.
Chapter 5 will go on to consider similar problems with the implementation, operation and maintenance of control measures and SMS elements in Victorian MHFs.

Major incident investigations have developed to consider failures of the organisation, through the management system, rather than of the individuals involved (Wreathall & Reason 1992:448, Hale 2003:185). Kletz (2001:267) acknowledges this shift in focus, reporting that the Longford Royal Commission Report ‘describes the operator failings that led to the explosion but does not blame the operators, as reports in earlier times might have done, but shows how the operators’ failings were the result of inadequate training and other management failures’. IOSH (2003:25) reports a greater emphasis on worker and management behaviour in incident analysis. Human failures are increasingly considered as consequences of working in complex systems, rather than as the major cause as was previously thought (Reason 1997:10). Kletz (2001:271) warns of the limitations of SMSs and highlights the connection between people and systems:

>All that a system can do is harness the knowledge and experience of people...Knowledge and experience without a system will achieve less than their full potential. Without knowledge and experience a system will achieve nothing.

The interaction of people and systems must be considered as SMSs contain both human and machine aspects. For example in Figure 2.1, implementation may include procedural as well as engineering or mechanical controls. In some circumstances, computers perform monitoring and evaluation, however people interpret the results and make decisions. Many MHFs focus on engineering and hardware at the expense of ‘people’ issues (Anderson 2004:703). However, there is growing awareness of the complexity and diversity of human factors influencing OHS performance (Bluff 2003:33 and Waring 1996: xiii). An effective SMS must include human factors, rather than just a mechanistic approach to organisational and individual behaviour (Hale 2003:185, IOSH 2003:18, Cummings 2006:21).

Anderson (2004:703) stresses the need for human factors to include process safety aspects of controlling major hazards, such as connecting the wrong hose or omitting components (as occurred at Pasadena), rather than the traditional focus of human factors on personal safety. Part of the human aspect of controls is that all personnel involved must understand the nature of the hazards in their control and the possible

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An example of a human factor is monitoring the effects of human reliability on the effectiveness of control measures. 

Sarah Sinclair 45
magnitude and implications of a major incident. The challenge is to sustain this individual awareness and commitment when incidents fade from people’s memories (Environment Canada 1986:3).

Unfortunately, there are many examples, such as Texas City, Formosa, Longford and Deepwater Horizon (CSB 2007:103, Hopkins 2008:4, Visscher 2008:42, RLRC 1999:15.7 and Hopkins 2011:12), where previous incidents within an organisation could have provided valuable lessons in identifying and correcting the hazards which ultimately led to a catastrophic incident, if the information had been captured by the SMS and used (Hale 2003:194 and Koornneef 2000).

It might seem to an outsider that industrial accidents occur because we do not know how to prevent them. In fact, they occur because we do not use the knowledge that is available. (Kletz 1993:1)

Almost every aspect of what went wrong at Texas City had gone wrong before, either at Texas City or elsewhere. (Hopkins 2008:4)

The need to harness and use such knowledge is paramount, as noted by Flemming and Lardner (2002:2):

…good systems, procedures and engineering controls on their own are not enough, it is how well an organisation ‘lives’ its systems that matters.

The Baker report (2007:i), following the Texas City Refinery incident states:

The passing of time without a process accident is not necessarily an indication that all is well and may contribute to a dangerous and growing sense of complacency. When people lose an appreciation of how their safety systems were intended to work, safety systems and controls can deteriorate, lessons can be forgotten, and hazards and deviations from safe operating procedures can be accepted. Workers and supervisors can increasingly rely on how things were done before, rather than rely on sound engineering principles and other controls. People can forget to be afraid.

These sentiments are echoed by Tweeddale (2003:xiv) and Kletz (1993:1). Ackroyd (2008:787) comments that the Baker Report (2007) has ‘highlighted …how degradation [of OHS management arrangements] can readily occur even in ‘mature’ organisations’. Gradual degradation in organisational performance, or organisational drift, is often unnoticed (Berman & Ackroyd 2006:140). Long before organisational drift becomes
apparent, precursors to incidents are generated (Berman & Ackroyd 2006:149). ‘Practical Drift’ is the gradual deviation, from safe operating procedures, by individuals (Snook 2000). The management of organisational drift is a challenge for detection, as most organisations have well-developed processes for managing and enhancing OHS once the deterioration is brought to their attention (Berman & Ackroyd 2006:150). However, ‘Plenty of examples exist…where the gradual erosion of safety performance appeared never to breach a threshold of organisational consciousness, until a major incident or near-miss made everyone sit up and take notice’ (Berman & Ackroyd 2006:140). Berman & Ackroyd (2006:150) call for further work in the area of drifting performance detection, particularly regarding internal process effectiveness (Berman & Ackroyd 2006:150).

Organisational drift is a complex phenomena causing SMSs to fail in a number of ways. Thus VWA (2001:7) describes three types of inadequate SMS:

- ‘virtual’: consists of the necessary management elements and addresses the correct control measures, but does not reflect how these control measures are managed in practice;
- ‘misguided’: consists of the right management elements, but manages the wrong control measures, i.e. those not critical to major incidents, and
- ‘random’: does not have the appropriate management system elements to ensure proper monitoring and improvement of performance, yet addresses appropriate control measures, and reflects reality.

The analysis of major incidents above suggests a need for organisations to better understand their SMS, and how it can work effectively to prevent defects and deterioration in the barriers which stand between hazards and a major incident. Research suggests there are several factors which influence the effectiveness of OHS performance which may also influence SMS effectiveness, such as active senior management commitment, involved and empowered workers, OHSM being an organisational priority, a customised system, integration with business operation and systems, and established risk management and evaluation processes (Cohen and Cleveland 1983, Gallagher 1997, Shannon, Mayr and Haines 1997, Hale and Hovden 1998, Gallagher, Underhill and Rimmer 2003, Hale et al. 2010).

Chapter 8 will focus on identifying influencing factors on MHF regulatory performance, including SMS development, from analysis of the Case Studies presented in Chapters 6 and 7.
2.5 Regulatory Response to System Failure

The loss of life, injury, ill-health and cost of major incidents provide a strong impetus for incident prevention (Thygerson 1977:86-92, Fewtrell & Hirst 1998:7, Kirwan et al. 2002:3, CSB 2007:17). This section will examine the government’s role in forming OHS legislation, and more specifically, how public concern brings pressure on governments to legislate to prevent recurrence after major incidents.

OHS Legislation and the Role of Government

Views differ on the role of the state in OHS regulation. Oi (1980) suggests that OHS regulation is unnecessary as it is good business practice and can be left to the market to regulate. This is disputed by many, including Ayres and Braithwaite (1992), Baram (2002), Coglianese & Lazer (2003), de Mol & van Gaalen (2002), Grabosky (1995), Kirwan et al. (2002), Noble (1986), Parker (2002) and Robinson (1991). Many of these authors promote regulatory action that ‘motivates, molds [sic], and augments the self-regulatory impetus of sites to control risk’ (Haines 2009:32). As Chapter 3 will show, self-regulation at Longford was not successful.

Until recent years OHS legislation did not generally attract major public interest, and was therefore rarely high on government agendas. However this situation can change following a catastrophic incident. According to Kirwan et al. (2002:279), ‘Public pressure, when it is mobilised, can be extremely powerful’. Major incidents focus the attention of all political parties, stakeholders, and the media.

If one company has a serious accident, the whole industry suffers in loss of public esteem, while new legislation may affect the whole industry. So far as the public and politicians are concerned, we [industry] are one. (Kletz 1998:396)

In these circumstances there may be strident demands for urgent legislative action to prevent or minimise the possibility of similar incidents.

What legislative options exist for governments? Robens43 (1972) revolutionised OHS regulation by recommending legislation be goal-setting or performance-based. While there is general support for performance-based legislation (Kast & Rosenzweig 1974, Black 1997, Haines 2009, and Weick, Sutcliffe, & Obstfeld 1999), process-based

legislation which specifies the process (such as conduct hazard identification and risk assessments, rather than the specific solution), bridges the gap between the ‘vague’ performance-based requirements and the restrictive prescriptive legislation (Hopkins 1994:435, Gunningham & Johnstone 1999:36). As previously discussed, ‘process-based’ legislation has evolved further in some jurisdictions, such as MHF regimes, into ‘systems-based’ regulation, with the legislated requirement to include SMSs (Gunningham & Johnstone 1999:38, Kirwan et al. 2002:4-5) providing ‘one of the most potent opportunities for regulatory reform in many years’ (Gunningham & Johnstone 1999:172).

Three broad options are available to policy makers to encourage a systems-based approach to OHS:

1. leave it to the market (voluntary implementation of SMSs);
2. require by law that all or some enterprises implement SMSs, or
3. provide incentives to enterprises to implement SMSs (no compulsion) (Gunningham & Johnstone 1999:310).

As will be shown in Chapter 3, the Victorian MHF Regulations align with the second category, requiring some enterprises (declared MHFs) to implement SMSs.

Major Incidents and Regulatory Response

The previous section discussed different approaches to regulation. This section will show how major incidents lead to regulation. Table 2.9 shows this sequence of events and response – albeit often a delayed response.

<table>
<thead>
<tr>
<th>Incident</th>
<th>Number of fatalities</th>
<th>Country</th>
<th>Year occurred</th>
<th>Legislation</th>
<th>Country/region</th>
<th>Year promulgated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flixborough</td>
<td>28</td>
<td>UK</td>
<td>1974</td>
<td>CIMAH</td>
<td>UK</td>
<td>1984</td>
</tr>
<tr>
<td>Seveso</td>
<td>-</td>
<td>Italy</td>
<td>1976</td>
<td>EC Directive of Major Accident Hazards (Seveso)</td>
<td>Europe</td>
<td>1982</td>
</tr>
<tr>
<td>Sandoz</td>
<td>-</td>
<td>Switzerland</td>
<td>1986</td>
<td>Seveso II</td>
<td>Europe</td>
<td>1996</td>
</tr>
<tr>
<td>Kings Cross</td>
<td>31</td>
<td>UK</td>
<td>1987</td>
<td>Rail Safety Cases</td>
<td>UK</td>
<td>1994</td>
</tr>
<tr>
<td>Piper Alpha</td>
<td>167</td>
<td>UK</td>
<td>1988</td>
<td>Off shore Safety Cases</td>
<td>UK</td>
<td>1992</td>
</tr>
<tr>
<td>Pasadena</td>
<td>23</td>
<td>USA</td>
<td>1989</td>
<td>OSHA Process Safety Management</td>
<td>USA</td>
<td>1992</td>
</tr>
<tr>
<td>Longford</td>
<td>2</td>
<td>Australia</td>
<td>1998</td>
<td>Occupational Health and Safety (MHF) Regulations</td>
<td>Australia (Victoria)</td>
<td>2000</td>
</tr>
</tbody>
</table>

Following the Flixborough explosion, a Court of Inquiry chaired by R.J. Parker, was established\textsuperscript{47} to determine the ‘causes and circumstances of the disaster and to point out any lessons’ (Parker 1975:para 2). The Flixborough Disaster, Report of the Court of Inquiry, was a comprehensive and important document for the chemical industry (Lees et al. 1996: A2/2), revealing many inadequacies in the quality of the management and engineering procedures (Withers 1988:25).

Flixborough aroused widespread concern and had much influence on future official activity and legislation (Withers 1988:25). The Flixborough explosion drew public attention to hazards arising from chemical installations and questions were raised regarding MHFs and the adequacy of control measures. Flixborough was a milestone in the history of the chemical industry...[showing] that the hazards of the chemical industry were greater than had been generally believed by the public. (Kletz 2001:83)

\textsuperscript{44} Agricultural chemicals warehouse fire in Basel, Switzerland. Up to 30 tonnes of chemicals including mercury-containing pesticides were washed into the Rhine River with the fire water (Atherton & Gil 2008:300).

\textsuperscript{45} While not a major incident involving chemicals, Kings Cross rail disaster is included to show the introduction of Safety Cases to the rail industry.


\textsuperscript{47} under Section 84 of the Factories Act 1961 (UK).
In response to public concern the UK Government formed the Advisory Committee on Major Hazards (ACMH), which assisted in the development of the Control of Industrial Major Accident Hazards (CIMAH) Regulations in the UK and the EEC Major Accident Hazards Directive (Lees et al. 1996:A2/14). At the time, CIMAH was ‘a new and radical approach’, requiring manufacturers to examine their sites and make their own assessment of risk potential and control through the preparation of a written safety report (Wilkinson 2002:4). It took about ten years for ACMH’s recommendations to be made and to come into force as CIMAH (Kletz 2001:95). Lord Robens (1972) had recommended an advisory committee be established to give advice on explosives and flammable substances (Marshall 1987:443). This recommendation was not acted upon until after the Flixborough explosion. In contrast to the UK, the USA’s ‘reaction to the Flixborough event was minimal’ (OSHA 1990:29).

Seveso showed that industrial incidents could have serious consequences beyond national borders (Withers 1988:xii). Following the toxic release at Seveso, the Italian government established a Parliamentary Commission of Inquiry to investigate the disaster and regulation of the Italian chemical industry, a far wider scope than the Flixborough Inquiry. The terms of reference combined ‘the functions in UK terms of the Flixborough Inquiry, the Major Hazards Advisory Committee and the Royal Commission on Environment Pollution’ (Marshall 1980:499). The Seveso incident had a greater impact on continental Europe than Flixborough, and increased the public’s awareness of chemical industry hazards, which in turn increased the public’s demands for effective controls at MHFs (Lees et al. 1996:A3/2). The resulting legislation, to achieve the public’s demands, was the EEC Directive on Major Accident Hazards, often referred to as the ‘Seveso Directive’ (Kletz 2001:103). Withers (1988:61) reports considerable variation in the implementation rate of the Seveso Directive by EEC member countries. Withers (1988:61) and Oh (2002:47) suggest this is due to the differing bureaucracies, parliamentary processes and the different policies of these member countries.

The Seveso Inquiry also influenced ACMH. Notification of ultra toxics was added to the second report of ACMH (Lees 1996:A3/14). The Seveso Directive was implemented in

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48 Replaced by the Control of Major Accident Hazards (COMAH) Regulations.
49 After about 3 years of negotiation (Oh 2002:46).
the UK in the CIMAH Regulations, however it is noted that CIMAH would have been enacted in a slightly different form if Seveso had not occurred (Kletz 2001:103, Williams 1993:16).

Following Bhopal, the worst-known industrial chemical disaster (Tweeddale 2003:1, Broughton 2005), there was immediate response in India. The Gujarat Pollution Control Board ordered the closure of 12 pesticide plants pending a review of their safety precautions. Three days after the incident, the Madhya Pradesh51 state government announced a survey of all industrial plants in the state, with the aim of identifying potential for a similar incident. The states of Maharashtra and West Bengal also ordered their Pollution Control Boards to study the safety standards of all potentially hazardous factories. The national government announced tax incentives for the installation of pollution-control equipment. Three key acts dealing with industrial hazards were amended: The Factories Act (1948), The Water Act (1974 and 1977) and The Air Act (1981) (Shrivastava 1992:128). However this ‘flurry of activity resulted in no major changes’ (Jones 1988:146) as the desire to attract multinational corporations to India outweighed the need to tighten safety regulations (Shrivastava 1992:129).

The Chief of the Occupational Safety and Health Branch of the ILO visited India in February 1985, and in April 1985 an ILO delegation was sent at the request of the Indian Government, to identify and advise on the early priorities for establishing a system for controlling major accident hazards (Saxena 1997:4). The Indian Ministry of Labour implemented the ILO project’s recommendations in 12 selected states and later extended this to the ports. The Ministry of Environment and Forests included the MHF legislation as the ‘manufacture, storage and import of hazardous chemicals rules, 1989’ under the Environment (Protection) Act of 1986. This ILO project ceased in 1993, with the Director-General of the Directorate General Factory Advice, Ministry of Labour, Government of India, stating ‘It may take a long time before the system has a strong base, especially in a developing country, such as India, where there are various constraints’ (Saxena 1997:6). The ILO published a code of practice on the Prevention of Major Industrial Accidents in 1991, followed by the Prevention of Major Industrial Accidents Convention and Recommendations in 1993.

The USA responded to Bhopal, as the plant was operated by the US-based Union Carbide Corporation, with Congressional inquiries into the chemical industries (Jones 1988:146). Table 2.10 contains the bills introduced in the US Congress (Shrivastava

51 Bhopal is the capital of Madhya Pradesh.
1992:143) in response to Bhopal. In the USA, the Chemical Manufacturers Association introduced the Community Awareness and Emergency Response (CAER) program and the National Chemical Response and Information Centre (NCRIC) (Kletz 2001:120). The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA; Public Law 99-499) was enacted requiring state and local governments to plan for emergencies and chemical facilities to report information about chemical hazards to government and the public (Kleindorfer et al. 2003:865). The Environment Protection Agency initiated the Chemical Emergency Preparedness Program (CEPP) (Shrivastava 1992:70).

Table 2.10: Bills Introduced in the US Congress in Response to Bhopal

<table>
<thead>
<tr>
<th>Bill</th>
<th>Date</th>
<th>Legislation amended</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR1101</td>
<td>19/2/85</td>
<td>Hazardous Materials Transportation Act 1985</td>
<td>Restrict the transportation of radioactive material through large cities.</td>
</tr>
<tr>
<td>HR1660</td>
<td>21/3/85</td>
<td>Solid Waste Disposal Act &amp; Toxic Substances Control Act 1976</td>
<td>Prevent releases of toxic &amp; hazardous substances that are presently not adequately controlled, to establish a community right to know.</td>
</tr>
<tr>
<td>HR2576</td>
<td>22/5/85</td>
<td>Section 112 of Clean Air Act 1970</td>
<td>Control toxic releases into the air.</td>
</tr>
</tbody>
</table>

The World Bank\(^{52}\) introduced guidelines for Major Hazard Installations in Developing Countries in 1985 (World Bank 1985). In March 1985, the American Institute of Chemical Engineers (AIChE) formed the Centre for Chemical Process Safety (CCPS). CCPS provided a focus on preventing major incidents through a collaborative approach with industry, publishing a process safety guideline book, *Guidelines for Hazard Evaluation Procedures*, and by 1990, more than a dozen guideline books had been published (AIChE 2007).

The Canadian review of Bhopal found that while some lessons had been learned from local major chemical incidents and some improvements had been made, ‘Bhopal has shocked the whole system and made all parties more receptive to review and change for improved industrial safety and loss prevention’ (Environment Canada 1986:1). The report continues with the statement that ‘the greatest challenge is to sustain this awareness and continuing concern in the months and years ahead’ (Environment Canada 1986:1).

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\(^{52}\) based in Washington D.C.
The Canadian review did not make any recommendations regarding legislation, having responded to its own major incident in the City of Mississauga in 1979, resulting in the *Transportation of Dangerous Goods Act 1980* and subsequent regulations in 1985 (Environment Canada 1986:vii), just prior to Bhopal.

However in Europe, the response to Bhopal was far more subdued than in America. Both government and industry reassured the public that everything was under control, citing the EEC Seveso Directive on major industrial hazards as sufficient regulation to protect them. The Seveso Directive was intended to be fully implemented by all EEC states by 8 January 1984 (some 11 months prior to the Bhopal incident), however by February 1986 fewer than half of the then EEC states had formally implemented it (Jones 1988:152). Shrivastava (1992:70) comments that following Bhopal ‘*legislative initiatives in most countries were fragmented and addressed only immediate local concerns*’. Despite being ‘*the worst industrial disaster in world history*’ (Marshall 1987:379), Bhopal has resulted in less ‘*regulatory fallout*’ than Flixborough or Seveso’ (Kletz 2001:119).

In the aftermath of Piper Alpha, the worst off-shore platform incident, a Public Inquiry presided over by Lord Cullen was established (Lees et al. 1996:A19/2). The Inquiry was to establish the circumstances of the disaster, its cause and make recommendations to avoid a repeat event (Cullen 1990:7). Lord Cullen’s recommendations ‘*led to a radical change in the approach to offshore hazards demanded of managements and of the regulatory authorities*’ (Kletz 2001:196).

Prior to the Piper Alpha incident, the offshore industry had been ‘*insulated from the development of safety cases as a tool for managing major accident hazards*’ (Wilkinson 2002:4). Lord Cullen’s Report recommended the introduction of a Safety Case regime for offshore installations, including a demonstration by the operator that the SMS ensures safe design and operation of the installation (Hale, Goossens and v.d. Poel 2002:79 and Lees et al. 1996:A19/16). A major recommendation was to shift the focus of inspection from the details of technical compliance to the establishment and assessment of SMSs and Safety Cases (Hale, Goossens and v.d. Poel 2002:79). Lord Cullen stated that the

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53 requiring the evacuation of 200,000 residents.
54 In 1987, chemical threshold quantities in the Seveso Directive were amended (Directive 87/216/EEC, Official Journal of the European Communities No L85, 28/3/87, p.36). This is attributed to Bhopal (Williams 1993:18).
55 under the *Public Inquiries Regulations – Offshore Installations Regulation 1974*.
56 The Cullen Inquiry thus fulfilled a dual role, which compared to Flixborough was the equivalent of the Court of Inquiry and ACMH’s recommendations (Lees et al. 1996:A19/3).
SMS should be based on quality assurance principles similar to ISO 9000 and contain the following elements:

- Organisational structure,
- Management personnel standards,
- Training, for operations and emergencies,
- Safety assessment,
- Design procedures,
- Procedures, for operations, maintenance, modifications and emergencies,
- Management of safety by contractors in respect of their work,
- Involvement of the workforce (operators and contractors) in safety,
- Accident and incident reporting, investigation and follow-up,
- Monitoring and auditing of the operation of the system, and

These 11 principles have laid down the structure for subsequent SMS regulation.

The Cullen Report also found the Department of Energy unsuitable to administer the Offshore Safety Case regime and recommended the transfer of responsibility to the Health and Safety Executive (HSE), which occurred in April 1991. Kletz (2001:196) reports that ‘the destruction of the Piper Alpha offshore oil platform in 1988 had a similar effect on the UK offshore oil and gas industry as Flixborough had on the chemical industry in the UK in the late 1970s’. Australia considered the Cullen Report for its relevance to the offshore oil and gas industry and also decided to implement an offshore safety case regime (Wilkinson 2002:4) - *Petroleum (Submerged Lands) (Management of Safety on Offshore Facilities) Regulations 1996*.

The 1989 major incident in Pasadena reinforced the need for action in the USA to control the risk of major incidents, which had begun following Bhopal (DLI 2002:11). Anthony & McKetta (2001:52) provide a detailed account of the developments to improve process safety by government agencies and trade organisations which had begun following Bhopal, but had not been completed prior to Pasadena, reporting a ‘consensus started to emerge in 1990’. The US Congress enacted the Clean Air Act Amendments (CAAA) in 1990, directing OSHA and the Environmental Protection Agency (EPA) to develop regulations to reduce the frequency and severity of chemical plant accidents (Anthony & McKetta 2001:170). OSHA promulgated the Process Safety Management regulation on February 1992 to protect workplace employees and the EPA promulgated its Risk...
Management Program regulation in 1996, to protect the public and the environment (Anthony & McKetta 2001:170). The U.S. Chemical Safety Board (CSB) was also established under law to conduct independent investigations of major chemical accidents\(^{57}\) and to report on their cause and circumstance (Visscher 2008:34).

Following the BP Texas City incident, the CSB investigated not only BP’s safety performance at Texas City, but also the role played by BP Group Management, based in London (CSB 2007:17). CSB’s first ever urgent safety recommendation was issued to BP in August 2005, calling on it to convene an independent panel to assess the effectiveness of BP North America’s corporate oversight of SMSs at its refineries and its corporate safety culture (Baker 2007:viii, HSE 2007:1, Hopkins 2008:2). In response, a panel, led by former US Secretary James Baker III, was appointed by BP Group Chief Executive in October 2005 (HSE 2007:1).

In October 2005 the CSB issued a further urgent safety recommendation on the American Petroleum Institute to develop new safety guidance for placement of trailers (HSE 2007:1). The CSB further examined the effectiveness of OSHA, which has primary U.S. federal government oversight responsibility for worker OHS (CSB 2007:18). OSHA announced a National Emphasis Program (NEP) for petroleum refineries focusing on the Process Safety Management (PSM) standard, committing to perform inspections at all 81\(^{58}\) U.S. refineries by the end of 2008 (Fairfax 2007).

While at the time of writing, no specific changes to legislation have resulted from the Texas City incident, the Baker Report and the CSB Report have ‘already had ramifications across the world’ with major oil companies taking ‘the report seriously and ….taking appropriate action’ (Pape 2008:1006).

This examination of several major incidents and resulting legislative change, suggests several inferences:

- legislation occurs in response to a major incident (reactively);
- with increasing years there was a shorter elapsed time between an incident occurring and the introduction (or review) of legislation (reduced from 10 to two years);
- the European Union has generally led the UK in the introduction of legislation. The USA and Australia have lagged behind the UK, and

\(^{57}\) Any accidental release resulting in a fatality, serious injury or substantial property damages.

\(^{58}\) Under federal jurisdiction.
• countries or regions that did not experience the incident generally did not proactively introduce legislation.

Bhopal put major hazards on the public agenda world-wide, particularly in India and the USA, which had not reacted strongly to Flixborough or Seveso (Lees et al. 1996:A5/9 and Kletz 2001:95). The apparent lack of learning demonstrated by countries not directly impacted by the incident may reflect more on the lack of pressure brought to bear on government by constituents and lobby groups. Victoria did not respond to Bhopal, Flixborough or Seveso. Victoria's own major incident at Longford in 1998 created the political pressure to stimulate regulation. This will be discussed in Chapter 3.

2.6 Conclusions

Major incidents are low likelihood - high consequence industrial events involving hazardous chemicals and were defined as ‘an uncontrolled incident, including an emission, loss of containment, escape, fire, explosion or release of energy, that (a) involves Schedule 1 materials, and (b) poses a serious and immediate risk to health and safety’ (MHF Regulations 2000:4).


Increasingly SMSs are seen as a method to avoid or mitigate major incidents. An SMS provides a framework to co-ordinate the independent activities needed to achieve this end. The definition of an SMS for this study will be taken from the Australian and New Zealand Standard, AS/NZS 4801:2001:

that part of the overall management system which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the OHS policy, and so managing the risks associated with the business of the organisation. (AS/NZS 4801:2001, 4)

However SMSs are not fool proof. Multiple failings of the SMS were identified as causes in all the major incidents examined. The multi-causal nature of major incidents was demonstrated, that is, the combination of a series of failures occurring simultaneously, as
illustrated by Reason's Swiss Cheese Model (Reason 1997:9). Many of these failings were latent, requiring a trigger event to initiate the major incident sequence. This sequence can be interrupted, which is the focus of major incident prevention activities.

The analysis of causes of major incidents over time has shown a change in the nature of major incidents and SMS deficiencies. Analysis indicates that in earlier major incidents such as Flixborough, control measures were not in place due to a lack of understanding of potential hazards. This situation has changed, with industry identifying the need for control measures and implementing them. However in later major incidents the control measures, while present, were not sufficiently effective when required to avert a major incident. All control measures should be managed by the SMS, which should prevent both latent failures and trigger events that cause major incidents.

A dominant theme in the review of major incidents concerned failings in SMSs due to erosion or degradation of the SMS. Management inattention over time, poor auditing, poor training and poor communication breed failure in key elements of the SMS.

Major incidents such as Flixborough and Piper Alpha were also shown to have been the catalyst for new legislation concerning MHFs in various jurisdictions around the world. It was demonstrated that governments generally do not act to legislate the prevention of major incidents until one has happened in their jurisdiction, generating public pressure demanding the prevention of future major incidents. Victoria was no different – it did not respond to major incidents overseas. MHF Regulations were only introduced in 2000 following a local major incident at Longford. A detailed analysis of the 1998 Longford gas plant explosion and its aftermath, focusing on the Royal Commission, as well as the resulting Victorian MHF Regulations, is presented in the next chapter.
CHAPTER 3

THE LONGFORD GAS PLANT EXPLOSION AND ITS REGULATORY AFTERMATH

3.1 Introduction

Chapter 2 developed a general argument linking the occurrence of major incidents around the world to regulatory intervention – increasingly to mandate SMSs as a framework in which to manage the control measures that can interrupt the sequence of latent failures and trigger events. In this chapter, these processes will be explored in detail for Victoria following the Longford major incident in 1998. This exploration will deal with the course of events after the Longford incident including:

- Public opinion and political pressure in the aftermath of the incident;
- The Longford Royal Commission Report, its findings and recommendations;
- Responses to the Royal Commission Report by Esso, the government and other stakeholders, and
- Victoria’s MHF Regulations including the designation of the roles of employer and the regulator, and the special or unique nature of these Victorian regulations.

The aim of this chapter is to provide essential context for the research questions addressed in this thesis.

A criminal trial and civil litigation followed the Longford Royal Commission (see Appendix C). Esso was charged and convicted of 11 criminal offences under existing OHS legislation, which can all be linked to failures in the SMS. Total fines of A$ 2 million were imposed - the highest penalties ever under Victorian OHS law to that time. An out-of-court settlement for A$ 32.5 million for property damage sustained by industry and the general public, following the loss of gas, was reached. This was the largest civil damages claim in Australian history at that time (Johnson Tiles v Esso Australia (No 4) [2004] SCV). Figure 3.1 indicates the chronology of significant events following the Longford major incident.
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 September 1998</td>
<td><strong>Longford Gas Plant Fire &amp; Explosion</strong> Loss of industrial &amp; domestic gas supply 2 killed, 8 seriously injured, multi-billion dollar financial losses</td>
</tr>
<tr>
<td>12 October 1998</td>
<td><strong>Royal Commission announced</strong> by Victorian Government</td>
</tr>
<tr>
<td>14 October 1998</td>
<td><strong>Gas supply fully re-instated</strong></td>
</tr>
<tr>
<td>20 October 1998</td>
<td><strong>Royal Commission appointed</strong> by Victorian Government to enquire into all aspects of the Longford major incident</td>
</tr>
<tr>
<td>14 December 1998</td>
<td><strong>Royal Commission hearings commence</strong> 63 witnesses and 175,000 pages of evidence</td>
</tr>
<tr>
<td>15 April 1999</td>
<td><strong>Royal Commission concludes</strong></td>
</tr>
<tr>
<td>28 June 1999</td>
<td><strong>Royal Commission Report published</strong> recommending mandatory Safety Case Regime for all Victorian MHFs</td>
</tr>
<tr>
<td>20 August 1999</td>
<td><strong>Draft OH&amp;S (Major Hazard Facilities) Regulations published</strong> with Regulatory Impact Statement for public response</td>
</tr>
<tr>
<td>1 February 2000</td>
<td><strong>Esso Australia committed by the Melbourne Magistrates’ Court for trial in the Supreme Court of Victoria on 45 criminal charges under the OHS Act</strong></td>
</tr>
<tr>
<td></td>
<td>Charges later reduced by the Director of Public Prosecutions (DPP) to 21 counts</td>
</tr>
<tr>
<td>22 June 2000</td>
<td><strong>OH&amp;S (Major Hazard Facilities) Regulations 2000 gazetted</strong></td>
</tr>
<tr>
<td>1 July 2000</td>
<td><strong>OH&amp;S (Major Hazard Facilities) Regulations 2000 take effect</strong> requiring development of a Safety Case</td>
</tr>
<tr>
<td>7 August 2000</td>
<td><strong>Esso Australia presented in Supreme Court of Victoria on 21 counts</strong></td>
</tr>
<tr>
<td>16 August 2000</td>
<td><strong>Esso Australia pleads not guilty</strong></td>
</tr>
<tr>
<td>1 – 8 February 2001</td>
<td><strong>DPP seeks to proceed on 11 counts only</strong> Defence opposes this application and seeks to proceed on 3 counts only</td>
</tr>
<tr>
<td>13 February 2001</td>
<td><strong>Justice Cummins grants application by the DPP to proceed to trial on 11 counts</strong></td>
</tr>
<tr>
<td>5 March 2001</td>
<td><strong>Criminal Trial in the Supreme Court of Victoria commences</strong> Trial by jury lasted 115 days and Esso convicted on 11 counts</td>
</tr>
<tr>
<td>30 July 2001</td>
<td><strong>Maximum penalties imposed</strong> by Supreme Court Justice Cummins totaling A$2 million, the heaviest penalties ever imposed under the OHS Act in Victoria (and Australia)</td>
</tr>
</tbody>
</table>

Figure 3.1: Chronology of Significant Events Following the Longford Major Incident

Chapter 2 indicated that regulation of MHFs generally does not occur until a local major incident is experienced. The development of MHF legislation in Australia further suggests this, with a series of potential major incidents in Australia in 1989, 1990 and 1991, including the Boral LPG incident in Sydney ($4.1m losses including disruption to Sydney Airport) and the Coode Island incident in Melbourne ($90m losses including $53m in emergency response costs) providing the impetus for the introduction of a National Standard several years later in 1996 (VWA 1999a:2). Appendix D contains
further information regarding the preparation of the National Standard and, at times, reluctant introduction of MHF regulation in the states and territories. Despite the National Standard, MHF legislation was not introduced in most Australian states until a major incident was experienced. This was the situation in Victoria on 25 September 1998.

3.2 Public Opinion and Political Pressure in the Aftermath of the Longford Gas Plant Explosion

Saturation media coverage was inevitable in the aftermath of the Longford Gas Plant Explosion on Friday, 25 September 1998. On many counts this was the worst industrial disaster in Victoria’s history. The major economic losses and inconvenience suffered by industry and domestic consumers created immediate community demands on the Victorian government to take action to investigate the incident, apportion blame and punish where fault was involved, and to take any action necessary to prevent a repetition of this event, or at least to reduce its impact.

Melbournians were subjected to a variety of inconveniences, among them the physical discomfort of cold showers. This collective experience of adversity generated a spirit of almost wartime solidarity. The majority of Victorians thus had a personal interest in the crisis and a continuing interest, even after its resolution, in finding someone to blame. This was a politically dangerous situation for the government of the day. (Hopkins 2000:2)

Mr Kennett, the State Premier, demanded full answers on his desk ‘by noon tomorrow’ (The Sunday Age59 27 Sep. 1998:1), a rather optimistic demand given the enormity of the disaster! The Coroner’s Office, Victoria Police and the VWA had each begun investigating the incident. The Premier considered setting up a judicial inquiry and would not rule out a Royal Commission (The Age 28 Sep. 1998:1). The largest class action in Australian legal history was launched and the state parliamentary Opposition called for a full inquiry (The Age 28 Sep. 1998:2). Allegations of lax maintenance practices at Longford were published, with denials by Esso (The Age 29 Sep. 1998:2).

The failure of Victoria’s gas supplies was a national issue (The Age 3 Oct. 1998:9). The Federal government, in the midst of an election campaign, announced an emergency Gas Assistance Fund, estimated at $100 million, to assist individuals, small businesses

59 ‘The Age’ is a major Melbourne newspaper.

**Appointment and Terms of Reference of a Royal Commission**

The Victorian Government responded to increasing political pressure and on 12 October 1998, 17 days after the explosion, the Premier announced the appointment of a Royal Commission (Victorian Government Gazette 1998:1). Sir Daryl Dawson, a retired High Court judge and a former Victorian solicitor-general, was appointed as Chair and Mr Brian Brooks, an eminent chemical engineer, appointed as a Commissioner (RLRC 1999:A.1). The Terms of Reference (TOR) of the Royal Commission required the Commissioners to consider three major questions (Appendix E).

The first concerned the identification of the causes of the explosion and fire on 25 September 1998 and the failure of gas supplies from the Longford facility following the explosion and fire.

The second concerned whether any of eight listed factors caused or contributed to the explosion, fire and failure of gas supply, including:

(a) the design of the Longford facilities including the interdependence of
   (i) the plants and other components which comprise these facilities; and
   (ii) the Longford facilities and other facilities at, or upstream of, the Esso site at Longford;
(b) operating standards, practices and policies;
(c) maintenance standards, practices and policies;
(d) asset management practices and policies;
(e) risk management and emergency procedures;
(f) any relevant changes in the standards, practices and policies referred to in sub-paragraphs (b), (c), (d) and (e) which had taken place before that occurrence;
(g) the hydrate incident at the Longford facilities which occurred in June 1998, and any other previous incidents considered by the Board to be relevant;
(h) whether there was any breach of, or non-compliance with, the requirements of any relevant statute or regulation by Esso or BHP.

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60 In Victoria and interstate.
61 A Royal Commission, unlike a criminal or civil trial, is an inquisitorial procedure designed to establish the facts of a situation rather than to prove guilt or apportion blame.

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Parts (a) to (e) above are SMS elements. Part (f) would be included in management of change, which is also an SMS element. An examination of (g) would be incorporated in incident reporting and investigations, which is also an SMS element. Hence the second question predominantly examines Esso’s SMS and its possible contribution to the major incident.

The final question concerned what steps should be taken by the operator to prevent or lessen the risk of a repetition of the incident of 25 September and a further disruption of gas supplies from Longford. The Commission was also specifically directed to make any recommendations including ‘any legislative or administrative changes that are necessary or desirable’.

Unions, business and the Opposition regarded the TOR as being too narrow (The Age 14 Oct. 1998:1), as it ‘failed to examine the role of Government and the need to review the structure of the gas industry’. The Victorian Trades Hall Council (VTHC) applied unsuccessfully to broaden the TOR (RLRC 1999: 14.2-4).

The extent of the Commission’s work is illustrated by the fact that 13 parties were granted leave to appear before the Commission; 63 witnesses appeared; 590 exhibits were produced; 175,000 pages of documents were tendered and the 53 sitting days resulted in 6,569 pages of transcripts (RLRC 1999:245-249). The Commissioners handed their 287-page report to the Governor of Victoria on 28 June 1999, nine months after the Longford Explosion (RLRC 1999:1).

3.3 The Longford Royal Commission Report, its Findings and Recommendations

In this section, the Report of the Longford Royal Commission (RLRC) will be summarised, describing the incident and Esso’s SMS – hence focusing on questions 1 and 2 of the Commission’s TOR.

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62 It is noted that BHP (Broken Hill Proprietary Company Limited, now BHP Billiton) is included in the Terms of Reference because the Longford plant was part of a joint enterprise owned by Esso and a subsidiary of BHP. However, the facility was controlled and operated entirely by Esso Australia (RLRC 1999:1.2).
The Longford Incident and its Causes

The Esso Longford facility consists of three gas plants (GP) known as GP1, GP2 and GP3, built in 1969, 1976 and 1983 respectively, and a crude stabilisation plant (CSP) built in 1970. They process gas and crude oil from off-shore platforms into natural gas, LPG and stabilised crude oil, which are exported via pipeline (Exxonmobil 2011). The Longford facility was the sole supplier of natural gas to the state of Victoria (Kletz 2003:54).

A process up-set during normal operation occurred on 25 September 1998, leading to the tripping of a lean oil circulation pump in GP1 (Kletz 2003:54). The pump was not restarted for some hours, resulting in a lack of heating medium to several vessels (Kletz 2001:268). These vessels still received a cold fluid and with no heat exchange occurring, the vessels dropped in temperature to an estimated -48°C, causing embrittlement of the vessel’s steel shell (RLRC 1999:3.49). The pump was eventually re-started and the introduction of hot lean oil resulted in brittle fracture of the vessel, causing the vessel to rupture, creating a hole greater than 1m diameter with a pressure of 2800 kPa behind it (RLRC 1999:5.61 and 7.2). An estimated 10 tonnes of hydrocarbon vapour was released from the vessel, travelling approximately 170 m to the fired heaters where it ignited, causing an explosion and fire (RLRC 1999:7.3-5). An estimated further 10-15 tonnes of hydrocarbons were consumed in the explosion and fire (RLRC 1999:7.6). Two workers were killed and eight were injured. Gas continued to flow and fuel fires for 53 hours because of the inter-connectedness of the three gas plants and the absence of isolation valves (RLRC 1999:8.3). The Royal Commission found that the efforts of personnel to fight the fire were heroic (RLRC 1999:8.47).

Due to the location of the failed vessel in GP1, the layout of the plant, and the lack of isolation valves, the three gas plants at Longford were shutdown (even though only GP1 had sustained damage) (RLRC 1999:1.9). Gas supplies to Victoria were stopped (RLRC 1999:1.9). A Periodic Risk Assessment (PRA) in 1994 had noted the absence of an effective Emergency Shut Down (ESD) system to isolate various parts of the plant, but no remedial action was taken (RLRC 1999:8.50). Gas supplies were re-instated in a staged process with full gas supply occurring on 14 October 1998, some 20 days after the incident (RLRC 1999:1.9).

63 The process up-set resulted in a change in composition which would have also contributed to the reduced temperatures (RLRC 1999:5.48-49).
The tripping of the lean oil pump, the chilling of the equipment to -48°C and the rupture of the vessel due to the re-introduction of hot lean oil were termed the ‘immediate causes’ of the major incident by the Royal Commission (RLRC 1999:15.2). The Royal Commission identified the ‘real causes’ of the disaster as being the failure of operators and supervisors to identify the potentially dangerous consequences of the pump failure and its effect on the integrity of downstream vessels (RLRC 1999:15.6). These vessels could have been isolated, by closing valves, to prevent the entry of cold liquids (RLRC 1999:15.6). This damning conclusion indicated a lack of training and operating procedures.

*Those who were operating GP1 on 25 September 1998 did not have knowledge of the dangers associated with the loss of lean oil flow and did not take the steps necessary to avert those dangers. Nor did those charged with the supervision of the operations have the necessary knowledge and the steps taken by them were inappropriate. The lack of knowledge on the part of both operators and supervisors was directly attributable to a deficiency in their initial or subsequent training. Not only was their training inadequate, but there were no current operating procedures to guide them in dealing with the problem which they encountered on 25 September 1998. (RLRC 1999:15.6)*

To gain a greater understanding of the ‘real causes’ of the major incident, the Royal Commission then examined Esso’s SMS.

**Esso’s Safety Management System – Theory and Practice**

Following the infamous *Exxon Valdez* tanker oil spill off the coast of Alaska in 1989, and other global incidents involving other companies, Exxon International ‘developed a framework for the safe and environmentally sound operation of its various undertakings’ (RLRC 1999:13.1). The over-riding document was termed the Operations Integrity Management Framework (OIMF) which included a series of Exxon Company International (ECI) expectations and guidelines. From OIMF and the ECI guidelines, Esso developed its SMS, known as OIMS (Operations Integrity Management System) (RLRC 1999:13.3). Eleven elements were contained in the ECI Upstream Guidelines and all elements were expected to be met in all Exxon affiliated operations world-wide, including Esso (RLRC 1999:13.1). Esso thus had voluntarily introduced an SMS at Longford and this system theoretically was in operation at the time of the major incident.
The 11 elements of the OIMS were:

Element 1 - Management leadership, commitment and accountability;
Element 2 - Risk assessment and management;
Element 3 - Facilities design and construction;
Element 4 - Information/documentation;
Element 5 - Personnel and training;
Element 6 - Operations and maintenance;
Element 7 - Management of change;
Element 8 - Third party services;
Element 9 - Incident investigation and analysis;
Element 10 - Community awareness and emergency preparedness, and
Element 11 - Operations integrity assessment and improvement

(RLRC 1999:13.2).

The OIMS Systems Manual contained the scope, objectives, system ‘owners’\(^{64}\), manuals, charts and other ‘controlled’ documents addressing each of these 11 elements (RLRC 1999:13.3).

Evidence was given at the Commission that OIMS was a ‘world class’ SMS, complying with ‘world’s best practice’ (RLRC 1999:13.38). But like the major incidents presented in Chapter 2, were there multiple failings in Esso’s SMS which caused the incident of 25 September 1998? The Commission’s report is damning upon the actual implementation and operation of Esso’s SMS at Longford in the years leading up to the explosion on 25 September 1998, in stark contrast to its theoretical adherence to world’s-best management practices as described in its OIMF and other documents. The expectations and guidelines for OIMS were ‘world class’ however ‘the same cannot be said of the operation of the system in practice. Even the best management system is defective if it is not effectively implemented. The system must be capable of being understood by those expected to implement it.’ (RLRC 1999:13.38)

The Commission’s concerns are illustrated in the following paragraph:

The ECI Upstream Guidelines required the development and maintenance of procedures to ensure the safe operation of the facility, to ensure that procedures were accessible to all personnel required to use them, to ensure that deficiencies were identified and improvements made, to deal with the

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\(^{64}\) The person responsible and accountable to ensure that each system was working and achieving its objectives in an efficient manner.

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safety of critical equipment, with the temporary defeat of critical equipment
and with the transmission of information between shifts. These
expectations .....were reflected in the OIMS Systems Manual. However, in
many respects, there were shortcomings in the way in which Esso
implemented its OIMS system at Longford and thus, in the way in which it
implemented the ECI Upstream Guidelines. (RLRC 1999:13.5)

The Royal Commission detailed a number of OIMS deficiencies. Esso mandated a
structured approach to risk assessment and risk management and a HAZOP study was a
basic feature of this approach (RLRC 1999:13.44-47). A HAZOP was scheduled for GP1
in 1995, but it never occurred (RLRC 1999:13.53-54).

The Commission was critical of the deficient level of operator training, operating
procedures and inadequate supervision of operators, resulting in their failure to observe
basic operating practices ‘including monitoring plant conditions, responding appropriately
to alarms, reporting process upsets to supervisors and undertaking appropriate checks
before making adjustments to process variables’ (RLRC 1999:13.32). The Self
Assessments mandated by the OIMS Systems Manual were also found to be deficient by

Two previous incidents at Longford, a hydrate incident in June 1998 and a cold
temperature incident on 28 August 1998, were considered by the Commission. The
Commission concluded that the cold temperature incident ‘should have given warning of
the consequences of operating the plant without lean oil circulation’ (RLRC 1999:12.1).

The Commission also concluded operators were transferring condensate to GP2 ‘without
a full understanding of the potential hazards associated with the process’ (RLRC
1999:13.75) due to poor management of change. Further examples of failure to manage
change were identified (RLRC 1999:13.65-86), including the relocation of plant engineers
from Longford to Melbourne, resulting in the absence of experienced engineers at
Longford on the day of the explosion65.

The Commission found Control Room Logs and Shift Handover procedures and records
were ‘confusing and incomplete’ (RLRC 1999:13.97). An elaborate system of audible
and visual alarms activated when processes operated outside of set parameters (RLRC
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65 All Longford plant engineers were moved from Longford to Esso’s Head Office in Melbourne in
It was common for multiple alarms to be operating in the GP1 control room at any time, resulting in operators having a very high degree of tolerance to these alarms (RLRC 1999:13.115 & 13.120).

The Commission was critical of the lack of monitoring of operating systems (RLRC 1999:13.128). The transfer of engineers to Melbourne in 1992 resulted in limited opportunities for surveillance of plant activities and interaction between engineers, supervisors and operators (RLRC 1999:13.133).

Regarding the structure of the OIMS, the commission reported:

- It was repetitive, circular, and contained unnecessary cross referencing.
- Much of its language was impenetrable. These characteristics made the system difficult to comprehend both by management and by operations personnel. (RLRC 1999:13.39)

The Commission also found that:

- There was a tendency for the administration of OIMS to take on a life of its own, divorced from operations in the field [where]...concentration upon the development and maintenance of the system diverted attention from what was actually happening in the practical functioning of the plants at Longford. (RLRC 1999:13.40)

The Commission found that OIMS elements were either defective or not implemented and ‘reliance placed by Esso on its OIMS for the safe operation of the plant was misplaced. The accident on 25 September 1998 demonstrated in itself, that important components of Esso’s system of management were either defective or not implemented’ (RLRC 1999:13.42).

Table 3.1 summarises the SMS deficiencies at Longford gas plant identified by the Royal Commission.
Table 3.1: Possible SMS Deficiencies Identified in the Longford Incident

<table>
<thead>
<tr>
<th>Deficiency identified</th>
<th>Policy</th>
<th>Planning</th>
<th>SMS Framework (from Figure 2.1)</th>
<th>Measurement and Evaluation</th>
<th>Management Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>OIMS not fully implemented</td>
<td></td>
<td></td>
<td>Complete implementation not achieved.</td>
<td>Audits did not challenge level of implementation.</td>
<td>Management not actively monitoring or requiring increased level of implementation.</td>
</tr>
<tr>
<td>Deficient level of operator training and knowledge</td>
<td>Resources not allocated for operator training.</td>
<td>Key information regarding hazards associated with the loss of lean oil flow not provided in training or available to operators.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate written operating procedures</td>
<td>Impact on operators from change in supervisor responsibilities not analysed.</td>
<td>Operating procedures did not include hazards of loss of lean oil flow and what actions to take.</td>
<td>Operating procedures not audited for currency or breadth of coverage.</td>
<td>Impact of change in supervision levels not reviewed.</td>
<td></td>
</tr>
<tr>
<td>Inadequate level of supervision</td>
<td>Limited resources allocated for supervision.</td>
<td>Adherence to operating practices not evaluated.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIMS too complex</td>
<td>Complexity of OIMS made it difficult to understand and implement.</td>
<td>Audits did not identify complexity as a problem.</td>
<td>Management did not challenge OIMS’s level of complexity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAZOP for GP1 not performed</td>
<td>Resource planning for GP1 HAZOP not performed.</td>
<td>Monitoring of HAZOP completion not performed.</td>
<td>Management did not require HAZOP of GP1 to be conducted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management of change (MOC) procedures unclear</td>
<td>Procedure for risk assessment optional as part of MOC. MOC not applied to organisational changes.</td>
<td>Audits had not identified need for risk assessment procedure as part of MOC.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor handover practices</td>
<td>Control room logs not kept in accordance with requirements.</td>
<td>Evaluation of logs against requirements not performed.</td>
<td>Logs not reviewed by management.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarms tolerated</td>
<td>Alarms commonly tolerated and overridden by operators.</td>
<td>Alarm frequency and response not monitored or reviewed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No system for monitoring operating conditions</td>
<td>Resources not allocated for analysing plant records.</td>
<td>Plant records not systematically analysed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incident reporting focused on personal injury</td>
<td>Process upsets were not reported as incidents unless injury or property damage resulted.</td>
<td></td>
<td>Management did not require broad definition of incident (as per OIMS) to be applied.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A review of Table 3.1 indicates all of the SMS deficiencies at Longford were in implementation, with many deficiencies in measurement and evaluation and/or management review.

_The fundamental shortcoming was in the implementation of OIMS._ (RLRC 1999:13.41)

_The methodology employed by the [external audit] assessment team was flawed in that the team failed to identify significant deficiencies in the extent to which “individual EAL Management Systems” conformed to the guidelines, particularly in relation to GP1, and were implemented._ (RLRC 1999:13.37)

These SMS deficiencies were not unique to Esso – they were also identified as contributors to previous major incidents discussed in Chapter 2.

The importance of considering both the mechanical elements and the human dimensions of an SMS, discussed in Chapter 2, are highlighted throughout the Royal Commission’s Report. The sophisticated process control devices, with alarm systems, were rendered ineffective, due to systemic failure by Esso over some years to manage its systems efficiently and effectively. ‘There was no evidence that any system existed at Longford for the regular monitoring of operating conditions or operator practices’ (RLRC 1999:13.88). This situation was particularly serious in human terms due to an ongoing failure to manage, supervise and train plant supervisors and operators, resulting in ignorance of the potential dangers of operating the plant outside its parameters (RLRC 1999:13.18).

This information clearly supports what should be a very basic concept, discussed in Chapter 8 of this study, that the effectiveness of any SMS, no matter how sophisticated, is only as good as the capability of management, the training and skills of those who actually operate the system, and how well the organisation ‘lives’ its system (Flemming & Lardner 2002:2).

The Longford Royal Commission made its findings against its TOR (Appendix E). The findings regarding question 2 of the TOR focus on the SMS and will now be summarised.

The Commission found that while some aspects of the GP1 design were deficient and inappropriate, the design did not cause or contribute to the incident (RLRC 1999:15.7). Esso’s operating standards, practices and policies were heavily criticised for the lack of a HAZOP study on GP1 (RLRC 1999:15.7). The failure to conduct a HAZOP on GP1 was
‘a contributing factor to this incident’ (RLRC 1999:13.56). Like many other major incidents, Esso had failed to identify and understand potential hazards.

The Commission found that the level of training and supervision of operators demonstrated significant failure by Esso management and ‘the lack of proper operating procedures contributed, therefore, to the occurrence’ (RLRC 1999:15.7).

The Commission was inconclusive regarding ‘whether the departure from proper maintenance standards, practices or policies with respect to these matters caused or contributed to the explosion, fire or failure of gas supply’ (RLRC 1999:15.7). The Commission found that while Esso’s asset management practices and policies, including the failure to conduct the HAZOP on GP1, transfer of engineers to Melbourne and reduction in supervision, may have contributed to the occurrence, it was ‘not possible to establish any more direct causal link’ (RLRC 1999:15.7).

When considering risk management procedures and emergency procedures, the Commission was again critical of the lack of a HAZOP study on GP1 (RLRC 1999:15.7). The Commission found that while there were some deficiencies in the emergency response procedures, they were ‘in all the circumstances, appropriate and effective’ (RLRC 1999:15.7).

The Commission found that the Hydrate Incident in June 1998 and the Cold Temperature Incident on 28 August 1998 were not a cause of the 25 September occurrence, nor did they contribute to it. However the Commission stated:

*The failure to report this [cold temperature] incident thus stands as another example of a failure in Esso’s implementation of its management systems (RLRC 1998:13.148)....Had the incident been reported and appropriate action taken after the report, the events of 25 September 1998 could have been averted (RLRC 1999:15.7).*

As identified in Chapter 2, the failure to report and learn from previous incidents is not isolated to Esso and is a latent failure present in other major incidents (CSB 2007:103, Hopkins 2008:4, Visscher 2008:42 and Hopkins 2011:12).

The Commission’s findings for question 2 of the TOR clearly show failure of Esso’s SMS. Like other major incidents, Esso’s SMS failed in multiple ways with catastrophic effect, in both human and economic terms. The Royal Commission was to determine if legislation had been breached and to make recommendations regarding any legislative or
administrative changes, as well as recommendations which might prevent any repetition of this event.

**Preventing Event Repetition**

With regard to question 3 of the TOR (Appendix E) which asked what steps should be taken by Esso to prevent or lessen (a) a repetition of the incident; or (b) further disruption of gas supply, the Commission noted that Esso had changed its processes since the accident and no longer used the earlier process, hence a repeat of the incident could not occur (RLRC 1998:15.9). However the Commission reported that if Esso ever re-introduced the process it should do so only after the most rigorous safeguards in the design of equipment and risk assessment procedures (RLRC 1999:15.9). Esso has since re-introduced Lean Oil Absorption in GP1 with additional control measures in place, including a higher standard of materials of construction in some equipment items (VWA 2002b:1). The Commission also stated that all ESD systems should be reviewed against ‘good engineering practice’ to ensure the four plants (GP1, 2 & 3 and CSP) can be effectively isolated (RLRC 1999:15.9). The Commission’s final significant step for Esso to take, was to obtain approval of a Safety Case (RLRC 1999:15.11). Thus the beginning of legislative reform for all MHFs in Victoria was heralded.

**Findings on Breaches of Legislation and the need for MHF Reform**

As required by its TOR (Appendix E) the Royal Commission investigated ‘whether there was any breach of, or non-compliance with, the requirements of any relevant statute or regulation by Esso or BHP’. The Commission referred to Section 21 of the *Occupational Health & Safety Act 1985* (Vic) which states:

> (1)“An employer shall provide and maintain so far as is practicable for employees a working environment that is safe and without risks to health”.

Section 21(2) sets out some particular circumstances where an employer would fail to maintain a safe working environment for employees. The Commission found that Esso was in breach of Section 21(1) of the Act in the following terms:

> The conditions prevailing in GP1 on 25 September 1998 clearly did not constitute a working environment that was safe and without risks to health. The relevant plant and system of work was not safe and without risks to health. The arrangements for the handling of hydrocarbons in GP1 on 25 September did not ensure safety and the absence of risks. The workplace in GP1 on that day was not in a condition that was safe and without risks to

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66 The *Occupational Health and Safety Act 1985*, current at the time of the Longford incident, was replaced with the *Occupational Health and Safety Act 2004*, which came into effect on 1 July 2005 (s3).
health. And Esso had not on that day provided such information, instruction, training and supervision to its employees as was necessary to enable them to perform their work in a manner that was safe and without risks to health. (RLRC 1999:14.11)

The Commission also found that it was ‘practicable’ for Esso to have provided the conditions necessary for a safe working environment in terms of the Act (RLRC 1999:14.12). In short, Esso had failed in its statutory duties:

The causes of the accident on 25 September 1998 amounted to a failure to provide and maintain so far as was practicable a working environment that was safe and without risks to health. This constituted a breach or breaches of s.21 of the Occupational Health & Safety Act 1985 (Vic). (RLRC 1999:15.7)

The Commission identified the existence of a Safety Case (introduced in Chapter 2) as being a significant feature of a model for the safe operation of an MHF (RLRC 1999:14.30). It noted the emergence of the Safety Case model in the UK following the inquiry into Flixborough (1974), in continental Europe following Seveso (1976) and Piper Alpha in the North Sea (1988) (RLRC 1999:14.30), as was discussed in Chapter 2.

In 1996 the Australian National Occupational Health & Safety Commission (NOHSC) published the National Standard for the Control of Major Hazard Facilities and the National Code of Practice for the Control of Major Hazard Facilities (RLRC 1999:14.27) (see Appendix D for more information). The Royal Commission noted that ‘the code of practice is a document prepared for the purpose of advising employers and workers of acceptable ways of achieving the national standard’ (RLRC 1999:14.27). Both the national standard and code were prepared with the intention (on the part of NOHSC and the Commonwealth Government) that they would be given legislative force by each of the States and Territories67 (RLRC 1999:14.27). The standard itself has no legislative force and creates a framework for those managing MHFs (RLRC 1999:14.28). In September 1998 the standard was not supported by legislation in Victoria (RLRC 1999:14.28), despite the 1991 Coode Island fire, and Esso had not voluntarily implemented it at its Longford facility (RLRC 1999:14.30). The DNV/Aon Consultancy Report to the VWA (and submitted to the Royal Commission) strongly supported the National Standard as the basis for the development of (at the time) proposed MHF regulations in Victoria (RLRC 1999:14.37).

67 The states and territories exercise jurisdiction relating to OHS.
The Commission also noted that the *Petroleum (Submerged Lands) Act* 1967 (Cwth) which regulates the operation of off-shore oil and gas facilities, mandates a Safety Case (RLRC 1999:14.31). Esso’s facilities in Bass Strait were subject to this regulation (RLRC 1999:14.33). Similarly the Gas Safety Act 1997 (Vic) and its regulations mandated the preparation of a Safety Case68 (Gas Safety Act 1997:s1). This applied to the pipelines transporting hydrocarbons to and from the Longford gas plant, however the Safety Case provision did not take effect until 1 February 199969 (Victorian Government Gazette 1999:80).

No Safety Case legislation applied to the Longford gas plant, despite the fact that it applied to operations both upstream and downstream (RLRC 1999:14.33). Understandably, the Commission reached the conclusion that the operating conditions for the Longford plant were less stringent than those applicable to associated upstream and downstream operations and observed:

> Had Esso been required to submit a safety case with respect to its facilities at Longford before 25 September 1998, it is likely that it would have identified the very hazards which were in evidence on that day, hazards which a proper HAZOP study of GP1 would also have identified. (RLRC 1999:14.33)

Hence the Commission stated that Esso should be required to prepare a Safety Case or Report for approval - a finding under question 3 of the TOR (RLRC 1999:15.11). The Commission then used the ‘Recommendations’ section of its Report (RLRC 1999:15.13 – 15.27) to provide more detail regarding what a Safety Case should contain, with reference to the failings detected in the Longford major incident.

The Commission found that the reliance by Esso on its OIMS for the safe operation of the Longford facility was misplaced (RLRC 1999:15.14). It therefore recommended that ‘external obligations of a detailed and comprehensive kind (albeit identified by Esso itself) should be imposed upon Esso in order to avoid the repetition of an accident’ (RLRC 1999:15.14). These obligations would include an evaluation of the design of critical plant and the integrity of metals and development of an isolation philosophy; periodic review of operating standards, practices and policies and that each procedure include ‘an explanation of the potential hazards associated with the procedure’ (RLRC 1999:15.16).

68 Section 37 of the Gas Safety Act 1997 (Vic).
69 Legislation was enacted on 16 December 1997.
Training of employees was vital and Esso must ‘demonstrate that its training programs and techniques impart knowledge of all identifiable hazards and the procedures required to deal with them’ (RLRC 1999:15.17). Written procedures must be available to operators to enable them to respond to any deviation from normal operating conditions and a comprehensive incident reporting system (including significant process upsets) must be instituted (RLRC 1999:15.17). Plant operations must be monitored at all times at an appropriate management level with sufficient engineering, operating and maintenance skills available at all times (RLRC 1999:15.18). With reference to the SMS framework presented in Figure 2.1 of this study, all of the Commission’s recommendations are centred on the SMS.

The Commission’s recommendations provide further detail on how the content of a Safety Case should require the identification of all hazards, a systematic risk assessment and control measures to minimise the likelihood of an incident (RLRC 1999:15.20). Further content included a description of the design and layout of equipment including protective devices and inspection, maintenance and testing programs, monitoring, auditing and review of the implementation of safety policies, procedures and performance standards, as well as identification of all standards applied to design, construction, installation and operation of the facility (RLRC 1999:15.20-21). The Safety Case would also contain a fire risk analysis and emergency response plan, as well as procedures for emergency shutdown or isolation of pipeline connections (RLRC 1999:15.23). Reporting of significant accidents and incidents would be required (RLRC 1999:15.23). The Safety Case should also require a specified officer to be responsible for the safe operation of the facility and employees should be competent with the necessary skills, training and ability to undertake allocated tasks in a range of operating conditions (RLRC 1999:15.22). All these recommendations are reflected in the resulting Victorian MHF Regulations.

The Commission stated that all of its recommendations could be encompassed within the Safety Case for an MHF (RLRC 1999:15.19). Acceptance of the Safety Case by the relevant authority would be a prerequisite for the operation of the facility and failure to comply with its provisions would be an offence (RLRC 1999:15.19). This is a key recommendation, which this chapter will later show, led to the mandatory licensing of Victorian MHFs.

In recommending a mandatory Safety Case as a prerequisite for the operation of the Longford facility the Commission went further and recommended that:
...it would be inappropriate to confine the safety case procedure to a single onshore major hazard facility. A government authority would be required to administer such a procedure and its powers should extend to all major hazard facilities within the State. (RLRC 1999:15.25)

The Commission therefore recommended that legislation should be introduced to mandate the preparation of a Safety Case for every MHF in Victoria (RLRC 1999:15.26) and through its recommendations provided significant detail of the legislation's content.

It also recommended the creation of a specialised government agency to administer this regime and noted that this agency should be 'sufficiently independent of the VWA to avoid any conflict of interest' (RLRC 1999:15.26). This recommendation was to be the subject of serious debate amongst stakeholders following the publication of the report.

Thus the Royal Commission in June 1999 set the scene for the introduction of legislation in Victoria to mandate a Safety Case regime for all MHFs in Victoria, with specific recommendations focused on increasing the effectiveness of the SMS. How was the Commission’s Report received by the different stakeholders? Were the recommendations welcomed or rejected?

### 3.4 Responses to the Longford Royal Commission Report

It might reasonably be expected that the Royal Commission’s Report would attract significant media and stakeholder attention. Publication of the report on Monday, 28 June 1999, certainly fulfilled these expectations. The clear apportionment of blame to Esso and the recommendations intended to prevent a repetition of this major incident allowed little doubt as to the required action. The following day, both Melbourne newspapers, *The Age* and the *Herald Sun*, published front-page reports and editorials, and followed up with significant coverage of the political, economic, legal and human aspects of the explosion and its aftermath for five days following publication of the report.

Esso spokespersons refused to make any detailed comment (*The Age* 29 June 1999:1 and the *Herald Sun* 29 June 1999:1) and Esso’s Chief Executive Officer (CEO) refused to apologise for blaming workers for the explosion (*Herald Sun* 29 June 1999:1). During the Commission’s proceedings Esso had strenuously denied any fault, despite overwhelming evidence to the contrary, and sought to attribute blame to the plant operators working on the day of the disaster. Surviving employees were subject to intensive hostile cross-examination by Esso’s counsel. Despite this defence, and denial
of responsibility by Esso, the Commission specifically absolved all employees of any blame, and indeed praised them for their ‘heroic actions’ on the day.

During the following days Esso’s corporate behaviour became a significant issue, described as ‘a complete failure of corporate ethics’ (Leigh Hubbard, secretary of the VTHC, The Age 3 July 1999:7).

“Esso will seek a more senior staff member to blame … now that a royal commission has cleared the plant operator it previously blamed. The Esso Corporate culture is cannibalism and they are going to eat someone”. (Bill Shorten, secretary of the Australian Workers’ Union (AWU), The Age, 29 June 1999:8)

Esso’s failure to comment or apologise was indicative of its parent company’s world-wide corporate culture of non-cooperation and arrogance in dealing with investigations and legal actions (Elias 3 July 1999:7 and Hale 3 July 1999:7). Longford’s remoteness to Exxon’s headquarters was also noted, ‘The public image of Esso Australia, but a drop in Exxon’s global bucket, would scarcely be a cause for concern in Dallas’ (Lamperd 30 June 1999:12).

Esso’s conduct pre- and post- the incident was the focus of numerous media reports and opinion pieces (The Age 29 June 1999:1 and Herald Sun 29 June 1999:1). Editorials demanded Esso ‘accept most of the blame and the Government must act to guard against disasters’ (The Age 29 June 1999:14). There were calls for the State Government to ‘act quickly to implement a statutory regime of safety measures outlined in the [Commission] report in relation not just to Esso’s operations at Longford, but to all hazardous facilities throughout the state’ (The Age 29 June 1999:14).

The lead reports (summarised in Appendix F) address three major themes: Esso’s blame for the incident and its subsequent corporate behaviour following the publication of the report; political comments and pressures on the Government; and impending criminal and civil legal actions, in addition to a coronial inquest into the deaths of the two employees.

The net effect of this media was to re-enforce the political and economic pressures created by the Longford explosion on 25 September 1998, and place immediate pressure for action on the State Government to redress the major deficiencies identified in the management of Longford, and by extension to all MHF's.
The government’s response evolved as the Commission’s Report was digested. The initial response by the State Government to the report and recommendations was very positive. The Premier, Mr Jeff Kennett, whose Government had established the Royal Commission, said “We are happy with this report, we feel it is a good report”. Mr Kennett said the Government was likely to pass laws tightening safety procedures and establish a new industrial watchdog. “I clearly indicate that we will take on board and give a great deal of consideration to the recommendations” (Herald Sun 29 June 1999:10). Press editorials and unions strongly supported the Commission’s recommendations for a legislated Safety Case Regime, enforced by a statutory regulator independent of WorkCover. Mr Leigh Hubbard, secretary of the VTHC, said:

“We welcome the commission’s findings, particularly those which call for a tighter regulatory regime and the creation of any authority to regulate hazardous work sites. The findings show that companies cannot be left to regulate themselves”. (Herald Sun 29 June 1999:12)

Mr Bill Shorten, secretary of the AWU, the union that represented most workers at Longford, said “The commission report was a blow to the culture of corporate self-regulation for safety”. The Leader of the Opposition also claimed that self-regulation had failed (The Age 29 June 1999:9).

VWA was criticised for failing to identify and manage ‘real workplace risk’ (The Age 1 July 1999:18). Although the Royal Commission Report cleared the Government of any direct responsibility for the Longford disaster, it did note that closer regulation may have alerted stakeholders to the potential for a major incident. Hannan (The Age 30 June 1999:8) commented:

But while Sir Daryl sheets home responsibility for the Longford tragedy to Esso, his report raises important questions about the role of the Victorian WorkCover Authority and, by extension, the State Government, in the events leading up to the explosion.

It suggests that a more proactive approach by the Government in requiring Esso to comply with workplace safety regulations might have helped prevent the Longford explosion....One can only wonder what the royal commission would have found if the Government had been game enough to allow the terms of reference to specifically examine its role and the actions of WorkCover. (Hannan, 30 June 1999:8)

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Similarly to Esso, operators of MHFs made no press comments after the publication of the Commission’s report. The only employer comment published in the Melbourne press was a bland statement by the Victorian Employers’ Chamber of Commerce & Industry that said ‘the findings should prompt businesses to monitor their safety procedures’ (The Age 29 June 1999:9).

VWA’s position as both accident compensation provider and regulator of workplace health and safety was noted. The Royal Commission report stated that:

*It has been suggested that there is a conflict between the role of the VWA with respect to accident compensation and its role as the supervisor of workplace safety regimes. The Commission is in no position to reach a conclusion whether such a conflict exists, but it’s clear that if there is to be a MHU within the VWA, it should be given the independence necessary to ensure that any conflict is eliminated.* (RLRC 1999:14.41)

The State Opposition seized an opportunity to make some political capital in relation to the role of government and a possible conflict in the role of VWA, as both the insurer against workplace injury or illness and the regulator of workplace safety. Mr Bracks, Leader of the Opposition, said “WorkCover’s [VWA] roles as an inspector and insurer conflicted and should be separate, in line with the report’s recommendations” (The Age 29 June 1999:9). This view was supported by workplace safety expert, Dr Andrew Hopkins, a senior lecturer at the Australian National University, who gave evidence to the Commission (The Age 29 June 1999:9) and Ms Karen Batt, state secretary of the Community & Public Sector Union (CPSU) (Herald Sun 29 June 1999:11).

‘The WorkCover Authority and the State Government appear to be at odds over the findings of the royal commission’ (McKay and Button, The Age, 3 July 1999). Mr Kennett had supported a new authority independent of VWA. An internal memo from Mr Andrew Lindberg, CEO of VWA71, was leaked to the State Opposition, claiming ‘as expected there were no adverse findings against WorkCover’ and that there was ‘no potential’ for a conflict of interest between WorkCover’s dual roles. Mr Bracks demanded that Mr Lindberg be dismissed.

*“The fact that the head of WorkCover has so arrogantly and quickly dismissed this key recommendation for an independent major hazards unit*

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71 VWA was often referred to as ‘WorkCover’.
Mr Leigh Hubbard, secretary of the VTHC, supported the involvement of VWA; ‘while the new independent watchdog needed its own leadership, powers and inspection staff, it should still be linked to WorkCover so that it could use the authority to perform prosecutions and administration functions’ (The Age, 3 July 1999:7). It will be seen later in this chapter that the regulation of MHFs was to remain within VWA, rather than an independent authority.

Longford’s Legacy

The Longford Royal Commission identified failings in Esso’s SMS and recommended the introduction of a Safety Case regime in Victoria. Major incidents in other parts of the world had not previously resulted in regulation of Victorian MHFs, so prior to the Longford incident, the VWA did not have any specific focus on major incidents (O’Meara 2001:51). The VWA administered a regulatory regime which did not differentiate between a complex petrochemical plant and the local dry-cleaners, with inspectors who did not have the skill-set to identify hazards in complex facilities (Hopkins 2000:93).

Did the Victorian Government respond to this local major incident, by introducing legislation, as happened elsewhere? Did the findings and recommendations of the Longford Royal Commission have a significant influence on public policy formulation regarding MHFs in Victoria? The remainder of this chapter will identify and describe the major Government policy, legislative responses and implementation by the VWA which occurred in Victoria in the immediate aftermath of the Longford major incident. This discussion will answer subsidiary research questions regarding the process by which Victorian MHF legislation was developed and its distinguishing features.

Victorian WorkCover Authority Actions Following the Longford Incident

Any changes to the regulation of health and safety resulting from the incident would impact the VWA72. The VWA was thus galvanised into action following the Longford

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72 At the time of writing, the VWA had two distinct functions in its activities, with separate divisions to administer these. WorkSafe Victoria (WSV) is concerned with provision of OHS in all work places and in the wider community, and the prosecution of offenders. WorkCover is concerned with the compensation for employees (and their dependants) who are killed or injured as a result of occupational injury or disease. WorkCover administers a compulsory insurance scheme, contracted to approved insurers, and financed by employers for the payment of claims by employees or dependants. While the two distinct functions of the VWA existed at the time of the Longford disaster, there was then no differentiation in name, hence many references to VWA
major incident and immediately took several initiatives concurrent with, but independent from, the hearings of the Royal Commission. These actions included:

- the establishment of a Major Hazards Unit (MHU) within the VWA, announced in February 1999 to create, a multi-disciplinary group of experienced professionals in the fields of chemical engineering, risk management, auditing and technical safety, human factors and emergency planning (VWA 1999a:6 and VWA 1999:7);
- the appointment of external consultants, Det Norske Veritas (DNV) and Aon Pacific Risk Consultants, to advise on the future supervision of MHFs (VWA 1999:6 and DNV/Aon 1999:1.1);
- preparation of a submission to the Royal Commission regarding future supervision of MHFs; and
- proposals to Government to introduce new regulations concerning MHFs (VWA 1999:1).

MHU personnel were to establish VWA’s credibility with industry and other key stakeholders and professionally challenge safety cases (DNV/Aon 1999:4.3); a requisite feature of a good safety case regime (Hopkins & Wilkinson 2005:6), in contrast to the pre-Longford situation where VWA ‘inspectors were simply “out-gunned” by company experts’ (Hopkins 2000:93).

The consultant’s review of international practices concluded that ‘Seveso II’ legislation represented the current ‘state-of-the-art’ in major hazards control, with the UK’s HSE providing the most extensive guidance (for COMAH) (DNV/Aon 1999:7.1). The European approach was considered more effective than the US, because it requires clear demonstration of adequate control (DNV/Aon 1999:7.1). The existing National Standard for the Control of Major Hazard Facilities offered a good foundation, but should be updated to reflect the latest international thinking (DNV/Aon 1999:7.1). The consultants recommended scoping audits commence immediately, followed by more detailed ‘Baseline Audits’ at Victorian facilities likely to be MHFs with the aim of bringing these sites up to Safety Case standards within a reasonable time period (DNV/Aon 1999:7.2).

The Victorian WorkCover Authority’s ‘Submission on the Future of Control of Major Hazard Facilities in Victoria for the Longford Royal Commission’ (VWA 1999) noted that the Dangerous Goods (Storage and Handling) Regulations 1989 (Vic) had been following Longford refer to ‘VWA’ or ‘WorkCover’. The branding of ‘WorkSafe Victoria’ occurred sometime after the Longford incident and was not as a result of the incident.
amended in 1997 to allow MHF operators exemption from certain prescriptive regulatory requirements if they could demonstrate compliance with the National Standard for the Control of MHFs (National Standard) (VWA 1999:1). However, only one company, Kemcor, had indicated interest in this opportunity (DNV/Aon 1999:1.1). The VWA received expert advice on potential future directions in MHF administration and regulation (VWA 1999:1) and provided the Commission with a copy of the DNV/Aon Report (1999) (RLRC 1999:14.35). The VWA advised the Commission that it had established a dedicated MHU, had commenced scoping audits of more than 30 identified MHFs and had proposed to Government that all MHFs should be compelled to comply with the National Standard for MHFs (VWA 1999:1-3). VWA proposed the establishment of a high level government inter-agency group to develop a regulatory model favouring a Safety Report (case) approach, based on the National Standard and best current international practice (VWA 1999:1 & 4-6). Employer and employee groups, together with the wider community, would be consulted in this process (VWA 1999:1).

Pre-empting the recommendations of the Royal Commission, the VWA advised operators of all known Victorian MHFs on 4 March 1999 that scoping audits would be conducted from 9 March to establish the current situation and provide base-line data for later assessments of all MHFs (VWA 1999:8). On 15 March all MHF operators were briefed on the scope and expectations of the scoping audits and on the proposal to move to a safety case regulatory framework (VWA 1999:8). In April the VWA proposed to the Government that new MHF regulations based on a safety case model be introduced (VWA 1999:1), aligning with the later recommendation of the Commission73 (RLRC 1999:15.26). While the drafting of these proposed regulations proceeded, consultation and briefings with various stakeholders continued (VWA 1999a:43).

MHF reform was to be accomplished in Victoria with new regulations under the existing OHS Act74. Within two months of the Royal Commission Report’s publication, the draft MHF regulations were ready for Cabinet’s consideration (Parliamentary Counsel Victoria 1999).

73 Published in June 1999.
74 The Occupational Health and Safety Act 1985 was replaced with the Occupational Health and Safety Act 2004, which came into effect on 1 July 2005 (s3). The 13 regulations under these OHS Acts, including the MHF Regulations, were consolidated in 2007, referred to as the Occupational Health and Safety Regulations 2007, effective 1 July 2007 (WorkSafe 2007b:1).


3.5 Victoria’s MHF Regulations

In this section the regulatory impact statement and main provisions of the *Occupational Health and Safety (Major Hazard Facilities) Regulations 2000* (MHF Regulations) will be discussed, as well as the regulator’s assessment process. A brief overview will be offered, followed by a more extended discussion of the key regulatory features. Comparisons with foreign exemplars will be highlighted.

**Regulatory Impact Statement**

A Regulatory Impact Statement\(^{75}\) (RIS) was published\(^{76}\) with the draft *Occupational Health and Safety (MHF) Regulations 1999* (Vic) for public scrutiny, setting out the rationale for the legislation. The RIS covered the following matters:

- Introduction and objectives;
- Key policy issues;
- Detailed statement of the provisions of the proposed regulations;
- Cost-benefit analysis, and
- Alternatives to the proposed regulations\(^{77}\).

The objective of the proposed regulations was to ‘promote the safe operation of MHFs’ in Victoria (VWA 1999a:13) by mitigating risks to people and property from handling and processing dangerous goods in MHFs (VWA 1999a:1). A case was made for the introduction of specific mandated regulatory controls using a Safety Case model in all Victorian MHFs (VWA 1999a:8-9). The proposed MHF regulations would recognise current international procedures, the Australian National Standard and the findings of the Longford Royal Commission (VWA 1999a:9). The regulations would not prescribe how risks at MHFs were to be controlled, rather that they ‘set the standard to be achieved’ and the process to be followed with a ‘system of assurance through the Safety Case’ (VWA 1999a:9). The regulations would ‘focus on management systems’ to provide a ‘systematic approach to identifying hazards, assessing and controlling risks’ requiring ‘MHFs to implement a safety management system to ensure that the risks associated with the operation of an MHF are adequately controlled’ (VWA 1999a:9). The central importance of the SMS in the proposed MHF Regulations was evident, aligning with

\(^{75}\) required by the *Subordinate Legislation Act 1994* (Vic).

\(^{76}\) The VWA received a statutory certificate of adequacy of the RIS from an independent consultant as required by Section 10(3) of the *Subordinate Legislation Act 1994* (Vic) on 25 August 1999 (Donovan 1999).

\(^{77}\) as required by the *Subordinate Legislation Act 1994* (Vic):s10(1).
Gunningham & Johnstone’s (1999:310) second category\textsuperscript{78}, encouraging a systems-based approach to safety. This SMS focus is consistent with the findings and recommendations of the Longford Royal Commission (and similar to other major incident investigations presented in Chapter 2) regarding the deficiencies of OIMS and how its lack of effectiveness contributed to the Longford major incident.

The key policy issue discussed in the RIS was mandatory licensing, ‘considered necessary to ensure close monitoring of MHFs’ (VWA 1999a:12). The Longford Royal Commission Report did not specifically recommend ‘mandatory licensing of MHFs’, however it recommended a safety case ‘must be accepted by the relevant authority as a prerequisite to the operation of the facility’ (RLRC 1999:15.19). The RIS proposed that a licence be valid for a maximum period of five years and subject to renewal, with the provision that it could be suspended or cancelled at any time, or granted for a lesser period at the discretion of the VWA (VWA 1999a:12). A major potential disadvantage of the proposed mandatory licensing system was ‘it can be perceived that the regulating agency which issues the licence, assumes legal responsibility for the licensed activity’ (VWA 1999a:12). This was clearly not to be the case with any MHF in Victoria, as ‘the Safety Case approach…recognises that the responsibility for adequate controls must rest very clearly with the organisations which operate MHFs’ (VWA 1999a:12). This then established the framework for ‘a comprehensive meta-regulatory policy outcome\textsuperscript{79}, for the Victorian MHF regime (Haines 2009:39).

The usual justification for a proposed regulation is that the benefits of the regulation will exceed the costs of compliance (VWA 1999a:23). Cost estimates for MHF operators and the regulator are discussed in Appendix G, indicating total compliance costs for MHF operators between $45 million and $71 million discounted over a 10-year period, which if passed on to consumers equates to a yearly cost between $1 and $1.58 for each Victorian (VWA 1999a:27 - 29).

The RIS did not quantify the potential benefits of the proposed regulations in monetary values, but identified six benefits from reductions in:

- the number of fatalities and injuries;
- disruption costs (both to MHFs and the community) and damage to plant and equipment;
- legal and clean up costs;

\textsuperscript{78} Discussed previously in Chapter 2, page 49.
\textsuperscript{79} Discussed previously in Chapter 2, page 49.
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- property damage;
- demand for emergency responses to major incidents, and
- environmental damage (VWA 1999a:28).

The cost-benefit analysis concluded in favour of the regulations:

*Given the significant disruption that can occur to the State, as evidenced by both the Coode Island and Longford explosions, there is little doubt that Victorians would be more than willing to pay between $1 and $1.58 each year to ensure that similar events are less likely in future.* (VWA 1999a:29)

Two possible alternatives\(^{80}\) to the proposed regulations were considered and rejected (VWA 1999a:31-33). The VWA’s view of possible alternative approaches was unequivocal - the imposition of mandatory regulations was the only practicable means of providing for the safe operation of MHFs (VWA 1999a:31-33).

Public comment on the draft regulations was sought, with 64 written submissions received (VWA 2000:1). In summarising the submissions, VWA reported:

*Stakeholders expressed overwhelming support for specific regulatory control of Major Hazard Facilities (MHFs) and the adoption of a Safety Case regime. Concerns raised by submissioners tended to focus on clarifying the intent of the proposed Regulations. There was little dissent over the fundamental regulatory approach.* (VWA 2000:i)

A state election in late 1999 resulted in a change of government and the former Opposition party was given carriage of the new legislation, which became known as the *Occupational Health and Safety (Major Hazard Facilities) Regulations 2000*.

**The Occupational Health and Safety (Major Hazards Facilities) Regulations 2000**

The MHF Regulations made under the authority of the *Occupational Health and Safety Act* 1985 (Vic) and the *Dangerous Goods Act* 1985 (Vic) were approved on 22 June 2000 as Statutory Rule No. 50/2000 (MHF Regulations 2000:1). This was almost a year after the publication of the Longford Royal Commission’s Report - a relatively quick legislative response to a major incident as illustrated by Table 2.9. All provisions other than Regulation 801 (mandatory MHF registration and licensing) came into effect eight days later on 1 July 2000, with Regulation 801 coming into operation on 1 September 2000 (MHF Regulations 2000:r103).

\(^{80}\) A code of practice and other regulatory options.

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The Regulations consist of 10 parts and five schedules (as outlined in Appendix H). They focus MHF operators on reducing the likelihood and consequences of a major incident (MHF Regulations 2000:r101) in a goal-setting environment of reducing risk ‘so far as is practicable’ (MHF Regulations 2000:r304). Duties are placed on MHF operators (Part 3), such as the requirement to have an SMS, conduct hazard identification and safety assessment; however there is no specification of the methodology, leaving the operator to decide on a method best suited to their facility. Findings from these operator duties and other matters are contained in a Safety Case (Part 4), to demonstrate that the SMS is comprehensive and an integrated management system for control measures, as well as demonstrating the adequacy of the control measures adopted (MHF Regulations 2000:r402). This satisfactory demonstration then forms one of four requirements necessary to obtain a licence to operate an MHF (Part 8). Sharing information and knowledge of the risks with personnel, visitors and the community is required by Part 5. Another key provision of the Regulations is the time-based administrative requirements for registering as an MHF (Part 7).

Licensing mechanisms were provided for in the MHF Regulations, such as the mandatory submission of a Safety Case to the Authority (Regulation 401), which then must reach a decision of satisfaction or otherwise to grant a licence (Regulation 803(1)) in a prescribed timeframe (Regulation 803(2)). This decision is reached through assessing the Safety Case. If a positive decision is not reached, the facility has the right to appeal the decision to the Victorian Civil and Administrative Tribunal (VCAT) (Regulation 202), but if the decision is upheld, the facility must cease operation as an MHF (Regulation 801). The MHF Regulations also focus on the SMS as a result of the Longford Royal Commission findings (VWA 1999a:9). These regulations clearly incorporate the recommendations of the Longford Royal Commission (RLRC 1999:15.19 – 23).

**Distinguishing Features of the MHF Regulations**

The distinguishing features of the Victorian MHF Regulations compared with MHF legislation in other jurisdictions (see Appendix I) fall under the following headings:

- licence to operate as an MHF;
- submission of a Safety Case or Safety Report to the Authority;
- assessment by the Authority;
- restrictions on timing of the assessment;
The Longford Gas Plant Explosion and its Regulatory Aftermath

- re-submissions of Safety Cases or Reports if not to the satisfaction of the Authority;
- the ability for the Authority to cease operations at the facility, and
- the requirement to have an SMS.

**MHF Licence to Operate**

To the best of the author’s knowledge, until 31 December 2011, Victoria was the only jurisdiction in the world requiring each MHF to hold a licence to operate. In an attempt to establish uniform OHS legislation across Australia, a federal Work Health Safety Bill was drafted so each Australian state and territory could adopt the Victorian model. By January 2013 all states and territories have enacted the new Work Health Safety Act and subordinate regulations except Western Australia and Victoria. Chapter 9 of the subordinate regulations addresses Major Hazard Facilities and requires MHFs to have a licence to operate.

How is the significant difference of a licence to operate perceived by Victorian MHFs? In 2003, following the first round of MHF licensing in Victoria, VWA commissioned Sweeney Research Pty Ltd to evaluate the effectiveness of the implementation of the MHF Regulations. Seventy percent of respondents thought licensing was the right approach, 20% did not know and 10% stated that licensing was not the right approach. Eighty percent of plant managers agreed with the licensing approach (Sweeney 2003:100). When asked if there was an alternative approach to licensing, more than 40% of respondents stated that there was not a preferable alternative, 40% could not provide an answer, and less than 20% stated there was an alternative. Suggested alternatives were:

- keeping the regulations but removing the licence requirement;
- a more gradual approach of MHF regime introduction, and
- a process tailored to the business size and type (Sweeney 2003:101).

In contrast to the Sweeney Research study, the Plastics and Chemicals Industry Association (PACIA) recommended that other Australian states’ MHF legislation not include a licensing process, as it added ‘significant burden and demand’ on both industry and the regulator for little safety benefit (PACIA 2003:7). It is unclear to what extent this represented the views of MHFs or PACIA member organisations.

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81 The Australian Capital Territory has amended the regulations and does not have the MHF chapter.
82 More information regarding the Sweeney Research study is included in Chapter 5.
In contrast to PACIA, the Sweeney Study found that over 80% of respondents claimed that their organisation had gained value from having a documented Safety Case, despite the inefficiencies, frustrations and costs experienced (Sweeney 2003:iii-v). Two-thirds of respondents stated that there was greater focus on safety in their organisation as a result of the Safety Case process (Sweeney 2003:ii). Sweeney also found that 67% of all respondents felt that the Safety Case had changed staff attitudes towards safety, with almost 80% of Plant Managers and Safety Case Managers, and 67% of Health and Safety Representatives sharing this view (Sweeney 2003:97). Seventeen percent of respondents believed the Safety Case was simply a licensing process (Sweeney 2003:97).

At an MHF CEO breakfast seminar, a CEO commented that his organisation had:

*gained significant value, employees are more knowledgeable, the organisation understands its key risks better and can demonstrate to the community the company can run the plant safely.* (Engelsman 2002)

The Hazard Management Division (HMD) (incorporating MHU) of VWA also conducted surveys of CEOs, those responsible for Safety Case development, and HSRs, at the completion of each Safety Case assessment (WorkSafe 2004:1). These results were compiled and published in January 2004, showing that 82% of respondents agreed or strongly agreed that improvements to safety and/or the safety culture had been achieved through the Safety Case and 63% of respondents agreed or strongly agreed that attitudes towards safety have improved (WorkSafe 2004:2).

This research suggests that while the licensing regime resulted in increased safety benefits, inefficiencies and frustrations initially occurred as both the regulator and MHF operators did not have clear expectations or guidance regarding what constituted compliance.

**Submission of a Safety Case**

In the UK and Europe, references are made to a ‘Safety Report’, while Victoria refers to a ‘Safety Case’. Table I.2 (in Appendix I) shows other Victorian legislation to refer to a ‘Safety Case’ despite the National Standard making reference to a ‘Safety Report’. There would appear to be no substantive difference between a Safety Case and Safety Report (RLRC 1999:14.30) and hence both shall be referred to as a Safety Case in this study.
The international comparison in Table I.1 indicates that COMAH, Seveso II and Victorian MHF legislation require the submission of a Safety Case to the relevant Authority. However a notable exception is OSHA, which does not require a submission.

Tables I.2 and I.3 indicate that Safety Case submissions are required in other Australian and Victorian jurisdictions. The Victorian Electrical Safety Act 1998, while not a true Safety Case regime, provides for the submission of a safety management scheme for assessment in order to gain acceptance of the scheme.

**Assessment of a Safety Case**

The Victorian MHF legislation requires a licence to operate, however it does not specifically require an assessment by the Authority. The MHF Regulations require the Authority ‘be satisfied’ that (a) the Safety Case has been prepared in accordance with Regulation 402 (Safety Case Content); (b) the applicant has complied with the provisions of Part 3 (Safety Duties of Operators); (c) the applicant has the ability to operate the MHF safely; and (d) the applicant has complied with the provisions of Part 5 (Consulting, Informing, Instructing and Training). The Authority made a policy decision that a detailed Safety Case assessment and on-site verification will occur to inform the decision-making process (VWA 2001:1).

The National Standard is ambiguous regarding the need for Safety Case assessment by the relevant Authority (Hopkins 2000:98). The National Standard states ‘the role of the Authority is to ‘receive’ the Safety Case and to ‘give assurances to government that an appropriate level of safety applies, so long as the provisions are properly implemented’ (NOHSC 1996:22).

UK and European legislation provides for ‘examination’ by the relevant Authority, however in these regimes there is no MHF licence as a significant decision-point in the Authority’s examination process.

**Assessment Timing Restrictions & Re-submissions**

Both COMAH and Seveso II provide a non-specific assessment time frame to be ‘within a reasonable period of time’ from submission, compared with the MHF Regulations which provide a finite six months.
Feedback from Victorian MHF Operators and industry groups such as PACIA, following the first round of Victorian MHF licences, indicated that the legislated time frames were ‘very valuable in driving resolution and closure on issues’ in contrast with the COMAH Regulations in the UK which have resulted in ‘lengthy dialogue’ between industry and the Health and Safety Executive with little, if any, resolution (PACIA 2003:7).

The Petroleum (Commonwealth) and Gas Safety Regulations (Victorian) provide for re-submissions of the Safety Case if the Authority is not satisfied. The Victorian MHF Regulations do not specifically provide for re-submissions as the Authority has a legislative time restriction of six months from the date of submission. During the first assessments in 2002, it became apparent that operators not meeting the satisfaction of the Authority (some for minor deficiencies which could be addressed if time permitted) would need to cease operation as an MHF. An amendment was enacted in March 2002\(^3\) which effectively provided a six-month extension to the assessment period, which is discussed further in Chapter 5. However, should the Authority not be satisfied at the end of the 12-month period, no further re-submissions to the Authority are possible (unlike other overseas jurisdictions). In this case, the operator has the option of appealing to the Victorian Civil and Administrative Tribunal (VCAT), where new information can be introduced that was not in the Safety Case submitted to the Authority.

**Authority to Cease Operations**

The UK and European authorities have the ability to direct that MHF operations cease due to seriously deficient control measures and the failure to submit specific documentation. In Victoria, an MHF site is not permitted to operate unless it is licensed after satisfactory submission of a Safety Case. Licence suspension or cancellation can also occur for a number of reasons including seriously deficient control measures, the SMS no longer provides a comprehensive and integrated management system for all aspects of control measures, MHF operator convicted for contravening parts of the MHF Regulations or OH&S Act, or the operator no longer understands the Safety Assessment.

**SMS Requirement**

A common feature of most of the various regimes is an SMS. This highlights the international recognition of the important role an SMS has in preventing major incidents, as was discussed in Chapter 2. In preparing Seveso II,

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...certain areas were identified where new provisions seemed necessary on the basis of an analysis of major accidents .... since the implementation of Seveso I. One such area is management policies and systems. Failures of the management system were shown to have contributed to the cause of over 85 per cent of the accidents reported. (Mitchison & Porter 1998:i)

The exception is OSHA which does not specifically require an SMS. However the elements required by OSHA are key parts of an SMS e.g. employee consultation, process safety information (which includes hazard identification), process hazard analysis, operating procedures and training (OSHA 1992:28-36).

The Victorian Transport (Rail Safety) Regulations 1998 require an appropriate SMS and documentary evidence that demonstrates that an SMS is in place. However Gunningham (2004:3) notes that there is ‘inadequate specification’ and ‘no mandated performance standard for its scope or quality’ as well as ‘no explicit obligation to demonstrate’ that the SMS will ‘systematically and continually’ control and minimise identified risks.

**Distinguishing Features of Victorian MHF Regulations: A Summary**

From this analysis, it can be concluded that the Victorian MHF Regulations are similar to overseas and interstate MHF legislation as they require a Safety Case to be produced and have SMS requirements. However, the Victorian MHF Regulations have two distinguishing features: (i) a licence to operate and, (ii) a finite time for the Authority to determine its satisfaction or otherwise with the submitted Safety Case. Hence, the Victorian MHF regime imposes more stringent requirements on the Authority and MHF operator, than other jurisdictions. The Case Studies in Chapters 6 and 7 illustrate operator and regulator responses to these stringent requirements.

**Safety Case Assessment**

Due to the potential risks of either granting a licence to a facility that is not capable of operating an MHF safely, or refusing to grant a licence to a facility that is capable of operating safely, a rigorous assessment process was developed by the Victorian regulator. The decision to grant an MHF licence is made following a detailed assessment by the regulator of the facility’s Safety Case. As there was a number of facilities to assess and a number of different assessors, a consistent, transparent, fair and technically competent assessment process was required (VWA 2001a:1).
VWA’s Safety Case assessment process is based on 14 management principles and its technical foundation comes from 12 guidance principles (Appendix J). Assessors use detailed Technical Protocols (TPs) and Focus Rules (FRs) to direct the assessment.

The Safety Case assessment process consists of the following steps:

1. A serious deficiency check to determine whether the Safety Case contains sufficient information to be assessed (the time restrictions on the Authority’s decision-making necessitated the need for obvious deficiencies in operator submissions to be quickly identified and then rectified);

2. ‘Desk-top’ technical assessment of the Safety Case to determine whether the operator is complying with the MHF Regulations (see Appendix J for more information);

3. On-site verification of selected aspects of the Safety Case to ensure documentary accuracy, and

4. Formal reporting of findings from technical assessment and verification to the Licence Panel.

Figure 3.2 illustrates this process.
Figure 3.2: Safety Case Assessment Process with Regulator and Operator Interactions (after MHD 2001a:1)
The Licence Decision

The licence decision is made by the Regulatory Delegate (HMD Director) based on the assessor’s report (Assessment Findings Report) and advice from the Licence Panel\(^8\) (WorkSafe 2007). To grant an MHF licence, the Regulatory Delegate must be satisfied that all the requirements of Regulation 803(1) have been met, namely:

a) The operator’s Safety Case has been prepared in accordance with Regulation 402 (Content of Safety Case);

b) The operator has complied with the provisions of Part 3 (Safety Duties of Operators);

c) The operator has the ability to operate the MHF safely, and

d) The operator has complied with the provisions of Part 5 (Consulting, Informing, Instructing and Training).

Figure 3.3 shows the overall relationship between Management Principles, Guidance Principles, assessment, verification and licensing.

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\(^8\) Licence Panel members include industry experts and regulatory advisors.
Monitoring Between Licence Decisions

The Victorian Government sought assurance that the Safety Cases, under which MHFs were licensed, remained valid during the term of the licence and that MHFs achieved continuous improvement (Cooke et al. 2004:906). Monitoring throughout the licence term would provide the regulator with evidence of the operational level of the SMS and would allow comparison with the level observed during Safety Case assessment and licensing. This monitoring was achieved through Annual Inspection - a review of the site’s control measures and SMS over several days with a team of inspectors, performed in an audit style, once per year (Cooke et al. 2004:906). This intensive site inspection built on the success of verification during the Safety Case assessment period and, despite not being a legislative requirement in Victoria, is consistent with the European Seveso II Directive which requires the Competent Authority to conduct at least an annual inspection of each MHF (Seveso II Article 18). The Annual Inspection and other monitoring activities throughout the licence period will be discussed further in Chapter 4.

3.6 Conclusions

The Longford explosion created political pressures on the Victorian Government which led to the establishment of a Royal Commission into the incident.

The Commission’s findings showed that a theoretically good SMS was in existence at Esso, but had been neglected or ignored over a long period due to a number of factors, ultimately leading to the major incident. The Commission cited many implementation and operational deficiencies with the SMS, as well as design and maintenance deficiencies. The findings demonstrate that the effectiveness of any SMS, no matter how sophisticated or ‘world class’, is only as good as the level of management, training and skills of those who actually operate the system. The Commission concluded that the regulatory regime relevant to Esso’s Longford gas plant was less stringent than for the Esso facilities both upstream and downstream and found this situation to be anomalous. The Commission recommended that a Safety Case regime should be mandated by legislation as a prerequisite for the operation of any MHF in Victoria.

The Longford Royal Commission thus clearly established the basis for the introduction of mandated SMSs involving a Safety Case through new regulations under the Occupational Health and Safety Act 1985 (Vic), which came into effect on 1 July 2000 as the Occupational Health and Safety (Major Hazard Facilities) Regulations 2000. The provisions of the MHF Regulations closely followed the Longford Royal Commission’s
recommendations. The focused actions taken by the Victorian Government and VWA, including the establishment of a Major Hazards Unit, the appointment of external consultants, and the drafting of MHF Regulations, were as a direct result of the Longford incident and Royal Commission. Later chapters will investigate whether the regulations had as much impact on industry as intended by the parliament.

The requirement to be a licensed MHF in Victoria is the key distinguishing feature of the Victorian Regulations and includes a finite time for the Authority to determine satisfaction. Due to the significant risks associated with incorrectly licensing, or not licensing, an MHF, the VWA developed a rigorous Safety Case assessment process. The focus of this thesis is upon how MHFs satisfied this tough licensing test. It should also be noted that five-yearly licensing was supported by the practice of Annual Inspection. By any standards this appears to be a strong regulatory approach.
CHAPTER 4

RESEARCHING SMS DEVELOPMENT: CONCEPTS AND METHODS

4.1 Introduction

Chapter 3 discussed how the Victorian MHF regulations came into effect on 1 July 2000, requiring a Safety Case and SMS, and mandating a licence to operate an MHF. The aim of this chapter is to present some key concepts and to describe the research methods used to gather information regarding how Victorian MHFs performed in achieving compliance with the new regulations.

This chapter has an initial task of presenting an analytical model that is used for organising and analysing data. This is the SMS Development Model referred to in Chapter 2. The chapter also outlines the multi-method approach used for primary research, falling into two main parts - a sector analysis and case studies. First, an industry sector analysis of the Victorian MHFs was conducted to gain an understanding of the performance of all the MHFs across the four stages of the SMS Development Model. This information was also used in the selection of seven MHFs for in-depth case studies. Of the seven case studies, three were classed as ‘leaders’ (achieved full-term licences) and four were ‘laggers’ (licensing was problematic), providing a basis for multi-case analysis around the four developmental stages of the SMS. A cross-case or comparative analysis was performed for these seven MHFs, generating some conclusions regarding how compliance with the new regulations was achieved.

4.2 SMS Development Model

In Chapter 2 the concept of an SMS was discussed in terms of its use to prevent major incidents, its key elements and the way SMSs have failed. In Chapter 3 the concept was taken further to look at how the Longford incident prompted regulation which mandated a Safety Case incorporating an SMS. The aim of this section is to develop an SMS developmental model which can be operationalised through the application of empirical data to test how well Victorian MHFs performed in meeting the requirements of the new regulations. Essentially this SMS Development Model is a dynamic concept with a

Sarah Sinclair
Consistent with the Victorian meta-regulatory approach to MHFs (Haines 2009:39), no specific SMS model or structure is stipulated by the Victorian MHF Regulations. Indeed, many different management system models are allowed (OECD 2005:12-14 and Bluff 2003:5-7). However, there are some specific SMS requirements (outlined in Appendix K) as a direct response to the Longford incident (such as the need for procedures for ensuring the mechanical integrity of the plant and provisions for isolating parts of the MHF in an emergency). Fundamentally, the regulations require the SMS to be ‘established and implemented’ (MHF Reg 301(1)) and ‘used’ as ‘the primary means of ensuring the safe operation of the MHF’ (MHF Reg 301(2)). Furthermore, the SMS must be ‘reviewed and revised’ (MHF Reg 301(5)). These regulatory requirements suggest a four-stage SMS development process that incorporates:

- establishing the SMS through initial design (MHF Reg 301(1));
- implementing the SMS so that what is designed is put into use (MHF Reg 301(1));
- using the SMS on an on-going operational basis (MHF Reg 301(2)), and
- maintaining and improving the SMS through reviewing and revising (MHF Reg 301(5)).

Based on Deming’s model (previously presented in Figure 2.2), a four-stage SMS Development Model of ‘Design, Implementation, Operation, Maintenance’ was created for this study to encompass the four stages of SMS development required by the Victorian MHF Regulations (Figure 4.1).
The significant difference between the two models is the SMS Development Model’s separation of Deming’s ‘do’ into two stages of ‘implementation’ and ‘operation’, and the amalgamation of ‘check’ and ‘act’ into the single stage of ‘maintenance’. The reason for these differences will now be explained. Implementing a process or procedure for the first time requires a different focus from on-going operation (such as training personnel in how to use the new procedure), as will be demonstrated by the case studies. This is particularly important when new legislation is being complied with for the first time, possibly resulting in many new aspects of a system being implemented. ‘Operation’ is the day-to-day use of the system during the operation of the MHF. ‘Maintenance’ is a common term at MHFs for the up-keep of instrumentation and equipment incorporating both ‘check and act’ activities, that is, finding the fault and then rectifying it. Table 4.1 provides further definition and rationale for the four stages of the SMS Development Model and draws specific links to the MHF Regulations.

### Table 4.1: Rationale for the Four Stages of the SMS Development Model

<table>
<thead>
<tr>
<th>Deming cycle</th>
<th>This study</th>
<th>Definition for this study</th>
<th>Rationale</th>
<th>MHF Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>Design</td>
<td><strong>Design</strong> - the theoretical plan, purpose and intention of a model to establish an SMS.</td>
<td>New activities at an MHF require more than a plan, they need to be designed to be appropriate for the MHF. Design is the starting point for engineering activity and hence is a common term at MHFs.</td>
<td>301(1) ‘establish’ an SMS.</td>
</tr>
<tr>
<td>Do</td>
<td>Implementation</td>
<td><strong>Implementation</strong> - the ‘putting into effect’ of the design plan and procedures.</td>
<td>‘Do’ traditionally incorporates both ‘implementation’ and ‘operation’ (IOSH 2003:9). However ‘doing’ for the first time requires a focus on implementation, which is a separate and distinct phase from on-going operation.</td>
<td>301(1) ‘implement’ an SMS.</td>
</tr>
<tr>
<td>Check</td>
<td>Operation</td>
<td><strong>Operation</strong> - the actual performance and discharge of functions following their implementation.</td>
<td>Operation is the main focus of any MHF, as this is what keeps the facility in business. ‘Operation’ is important enough to be a single phase, separated from implementation.</td>
<td>301(2) ‘use the SMS as the primary means of ensuring the safe operation of the MHF’.</td>
</tr>
<tr>
<td>Act</td>
<td>Maintenance</td>
<td><strong>Maintenance</strong> - the need for procedures and practices to be in place to facilitate the effective and efficient continuation of existing operational functions.</td>
<td>Maintenance is a common term at MHFs for the up-keep of instrumentation and equipment. Maintenance at MHFs incorporates both ‘check and act’ activities, that is, finding the fault and then rectifying it.</td>
<td>301(5) ‘review and revise’ the SMS.</td>
</tr>
</tbody>
</table>
Researching SMS Development: Concepts and Methods

It is logical that these four stages must initially be performed in order: without design of the SMS there is nothing to implement; without proper implementation, operation will not be successful; and maintenance cannot be performed on a system that is not operational. It is anticipated that these four stages are relevant to Victorian MHFs as they comply with the requirements of the MHF Regulations. The importance of these four stages can be shown by excerpts from the Longford Royal Commission Report:

Design

*There was no evidence that any system existed at Longford for the regular monitoring of operating conditions or operator practices.* (RLRC 1999:13.88)

Implementation

*The fundamental shortcoming was in the implementation of OIMS*. (RLRC 1999:13.41)

Operation

*The Commission gained the distinct impression that there was a tendency for the administration of OIMS to take on a life of its own, divorced from operations in the field. Indeed, it seemed that in some respects, concentration upon the development and maintenance of the system diverted attention from what was actually happening in the practical functioning of the plants at Longford.* (RLRC 1999:13.40)

Maintenance

*The methodology employed by the [external audit] assessment team was flawed in that the team failed to identify significant deficiencies in the extent to which “individual EAL [Esso Australia Limited] Management Systems” conformed to the guidelines, particularly in relation to GP1 [Gas Plant 1], and were implemented.* (RLRC 1999:13.37)

Thus the four-stage SMS Development Model (Design, Implementation, Operation and Maintenance) provides an analytical framework for all SMSs, regardless of their structure, complexity and length of time in operation at specific Victorian MHFs as they comply with the MHF Regulations. The SMS Development Model is constructed partly on the basis of the inductive analysis of data at a sectoral level (Chapter 5) and Case Study level (Chapters 6, 7 and 8). It is also constructed, as indicated in Figure 4.1 and Table 4.1, to match specific requirements of the Victorian MHF Regulations.

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85 Operations Integrity Management System (OIMS) was described in Chapter 3.
4.3 Sector Level Analysis

This section categorises Victorian MHFs into four industry sectors and describes the process and analytical framework for data collection at sector level. On 1 July 2000, when the Occupational Health and Safety (Major Hazard Facilities) Regulations 2000 (Vic) (MHF Regulations) came into effect in Victoria, 47 facilities were classified as MHFs, with a further site registering with intent to become an MHF (WorkSafe 2004b:2). This classification was made based on the quantity of specific chemicals listed in Schedule 1 of the MHF Regulations (see Appendix B) which were located at the facility. Prior to their Safety Cases being due, three MHFs reduced their quantities of Schedule 1 materials to below the MHF threshold and were deregistered. A further MHF closed for commercial reasons during this period, and was also deregistered (WorkSafe 2004b:2). Due to a change in ownership, four adjoining sites initially registered as separate MHFs were deregistered and then re-registered as a single MHF. Following initial Safety Case checks by the regulator and initial feedback, two operators reduced their Schedule 1 holdings and were deregistered. Hence a total of 39 Safety Cases progressed through the first assessment round (known as ‘Round 1’), with 39 licence decisions being made between March 2002 and September 2003 (WorkSafe 2004b:2). Figure 4.2 shows the location of the 39 MHFs and the change from 47 to 39 MHFs is recorded in Table 4.2. It is these 39 MHFs which will be followed in the Sectoral Analysis.

Figure 4.2: Map of Victoria Showing MHF Locations
Table 4.2: Number of Victorian MHFs from 1 July 2000 to 30 September 2003

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Changes</th>
<th>Intended MHFs</th>
<th>Registered MHFs</th>
<th>Licensed MHFs</th>
<th>Total MHFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial MHF registration in 2000</td>
<td>47 sites register + 1 intent</td>
<td>1</td>
<td>47</td>
<td>-</td>
<td>48</td>
</tr>
<tr>
<td>Safety Case development (2000-2002)</td>
<td>3 sites deregister (reduce Schedule 1 quantities)</td>
<td>1</td>
<td>44</td>
<td>-</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>1 site closes (commercial reasons)</td>
<td>1</td>
<td>43</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>Safety Case submissions</td>
<td>44 Safety Cases received</td>
<td>-</td>
<td>44</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>Safety Case assessment (2002 – 2003)</td>
<td>4 sites deregister then re-register as 1 site</td>
<td>-</td>
<td>41</td>
<td>-</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>2 sites deregister following initial regulatory checks of their Safety Cases</td>
<td>-</td>
<td>39</td>
<td>-</td>
<td>39</td>
</tr>
<tr>
<td>March 2002 - September 2003 (Round 1 licensing)</td>
<td>Number of licence decisions made</td>
<td>-</td>
<td>39</td>
<td>-</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 4.2 shows that the number of MHFs in Victoria was not stagnant, with organisations choosing to develop new facilities (greenfield sites which register their ‘intent’ to operate an MHF) or increase or decrease the Schedule 1 holdings at existing facilities, triggering a requirement to register or deregister as an MHF. The MHF Regulations (r 705) also provide for the Authority to ‘determine’ sites to be MHFs if they store between 10% and 100% of the Schedule 1 threshold quantity of materials and there is deemed to be potential for a major incident. Table 4.3 shows the outcome of the 39 Round 1 licence decisions and the continuing change in the number of MHFs.
Table 4.3: Changing Number of Victorian MHFs from 30 September 2003 to 31 December 2005

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Event</th>
<th>Licence Refused</th>
<th>Intended MHFs</th>
<th>Registered MHF</th>
<th>Full-term licensed MHF</th>
<th>Reduced-term licensed MHF</th>
<th>Licensed MHF in assessment</th>
<th>Total MHFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2003 (Round 1 licence decisions)</td>
<td>Licence decisions</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>32</td>
<td>5</td>
<td>-</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>• 2 licences refused by WSV</td>
<td>1</td>
<td>-</td>
<td>32</td>
<td>6</td>
<td>-</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 1 refusal reinstated by VCAT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Inspection (Ai) 2003/04</td>
<td>Second Safety Case for the shortest reduced-term licence being assessed.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>32 (in Ai)</td>
<td>5 (in Ai)</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td>New MHFs (2003 – 2005)</td>
<td>WSV determines 2 sites as MHFs and 3 greenfield sites register</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>32</td>
<td>6</td>
<td>-</td>
<td>38</td>
</tr>
<tr>
<td>Safety Case assessments (2004 - 2005)</td>
<td>2 determined sites and 1 greenfield site gain licences</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>34</td>
<td>7</td>
<td>-</td>
<td>41</td>
</tr>
<tr>
<td>Annual Inspection 2005</td>
<td>Second Safety Case for the second shortest reduced-term licence being assessed</td>
<td>2</td>
<td>-</td>
<td>33 (in Ai)</td>
<td>7 (in Ai)</td>
<td>1</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

**Sectors**

The 39 MHFs, submitting their Safety Case for assessment in 2002-2003, differ in both their characteristics and the approach taken to develop, implement, operate and maintain an SMS. An initial way to distinguish the 39 MHFs is to divide them into four industry sectors. VWA, the statutory regulator, nominated four industry Sectors (Petroleum, Plastics & Chemicals, Logistics and Utilities), grouping MHF operators with other operators they would consider peers (Cooke et al. 2004:904). This occurred partly in response to complaints from simple MHF operations that an ‘unlevel playing field’ was being applied, that is, that simple operations were being compared with complex petrochemical sites. VWA’s grouping of similar operations into four sectors was applied for this study. Characteristics of the four sectors are described below, with more detail in Appendix L. Each site was given an alpha-numeric identifier for this study, for example, ‘P&C5’ is the fifth Plastics & Chemical site.
Petroleum Sector

In 2003, the Petroleum Sector comprised eight primarily oil and gas production and refining facilities. A further two greenfields Petroleum MHFs were licensed after 2005, however no data for these sites are included in this study. Petroleum Sector facilities are complex operations involving temperature and pressure changes to separate and refine hydrocarbons. This sector is characterised by a small range of materials, predominantly Class 3 (flammable liquids) and Class 2.1 (flammable gases). Some toxic materials such as hydrogen sulphide and hydrofluoric acid are generated or consumed as part of the operation.

The majority of operators are large corporations, often multi-nationals, with the ability to access significant corporate support. The group is characterised as having a large pool of technical resources and knowledge. Their control philosophy for the safe operation of the plant is mainly engineering-based with reliance on corporate standards.

Plastics & Chemicals Sector

The Plastics and Chemicals Sector comprised a range of plastics, chemical and explosives manufacturers and consisted of 13 facilities in 2003. These facilities are medium to very high complexity operations involving the conversion of raw materials to intermediate or finished products. The conversion process usually involves temperature and pressure changes in either continuous or batch reactors. This sector handles a large range of materials (raw materials, intermediates and finished products) including formaldehyde, phenol, ethylene oxide, propylene oxide, styrene, acrylonitrile, butadiene, vinyl chloride monomer, mono-isopropyl amine, ethylene, propylene, aluminium alkyls, copper chrome arsenate, and chlorine.

The operators range from small-scale facilities specialising in a single product, to complex multi-plant sites. Their control philosophy ranges from procedural controls to engineering-based. Resourcing varies, with some MHFs being part of larger corporations. Some of these companies are direct competitors, however most compete with overseas imports. The sector is highly integrated in Victoria, with some facilities being suppliers to other MHFs in the sector. The age of the facilities varies, however the majority are more than 40 years old.

Utilities Sector

The Utilities Sector primarily comprised LPG facilities, water treatment facilities and industrial gases. In 2003, there were eight facilities, with a further site determined and
licensed in 2004. Utility Sector facilities are generally simple processing operations, involving one or two chemicals in either production, separation or purification processes. For example, the water treatment facilities use chlorine. One MHF is an outlier in the group, manufacturing and handling a large range of gases including ammonia, hydrogen chloride, hydrogen sulphide, nitrous oxide, methyl bromide, acetylene and sulphur dioxide. Several of the sites consume Schedule 1 materials produced at other MHFs.

The Utilities Sector operators are often large corporations or former government-owned utilities which are now privatised. Some gas and water treatment facilities operate unmanned for periods of time, with unsupervised operation by tanker drivers delivering or dispatching the Schedule 1 material. These operators rely on engineering controls, primarily asset integrity, and often standardise facilities across the state and country due to ease of operation.

**Logistics Sector**

The Logistics Sector primarily comprised warehouses and tank farms, and included petroleum storage terminals located separate from a refinery. These facilities are usually simple operations, with loading, storage and unloading practices. More complex activities such as blending and decanting may also occur. In 2003 there were 10 logistics facilities. A further greenfields site was licensed in 2005 and a further site determined and licensed in 2004. Hence there were a total of 12 Logistics facilities in 2005, which all participated in the second year of Annual Inspection. The majority of Logistics Sector MHFs are located close to a port.

Warehouses potentially store a wide range of materials, often for the Plastics and Chemicals Sector. Schedule 1 materials may be present on an intermittent, rather than a permanent, basis. Warehouses are generally small operators without corporate support. Business demand can be seasonal and therefore warehouses have a high reliance on contractors and casual employees. The operator of the facility seldom owns the product; they are primarily third-party service providers to industry. In contrast, bulk storage tank farms have a smaller range of materials servicing either the Petroleum or Plastics and Chemicals Sectors. Tank farms are often part of a multi-national organisation with access to corporate support.
Sectoral Analysis Methodology

The Sectoral Analysis uses the framework of the SMS Development Model (Figure 4.1) to examine the progress of MHFs in complying with key requirements of the MHF Regulations. As noted above, the framework has four stages - Design, Implementation, Operation and Maintenance. The 39 MHFs in operation in March 2002 were divided into four sectors and then various data sources were used to examine the progress of each sector across the four SMS Development stages. The framework and data are described below.

The Sectoral Analysis begins with Design, by examining whether the 39 MHFs had a common starting point to achieve compliance with the MHF Regulations. Sweeney Research data (described in the next section) provided evidence of this. The results provided an indication of the importance, or otherwise, of focusing on the design of the SMS. SMS Design analyses the theoretical construct of the SMS, expanding on the analysis in Chapter 2. First, the regulatory requirements of the SMS were considered and compared with the SMS framework (Figure 2.1). Guidance from the regulator was also examined. This allowed conclusions to be drawn regarding the provision of SMS design information.

SMS Implementation was considered in four parts. Firstly, voluntary SMS implementation prior to the regulatory requirement was examined using Sweeney Research data and data from Appendix L. Factors influencing voluntary SMS implementation were identified. Secondly, VWA verification of the SMS during Safety Case assessment provided an indication of the extent of SMS implementation at the first round of licensing. VWA reported these findings and the number of Safety Case assessment extensions granted in a summary report (WorkSafe 2004b). Thirdly, the operators’ observations regarding SMS implementation improvements throughout the Safety Case development process were gauged from Sweeney Research data. Finally, the extent of SMS implementation, and control measure implementation, were examined annually during the first licensing period via the Annual Inspection process conducted by VWA inspectors. These VWA-generated data were analysed by sector, providing an understanding of the extent of SMS implementation and how this varied by sector and in the years following licensing.

SMS Operation focused on examining VWA-generated data collected from Annual Inspections. These data report both SMS and control measure operability. Similarly to implementation, analysis of the Annual Inspection data for operability provided an
understanding of the extent of SMS operation and how this varied by sector and years following licensing. Incident data reported by MHFs to VWA were also analysed to provide a further indicator of SMS operation.

SMS Maintenance focused on examining VWA-generated data collected from Annual Inspections. These data report the extent of SMS auditing. Similarly to implementation and operation, analysis of the Annual Inspection data for maintenance provided an understanding of the extent of SMS maintenance and how this varied by sector and years following licensing.

The aim of the sectoral analysis is primarily to identify differences and similarities between the sectors in the four stages of the SMS Development Model. Lastly the sectoral analysis was reviewed to inductively construct a series of variables that affect SMS development and which form the framework for the cross-case analysis in Chapter 8.

**Sector Level Data**

The Sectoral Analysis used data from surveys commissioned by VWA, VWA administrative records and Annual Inspection data. In this context it is appropriate to introduce the role played by this researcher in VWA. Between August 2000 and June 2005 I was employed in the Major Hazards Unit, and later Hazard Management Division, of VWA, first as a Senior Safety Analyst, incorporating the role of Industry Facilitator for the Plastics & Chemicals Sector, and later as Manager, Major Hazards. The first role involved visiting MHFs to monitor their Safety Case progress, assessing Safety Cases, performing verification and Annual Inspections, and analysing Plastics & Chemicals sector performance. I also contributed to the development of assessment processes and monitoring, collection and collation of information under the legislation. In the second role, I was responsible for the implementation of the MHF Regulations including overseeing Safety Case assessments, providing technical advice to the regulatory delegate for MHF licence decisions, and being VWA’s technical representative on the Major Hazards Advisory Committee (WorkSafe 2007:2). As a public servant this work is directed by and attributed to VWA. However it must also be acknowledged that a possibility of bias towards the data exists. Wherever possible this will be acknowledged.
Sweeney Research Survey

VWA commissioned independent market research consultants, Sweeney Research Pty Ltd, in 2003 to evaluate the implementation of the MHF Regulations from July 2000 to the completion of the first round of MHF licensing in September 2003. Sweeney Research conducted 156 face-to-face structured interviews using a questionnaire which provided a range of coded and free text responses (Sweeney 2003:Appendix 2). The 156 interviews were conducted at all 38 licensed MHFs, including 31 Chief Executive Officers (CEOs), 32 Plant Managers, 21 Safety Case Managers, 32 Health and Safety Representatives (HSRs) and 16 other middle management (Sweeney 2003:2-5). The 31 CEOs covered the 38 licensed MHFs, as some organisations had several MHFs in Victoria. The Sweeney survey has obvious limitations for analysis:

- Data are reported at the respondent level and sectoral level, but cannot be disaggregated to the firm level, limiting its analytical applicability,
- Respondents were not selected to fit a rigorous structured sample, causing possible response bias.

The Sweeney Research survey was reviewed, with relevant questions for the SMS Development Model (Design, Implementation, Operation, Maintenance) being extracted for inclusion in the Sector Analysis.

The Sweeney Report gives some valuable aggregate data at the sectoral level, although it must be interpreted with care.

Hazard Management Division Survey

At the completion of licensing, the Hazard Management Division of VWA sent surveys to MHF personnel (CEOs, Safety Case Managers and HSRs) regarding the assessment process and VWA’s performance and interaction with the MHF. 145 surveys were issued and 81 were returned, giving a return rate of 56% (WorkSafe 2004:1). This survey highlights areas for the regulator to improve its processes and how MHF personnel viewed changes at their site as a result of developing a Safety Case.

While the survey responses are anonymous, bias may be present in the results due to the respondent’s knowledge that the regulator administers the MHF’s licence.

VWA Administrative Records

VWA administrative records include data provided by MHFs in notification and Safety Case Outline documents including the number of employees, chemicals on site, production processes and corporate support. VWA collects information regarding
enforcement action taken by VWA inspectors at MHFs and also maintains an incident database of information reported by MHFs. MHFs are required by law to notify VWA of any incidents that occur at their facility. VWA’s categories and definitions of reported incidents from MHFs are listed in Table 4.4 (WorkSafe 2006:1).

Table 4.4: Reported Incident Category and Definition

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
</table>
| Serious  | • Potential for a major incident (involving Schedule 1 materials or failure of major incident controls)  
• Potential for a fatality |
| Significant | • Involved quantities of Dangerous Goods in excess of 10,000 litres  
• The failure of major incident controls did not have the potential for a fatality  
• The injury required admission to hospital |
| Minor | • Involved quantities of Dangerous Goods below 10,000 litres  
• The failure of major incident controls did not have the potential for hospitalisation  
• The injury did not require hospitalisation |

VWA also holds administrative information regarding time extensions required during Safety Case assessment and the reasons for this, the length of licence issued and any conditions. Following the first round of licensing, VWA published a summary report (WorkSafe 2004b) which is useful for overall trends and sector comments, however this data cannot be attributed to specific MHFs.

All data held and/or generated by VWA regarding MHFs were collected, checked and stored in accordance with VWA protocols (see Appendix L).

**Annual Inspection**

The Annual Inspection process was introduced in Chapter 3 as a regulatory monitoring activity to provide performance assurance during the licence term. Data used to determine SMS implementation, operation and maintenance have been extracted from the regulator’s Annual Inspection Reports for each Victorian MHF and have been aggregated into industry sectors. The analysis was on a year-by-year basis, separately for control measures and SMS elements. The data collection process for Annual Inspection will now be described.

The Annual Inspection process focused on SMS elements and control measures (VWA 2002:7). While working for VWA, the researcher developed the following definitions for control measures and SMS elements through observations at verification activities (during Safety Case assessment) and then applied this to the Annual Inspection process.
This definition highlights the link between control measures and SMS elements. **Control Measures** are specific items, such as a piece of hardware or software, that acts as a preventative or mitigative barrier against a hazard, for example, a pressure relief valve (PRV) that protects the structural integrity of a reactor at a given pressure. On a complex chemical manufacturing site there may be several hundred PRVs. Hence it is necessary for a **management process** to exist to ensure that all required PRVs (control measures) are installed, monitored and maintained at the appropriate pressure across the facility. This overall management process for PRVs is an **SMS element**.

As there are many hundreds of control measures in complex facilities, it was necessary to develop a method to sample control measures. Similarly, due to the size and complexity of most SMSs, it was also not possible to examine every element, so sampling of the SMS was performed. An arbitrary number of 10 control measures and three SMS elements was set to be verified at each MHF over a three to five-day period by a team of up to five inspectors. These control measures and SMS elements were selected by VWA’s Safety Analyst assigned to the site, prior to the Annual Inspection, based on the site’s Safety Case. The MHF was informed of the date and expected duration of the Annual Inspection, the name and contact details of the lead inspector and given an indication of the areas/activities of interest. The exact items to be examined during the Annual Inspection were not disclosed to the site prior to the inspection occurring.

WorkSafe developed criteria around control measures and SMS elements being ‘implemented’ and ‘functional’. **Implemented** focused on the item being in place, available and understood. **Functional** focused on the item achieving its intended purpose. This means there exists on-going use on demand at the stated performance level, with failures identified and rectified. To align with the four stages of the SMS Development Model, VWA’s term ‘functional’ shall be referred to as ‘operable’ in this thesis. The actual definition of implemented and operable for each control measure and SMS element was based on the MHF’s own definition in the Safety Case or SMS, such as flowrates, inspection intervals, etc.. This is based on the acknowledgement that ‘there are major difficulties in comparing one establishment and one set of procedures with another’, as reported by Mitchison & Papadakis (1999:46).

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86 Disclosure prior to the Annual Inspection now occurs. VWA has found that systemic problems with SMS elements and control measures remain evident despite the forward notice to the MHF (Connell 2008).
Figure 4.3 provides an example of implemented and operable definitions for a sprinkler system in a chemical storage warehouse.

The list of items to be inspected and the relevant definitions were developed by the VWA Safety Analyst assigned to the MHF prior to the Annual Inspection being performed. Maintaining the focus on the site’s own Safety Case was critical to ensure the continued support of the Safety Case regime. In a performance-based regulatory framework, the regulator undermines the activities the site has undertaken to reduce risk if the regulator reverts to a pre-prepared list of control measures and SMS elements that may or may not be relevant to the site’s Safety Case. Based on the Inspection Team’s findings against the definitions, ratings were given to the control measures and SMS elements as either:

- fully meeting the information and criteria provided in the Safety Case and on site;
- partially meeting the information and criteria provided in the Safety Case and on site, or
- not meeting the information and criteria provided in the Safety Case and on site.

Table 4.5 provides an example of these definitions for testing and inspection of a field instrument. A strict definition of ‘fully meeting’ was applied, meaning that the MHF had to demonstrate that 100% of what they required was actually being achieved. ‘Partially meeting’ was the broadest category, covering anything from not quite ‘fully meeting’ the requirement, through to just above ‘not meeting’ the requirement.
Table 4.5: Example of Annual Inspection Ratings for Instrument Testing and Inspection

<table>
<thead>
<tr>
<th>Fully meeting</th>
<th>Partially meeting</th>
<th>Not meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument/item in the field.</td>
<td>Lower standard instrument/item in the field.</td>
<td>Instrument/item not installed.</td>
</tr>
<tr>
<td>Tested to required specification and standard/method. Test procedure documented.</td>
<td>Tested to different specification and standard than documented. Or partial test of system.</td>
<td>Tested to incorrect, less or no specification. Method unclear.</td>
</tr>
<tr>
<td>Test documented and filed. (If third party performing test – MHF has copy of test findings and action items being monitored).</td>
<td>Test documented (some documentation missing). (If third party performing test – MHF has copy of test, but actions are not being addressed or results incomprehensible).</td>
<td>No documentation of tests. (If third party performing test – MHF does not have copy of tests, and not aware of actions).</td>
</tr>
<tr>
<td>Tests occurring to schedule/proof test interval.</td>
<td>Test occurring (sometimes to schedule, sometimes not).</td>
<td>Tests not occurring, or consistently behind schedule.</td>
</tr>
</tbody>
</table>

For each SMS element examined during Annual Inspection, its maintenance was also examined by inspecting its audit process. The regulator maintained focus on the MHF’s performance against the facility’s own criteria, however the regulator was looking for these common features of SMS auditing:

- documented audit plan or schedule;
- auditing occurring to the documented schedule;
- auditing occurring by the method stated (including appropriate safety criteria in procedure);
- action items being generated, and
- action items being monitored.

Figure 4.4 provides an example of SMS auditing definitions (following from Figure 4.3).
To keep reporting standardised, the regulator used the same ratings for SMS auditing as for control measures and SMS elements, these being:

- fully meeting the information and criteria provided in the Safety Case and on site;
- partially meeting the information and criteria provided in the Safety Case and on site, or
- not meeting the information and criteria provided in the Safety Case and on site.

Annual Inspection data were gathered from quarter 4 (Q4) of 2003 to quarter 3 (Q3) of 2005, the first being conducted in the Petroleum Sector. Table 4.6 shows the year quarter in which the Annual Inspection was held for each sector, the number of sites inspected, the total number of control measures and SMS elements reviewed across the sector and the mean number of control measures and SMS elements reviewed by site. Only licensed MHFs undergo Annual Inspection. It should be noted that not all sites in the sector were inspected each year, for example, if a site had recently been licensed, an Annual Inspection was not performed as the site had recently been verified (which is a similar process to Annual Inspection).

Table 4.6: Annual Inspection Data Summary

<table>
<thead>
<tr>
<th>Sector</th>
<th>Date of Annual Inspection</th>
<th>No. of Sites Inspected</th>
<th>Total no. of Control Measures Inspected</th>
<th>Mean no. of Control Measures per Site</th>
<th>Total no. of SMS Elements Inspected</th>
<th>Mean no. of SMS Elements per Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum</td>
<td>Q4 2003</td>
<td>8</td>
<td>73</td>
<td>9.1</td>
<td>31</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Q4 2004</td>
<td>5&lt;sup&gt;87&lt;/sup&gt;</td>
<td>53</td>
<td>10.6</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>Plastics &amp; Chemicals</td>
<td>Q1 2004</td>
<td>12</td>
<td>113</td>
<td>9.4</td>
<td>42</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Q1 2005</td>
<td>12</td>
<td>93</td>
<td>7.8</td>
<td>39</td>
<td>3.3</td>
</tr>
<tr>
<td>Utilities</td>
<td>Q2 2004</td>
<td>7</td>
<td>67</td>
<td>9.6</td>
<td>22</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>Q2 2005</td>
<td>8</td>
<td>65</td>
<td>8.1</td>
<td>22</td>
<td>2.8</td>
</tr>
<tr>
<td>Logistics</td>
<td>Q3 2004</td>
<td>10</td>
<td>94</td>
<td>9.4</td>
<td>28</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Q3 2005</td>
<td>12</td>
<td>100</td>
<td>8.3</td>
<td>32</td>
<td>2.7</td>
</tr>
</tbody>
</table>

<sup>87</sup> Three storage terminals connected to refineries were included in the refinery's inspection in 2004. These sites were counted separately in 2003.
The nominal 10 control measures and three SMS elements were selected to provide a sample of the site’s activities and to provide an achievable task for the inspection team to perform at the site. It is recognised that this number of items is a very small sample at an oil refinery, but is a considerable number at a simple water treatment facility.

Figure 4.5 graphically shows the mean number of control measures and SMS elements inspected per MHF for a given inspection period (from Table 4.6).

Figure 4.5 indicates that the target of 10 control measures was only achieved in the Petroleum Sector in Q4 2004. The target of three or more SMS elements was achieved in almost two-thirds of inspection quarters.

The reduced number of inspected items occurred because:

- The allocated inspection duration did not allow time to complete the assigned activities. This was due to delays in completing items, predominantly caused by the MHF having difficulties in demonstrating the item as per their Safety Case description, or
- Regulator resource constraints reducing the number of inspectors available to participate in Annual Inspections (particularly during 2005 when the corporate decision was made not to recruit or train new inspectors due to changes being made that year to the Victorian *Occupational Health and Safety Act*). This decrease in resourcing for Q1 2005 is clearly evident in Figure 4.5.
In a small number of cases the evidence of failure to maintain the SMS and control measures was so clear that further inspection was abandoned. Enforcement action was taken in these instances.

**Annual Inspection Bias**

Chronological factors, particularly regarding incomplete skill development amongst both the regulator and operator may have influenced the results obtained from Annual Inspections. The first inspections focused purely on the individual site’s Safety Case. Control measures and SMS elements were selected from the Safety Case to achieve a balance across the following criteria:

- high to low level risk scenarios;
- a range of control measures such as engineering and procedural, and
- a balance of preventative and mitigative controls.

These initial Annual Inspections did not focus on sector-specific items, and relied on the individual Safety Analyst assigned to the site to select the items for inspection, using the above criteria as guidance. The details of the control measures and SMS elements were extracted from the Safety Case and sometimes from performance information on the site monitoring systems if the Safety Case did not contain the detailed performance information.

While the first round of inspections was useful for both the regulator and MHFs, the findings generated on one site were not directly comparable with another site, even within the same sector, as the inspection was based on the site’s Safety Case with items selected independently and at the discretion of the Safety Analyst. Trends across the sector with regard to a specific control measure or SMS element were difficult to identify, as the same item was not inspected on all sites in the sector.

For the second year of Annual Inspections, a sector-specific approach was implemented by the regulator to address the need for some comparison. The linkage between the control measure and SMS was also included in the second year. Annual Inspection preparation began by analysing the sector with all Safety Analysts allocated MHFs in that sector, identifying known common issues such as third-party services, or common operations such as reactors or tanker loading. Categories of control measures and corresponding SMS elements were then selected to provide a range of control measures including engineering and procedural and a balance of preventative and mitigative
controls. The assigned Safety Analyst remained responsible for selecting the specific item at the facility and ensuring the items covered a range of risk scenarios.

This revised Annual Inspection methodology maintained the fundamentals of the first year inspections while providing more consistency between sites in the one sector, allowing for better comparison between sites and maintaining the focus on the contents of the site’s own Safety Case. However, by focusing on the sector and its known issues, some negative bias was introduced into the sampling process for the second year. It is also possible that with increased experience in conducting Annual Inspections, the regulator became more stringent in the level of demonstration required during the Annual Inspection to achieve the ‘fully met’ rating.

So far, the methodology for Sectoral Level analysis has been discussed and it has been noted that the sector level data have two weaknesses:

- The Sweeney survey data is broad, not allowing in-depth analysis of management processes by which management adapted to the new regulations, and
- VWA data may be open to criticism for its technical nature which does not deal with the processes of managerial development and the soft skills that support fully implementing and maintaining an SMS.

Sectoral level data does not provide deep information regarding the social processes behind the application of the new MHF Regulations. Therefore more detailed research is necessary.

### 4.4 Case Studies

The sector analysis demonstrated that the Victorian MHFs were not a homogenous group with respect to their starting point, their Safety Case assessment process, licensing outcome, or Annual Inspection results. To gain a greater understanding of these differences and what influenced an MHF’s ability to achieve compliance, seven MHFs were selected for detailed case studies. One aim of the sectoral level analysis was to enable the selection of case study sites for more detailed investigation.

**Case Study Selection Criteria**

As the MHF licensing process provided a common point for comparison, it was the licence length that was the primary criteria for case study selection as a ‘leader’ or ‘lagger’. ‘Leaders’ were sites that achieved full-term licences in Round 1 and ‘Lagers’
were sites that had reduced-term licences or were refused a licence. The journey these seven MHFs undertook to produce their ‘leader’ or ‘lagger’ status was then analysed through case studies using the data sources listed below. A ‘multimethodological approach’ was taken to case study data collection (Stoecker 1991:101). Trochim (2001:162) notes ‘there is no single way to conduct a case study, and a combination of methods can be used’. The case studies are chronological narratives, outlining the experiences of the MHF and participant actions throughout the Safety Case development process and subsequent licensing rounds (essentially following Figures 4.6 and 4.7). Case study selection criteria focus on points of differentiation highlighted by the sector analysis and are discussed in more detail in Chapter 5.

**Case Study Methodology**

This study presents a unique and rare opportunity to follow a group of MHFs from the beginning of their journey to comply with new legislation. This study is exploratory in nature, developing ideas about the process of adjustment to new MHF Regulations from new data, rather than testing existing theories. This study will use case study methodology (Yin 2003a:3) and observe Stake’s (2005:459) identification of the major conceptual responsibilities of the qualitative case researcher, namely:

1. bounding the case and conceptualising the object of the study;
2. selecting phenomena, themes or issues, that is, the research questions to emphasise;
3. seeking patterns of data to develop the issues;
4. triangulating key observations and bases for interpretation;
5. selecting alternative interpretations to pursue, and
6. developing assertions or generalisations about the cases.

Case study methodology was deemed appropriate for this study due to:

1. the need for inductive analysis to suggest variables that may impact on SMS development and licence outcomes;
2. the desire to focus on lessons from the experiential knowledge of the cases with particular interest in the historical and political contexts (Stake 2005:444);
3. its ability to review contextual and multivariate conditions rather than isolated variables (Yin 2003b:xi);
4. its ability to use multiple sources of evidence (Yin 2003b:xi);
5. its strength in contributing to the practical knowledge of professionals who seek to understand issues and change their practice accordingly (Henry 2004:1); and
6. its applicability to learning from major incidents (Hopkins 1999:1).
Punch (1998:150) states that ‘while there may be a variety of specific purposes and research questions, the general objective is to develop as full an understanding of that case as possible’. This is true of this study, with the objective of developing a full understanding of the MHF’s journey to achieve compliance with the new Victorian MHF Regulations.

The empirical process of the case studies entails examination of several fields of interest. Stake (2005:447) describes six areas of interest for case study researchers:

1. the nature of the case, particularly its activity and functioning;
2. its historical background;
3. its physical setting;
4. other contexts such as economic, political, legal and aesthetic;
5. other cases through which this case is recognised, and
6. those informants through whom the case can be known.

Each case study in this thesis provides information on all of these six areas. However the first item is the central one. To expand on what is meant by the ‘nature of the case’ it is helpful to examine the wider use of policy-related case studies in OHS.

Case study research is a favoured technique for studying safety (Cox & Flin 1998:194). Major incidents (described in Chapter 2) due to their infrequent occurrence are case studies in themselves, and can be ‘a disciplined force in setting public policy’ (Stake 2005:460). The Longford incident certainly meets this criterion. Leading authorities in the field of process safety, Lees (1996), Kletz (1998, 2001, 2003), and Hopkins (1999, 2000, 2002, 2008), all use case studies to examine major incidents delving into the breadth and depth of information available. Following a major incident, ‘the workings of an organisation are laid bare and its failings, normally hidden from view, are open to scrutiny. Disasters therefore are an unparalleled opportunity to study the workings of an organisation and to identify where things are going wrong’ (Hopkins 1999:1). Kletz (2003) and Hopkins (2008) have extracted the similarities and generalities from the individual cases, generating patterns.

OHS case studies are said to be ‘typically (1) of organisations who have suffered major accidents (crisis-prone organisations), (2) of organisations who operate in a hazardous environment but who apparently have a low accident rate (high-reliability organisations) and (3) of organisations who are experiencing extensive change’ (Cox & Flin 1998:194). Esso Longford, meets the first test of having suffered a major incident. All Victorian
MHFs meet Cox & Flin’s second and third tests, with the extensive change being driven by the introduction of the new MHF Regulations.

The use of case studies in a policy setting is common. Yin (2003b:xi) states that:

*case studies have long been one of the most common methods of conducting research for use in public policy and in business and public administration…..case studies have generally been used to document and analyse implementation processes…and can be used to document and analyse the outcomes of public or privately supported interventions.*

The implementation of the MHF Regulations in Victoria, from the regulator’s perspective, is a matter of public policy in response to the Longford incident and public administration, and therefore fits well with Yin’s rationale. From industry’s perspective, the implementation of the MHF Regulations is a public intervention into their business. Both the regulator and industry have implemented processes to comply – the regulator has developed inspection and assessment protocols for MHFs, while industry has developed processes to ensure the safe operation of their plant and documented this through their Safety Case. Case study method is thus a legitimate means of investigating policy intervention upon MHF Regulation.

This study involves a significant interface between political, technical and human elements and their interaction in the regulation of MHFs. Scholz & Tietje (2002:3) report such integrative evaluation (integrating viewpoints from diverse disciplines) as ‘a crucial component of case studies’. This research study is aligned with Scholz & Tietje’s (2002:3) finding that ‘most case studies are conducted in order to improve action and make better decisions.’ While case study research can be conducted outside a policy setting, this was not true for this thesis. The case study research occurred in a context where policy evaluation was integral to the actions of the research participants and to the research protocols for the case studies.

There are multiple examples of case study research being used in the context of OHS policy evaluation. The Australian National Occupational Health and Safety Commission (NOHSC) identified the absence of research on the operation and effectiveness of SMS in Australia, suggesting research be conducted in this area using surveys, longitudinal case studies (mapping system effectiveness over time) and multiple case studies (for comparative purposes) (Gallagher et al. 2001:60). Gallagher’s own research to develop a cross-typology of health and safety management systems examined 20 workplaces.

The number of units studied was seven MHFs, making it a ‘multiple’ or ‘collective’ case study (Stake 2005:445). These data are a purposive, and not random, sample. Denzin and Lincoln (2000:370) state:

*Many qualitative researchers employ…purposive, and not random, sampling methods. They seek out groups, settings and individuals where…the processes being studied are most likely to occur.*

Mason (1996:93-4) further describes this data set as ‘theoretical sampling’ because a group, namely MHFs in Victoria, has been selected to be studied on the basis of their relevance to the research question and they possess certain characteristics which help to develop and test explanations.

This thesis is principally empirical in nature. No experimental controls are applied which Benbasat *et al.* (1987:371) note is a key characteristic of a case study. Case study methodology allows for future developments in the Victorian MHF regime, which were unknown at the outset of this thesis, to be incorporated into this study.

**Case Study Limitations**

The general limitations of case study methodology are recognised to arise from problems of:

1. construct validity – failure to develop a sufficiently operational set of measures with subjective judgement used in data collection (Burns 2000:476);
2. internal validity – inherent bias impacting the perceptions of the researcher such that objectivity and scientific rigour are lost (Yin 2003a:36);
3. external validity - lack of generalisability beyond the case studied (Burns 2000:476);
4. the researcher’s influence on the subjects over time for longitudinal studies (Walsham 1995:77);
5. vetting and approval of final write up of research by participants and/or funding body (Smith 1995:7), and
6. limited access to data and case study sites (Smith 1995:4).

The methods used to minimise these limitations are discussed below.
First is construct validity. The limitations of construct validity will not be considered at this point. This would relate to the SMS Development Model and its operationalisation, and will be considered during the cross-case analysis in Chapter 8.

Second is internal validity. A compromise in internal validity is a potential problem for all forms of qualitative research, not just case studies (Smith 1995:2). Internal validity will be strengthened in this research by triangulating the data, i.e., corroborating the data through multiple sources (Silverman 2005:121). All data collected at an MHF site are accompanied by evidence to confirm the finding, i.e., observations are supported with site documentation such as maintenance schedules, testing records, training records, etc.. Site personnel are interviewed by VWA inspectors and requested to provide the information required. The MHF site representative is informed of the inspector’s finding and is given the opportunity to add to the information. Prior to finalisation of reports, such as Annual Inspection and Assessment Findings Reports (see Appendix L, Table L.5), it is reviewed by three levels of VWA management (manager of the Inspectors, Industry Facilitator for the relevant industry sector and manager of the Safety Analysts), including a sampling review of evidence collected and conclusions drawn, and by MHF senior management (such as the MHF General Manager, Operations Manager and/or Safety Case Manager) with the MHF representative having the opportunity to refute the findings. This aligns with one of Yin’s (2003a:36) three tactics for increasing construct validity. While on site, strict protocols are adhered to by VWA inspectors including the taking of evidence. These protocols ensure consistency between the different individuals collecting data, a need highlighted by Smith (1995:8). As a Senior Safety Analyst, the researcher collected data at some of the sites and authored many reports. As Industry Facilitator for the Plastics & Chemicals Sector and later as Manager, Major Hazards, the researcher was a reviewer responsible for reviewing all reports compiled during that period. Hence the issue of construct and internal validity for the researcher is minimised due to the triangulation of data, and the range of VWA and MHF personnel involved prior to finalising the data.

As reported by Smith (1995:3), the multiple units included in this case study add to the theoretical rigour by providing a higher degree of substantiation of findings, by allowing important variables observed in one MHF to be viewed at other MHFs. Eisenhardt (1991:620) states that ‘multiple cases are a powerful means to create theory because they permit replication and extension among individual cases….This corroboration helps researchers to perceive patterns more easily and to eliminate chance associations….by
piecing together the individual patterns, the researcher can draw a more complete theoretical picture’.

Third is external validity. This is maximised through researching an on-going live operational situation with antecedent events. In terms of general applicability it should be possible to identify a number of common or general elements in the analysis and evaluation of data from the seven MHFs. As discussed by Yin (2003a:10), this study, like most case studies, does not seek to produce results that are universally applicable. Indeed ‘most case-study investigations leave many unanswered questions and pose many hypotheses for further research’ (Evans 1995:81). It should also be noted that the total number of MHFs in Victoria is not large enough to produce statistically significant data, nor are the seven MHFs selected for the case studies. As noted by Mitchell (1983:207) ‘in case studies statistical inference is not invoked at all. Instead the inferential process turns exclusively on the theoretically necessary linkages among the features in the case study’.

Fourth is the researcher’s influence in longitudinal studies. In a longitudinal study, research subjects can be influenced by the researcher over time, thus modifying their actions. This was identified by Giddens and is referred to as ‘double hermeneutic’ (Giddens 1984:284). The researcher’s role at VWA was noted earlier. The researcher’s personal influence at the seven MHFs studied is very limited, if any, due to the large number of VWA employees involved in collecting the data and interacting with the site personnel, rather than just the researcher. This is further limited by the checking of data and reports by three levels of VWA management, thus removing the personal influence of the researcher.

It must also be considered that the MHFs and the companies which operate them are not stagnant over the period of this study and are subject to internal and external influences which change the day-to-day operation of the MHF. Examples of such influences include resignation or termination of key personnel, sale of the facility, organisational restructures, expansion of plant production capacity, decommissioning of plant, changes in the world commodity markets, competition and improved technology. In the cross-case analysis in Chapter 8, internal and external influences on the seven case studies are examined.

Fifth is vetting and approval by research participants or funding bodies. No funding was sought or received from any source to support this research. This thesis has not been
vetted or approved by research participants. However research may have influenced MHF operators. Operators always received feedback at the end of each VWA visit in the form of a Field Report\(^8\) and reports were issued following Annual Inspections and verifications. It is possible that MHF operators could learn from these reports and modify their activities accordingly, and in fact this is the desired outcome when safety breaches are identified. This possibility is considered when analysing the data. However any potential influence is not due to the actions of the researcher, but rather the developing regulatory process of VWA. Also this form of response does not undermine the validity of the case study research process per se.

Sixth is access to data. Full access to data for the seven case study sites has been made available by VWA. This is a policy thesis, focusing predominantly on data held by the policy maker (VWA), however other sources of data have also been included. The next section will describe the data used in the case studies.

**Case Study Data**

Data used for the case studies can be broadly divided into five categories:

1. VWA-generated data;
2. MHF-generated data;
3. Comments and presentations made by MHF personnel in public forums;
4. Surveys commissioned by VWA (as discussed in sector analysis), and
5. Interview data with MHF personnel, contractors and VWA staff.

VWA-generated data were collected by VWA personnel at MHF site visits or assessments conducted during the Safety Case development, licensing and post-licensing process. An outline of VWA's Safety Case assessment process was contained in Chapter 3. Assessment is just one part of the Safety Case life cycle as illustrated in Figure 4.6.

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\(^8\) VWA operational requirement for inspectors, now called an ‘Entry Report’.
Further detail of the annual cyclical process of VWA’s oversight and monitoring phase is illustrated in Figure 4.7. VWA’s activities occurring annually throughout the MHF licence term included site visits as per the oversight plan, individual MHF Reviews, Sector Reviews and Annual Inspection. The oversight plan provides a topic structure for visits to focus on as well as the visit frequency. Individual MHF Reviews were conducted annually to gauge the effectiveness of the regulator’s activities at the site and the MHF’s performance since licensing (Cooke et al. 2004:909). The MHF Reviews provided information at a micro level (Cooke et al. 2004:906). When the individual MHF Reviews were combined across a sector, a macro view of the sector was achieved, known as the Sector Review (Cooke et al. 2004:910). The Sector Review checked for fairness and consistency of the regulator’s approach across all sites in that sector (Cooke et al. 2004:910). It also allowed for the identification of sector-specific issues and the development of proposals to address an issue. The Sector Review was used as a tool for resource allocation by the regulator and it informed future regulatory activity in that sector.
The Safety Case life-cycle (Figure 4.6) provides defined milestones in the chronological development of a Safety Case. VWA personnel monitored the Victorian MHFs and collected data at these milestones in accordance with VWA protocols (see Appendix L), which included a checking process by others of data and conclusions. Much of these data did not exist at the beginning of this study. As each new set of data was generated by the regulator, it was analysed for its applicability to this study and its relevance to each of the four SMS development stages was identified.

VWA-generated data accessed for the case studies included the following:

- **Scoping audits** conducted at potential MHFs prior to the introduction of the MHF Regulations. These provide evidence of the pre-2000 SMS status.

- **Safety Case assessment findings** made from 2001 to 2007 (Round 1 and Round 2) for each MHF were extracted from the Safety Case Assessment Database. These data were examined to identify specific issues and trends.
• **Verification reports** conducted during Safety Case Assessment to confirm stated activities were occurring at the MHF. These reports provide evidence of the SMS’s status.

• **Correspondence** from the regulator to MHFs, regarding assessment progress, extensions to the assessment period and licence decisions.

• **Licensing results** including significant issues discussed at licensing panel provided evidence of the reasons for the licence outcome.

• **Annual Inspection data** regarding control measures and SMS performance at each licensed MHF were collected by VWA Inspectors over a period of 27 months from October 2003 to December 2005. The data collection and recording process follows strict protocols to ensure it is consistent, repeatable and unbiased.

• **Meeting minutes** from meetings between the regulator and MHF personnel, and internal regulator meetings regarding MHF issues. Meeting minutes not only capture the significant issues, but also indicate the attitude of key individuals through their response to the regulator.

• **Sector reviews** comparing performance of MHFs in a given industry sector.

• **Major Hazards Advisory Committee (MHAC) minutes** regarding monitoring and improvement of the MHF regime.

MHF-generated data predominantly consists of documents required to be created by the MHF Regulations. Copies are retained by VWA and the following were accessed for the case studies:

• **Notification data** regarding the nature of activities at MHFs required when notifying VWA of their MHF status. This information was used to categorise sites according to industry sector and provide background information on the operating company.

• **Safety Case Outline** shows the MHF’s plan to develop the Safety Case within the regulatory timelines. This provided the MHF’s perspective on their initial SMS and their planned intent to improve the SMS, including resource allocation.

• **Safety Case** document containing regulatory requirements to demonstrate MHF’s ability to operate safely. Reviewed for SMS summary and documentation.
- **Correspondence** from the MHF to the regulator, regarding clarification points raised by the regulator, extensions to the assessment period and licence decisions.

- **Incident reports** regarding notifiable incidents at Victorian MHFs.

Throughout the Safety Case process, public forums were organised by the regulator, PACIA, unions and community groups for MHFs to share experiences and best practice, question the regulator and/or receive briefing information from the regulator. Many of these groups also made press comments and published reports. These provide an indication of stakeholders’ perception of the regulatory requirements.

Also personal interviews and communication with VWA staff, contractors and MHF personnel were conducted.

For both the sector analysis and case studies, data were examined across the four SMS development stages of Design, Implementation, Operation and Maintenance, as shown in Figure 4.8.

![Figure 4.8: Data Used for Each SMS Development Stage](image)

**Comparative Case Study Analysis**

The seven case studies provide different journeys to licensing and beyond. A greater understanding of the dynamics of achieving compliance with the new MHF Regulations
can be achieved through comparative analysis of the seven case studies. The cross-case analysis examines similarities and differences to identify factors associated with licensing success or otherwise. Twelve factors were identified, by inductive analysis of sectoral and case level data, as particularly relevant to SMS development (in general) and the licensing outcome - as a particular concrete indicator of SMS development. The twelve factors were:

i. Initial Preparedness
ii. Site Management Capability and Employee Representation
iii. Initial Management Acceptance of the MHF Regulations and the Regulator
iv. Initial SMS Development Stage
v. Plans for SMS Development
vi. Use of External Management Resources
vii. Site-specific SMS Development
viii. Regulator Evaluation of SMS Deficiencies
ix. Internal Auditing
x. MHF Licensing Outcomes
xi. Management’s Acceptance of the MHF Regulations and the Regulator – During and Post-Safety Case
xii. External Influences on MHFs

The manner in which these factors impacted the MHF influenced the outcome of the MHF’s licence and hence their status as a ‘leader’ or ‘lagger’.

4.5 Conclusions

Previous chapters have discussed the historical context, the technical justification and the political pressure that led to the introduction of the MHF legislation in Victoria. What remains now is to study the implementation of this legislation in order to explore how the Victorian legislation worked. What does evidence from the 39 MHFs show about the process by which they achieved compliance with the legislation?

This chapter introduced the SMS Development Model encompassing the four stages of SMS development required by the Victorian MHF Regulations. This model provides a common analytical framework for all SMSs and will be used in this thesis. The model is important because its chronological dimension permits evaluation of both MHF ‘learning’ about SMSs, and whether SMSs become real or just paper systems. This chapter has also outlined the methodology which will be used for the sectoral analysis of all Victorian
MHFs, followed by seven case studies and a cross-case analysis. The sectoral analysis, presented in Chapter 5, will examine all Victorian MHFs by dividing them into four sectors; Petroleum, Plastics and Chemicals, Utilities, and Logistics. This sector analysis provides the context for the case studies as well as preliminary findings regarding the SMS Development Model. It also provides selection criteria for the seven case study sites. Chapter 6 contains case studies of the four ‘lagger’ MHFs which did not receive full-term licences. Chapter 7 deals with the three ‘leader’ MHF cases which obtained full-term MHF licences. Chapter 8 then contains a cross-case analysis of all seven case study sites, looking for similarities and differences in their performance and testing the 12 factors listed above, which inductive analysis suggests may have influenced their performance.
CHAPTER 5
SECTORAL ANALYSIS

5.1 Introduction

The Major Hazard Facilities Regulations, which came into effect on 1 July 2000, provided for a performance-based regulatory regime, requiring a Safety Case and SMS, and mandating a licence to operate an MHF. Forty-seven Victorian MHFs were initially registered under the legislation. Of these, 39 continued with the development of their Safety Case as described in Chapter 4. As all 39 MHFs cannot be studied in detail, a sector analysis was performed to gain an understanding of how the MHF Regulations were being implemented by both regulator and industry at an aggregate level. The sectors examined (Petroleum, Plastics & Chemicals, Utilities and Logistics) were determined by the regulator to place MHF operators with industry peers.

This chapter presents the sectoral analysis of Victoria's MHFs using the SMS Development Model and the research methodology outlined in Chapter 4. Where data are available, but cannot be segregated into sectors, the analysis will be noted under the relevant SMS development stage. The aims of this chapter are two-fold. First, it allows broad evaluation of MHF performance against the requirements of the SMS Development Model. Second, it provides a framework to select three MHF 'leaders' and four MHF 'laggers' to be studied in more detail in the later chapters of this thesis and provides for the identification, by inductive means, of factors affecting MHF compliance with the regulations and licensing outcomes.

5.2 A Common Starting Point for all MHFs?

Both VWA, as the regulator, and industry had to come to terms quickly with the requirements of the new MHF Regulations, as the registration provision allowed only 30 months for registration as an MHF after 1 July 2000, as shown in Figure 5.1 (Cooke & Sheers 2003:606). This registration period included the 6-month provision for assessment by the regulator, effectively giving the MHF operator only 24 months to

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89 Part 7 of the MHF Regulations.
develop and submit their Safety Case. At the beginning of the 24 months, the operator was required to develop a plan for their Safety Case activities, referred to as a Safety Case Outline (SCO), and submit it to the regulator.

In the same 24-months from 1 July 2000, the regulator needed to develop an assessment process to determine if compliance had or had not been achieved, in order to grant or refuse a licence to operate.

Figure 5.1: Legislative Time Constraints on Preparing a Safety Case in Victoria
(after Sinclair 2003:3)

A key variable affecting industry’s readiness to meet the new requirements was the prior existence of an SMS. MHF personnel interviewed by Sweeney Research90 were asked Did your organisation have a documented SMS for your hazardous worksite? (Sweeney 2003:A2.17). Eighty-two percent of respondents stated that their facility had a documented SMS prior to the introduction of MHF legislation in Victoria, while 10% did not know if they had an SMS, and 8% stated that they did not have an SMS. Positive responses do not signify the effectiveness, or otherwise, of the SMS.

Figure 5.2 shows sectoral variation. All MHFs in the Petroleum Sector had SMSs in place prior to the introduction of the MHF legislation, and all respondents in that sector were aware of the SMS’s existence. The Utilities Sector had the greatest negative response, with 17% of respondents stating that there was not an SMS in place. The Logistics Sector had the greatest uncertainty, with 17% of respondents stating they did not know if there was an SMS.

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90 More information regarding the Sweeney Research study is contained in Chapter 4.
The more advanced adoption of integrated health, safety and environment management systems by the Petroleum and Plastics & Chemicals sectors was also found in Europe by Cacciabue et al. (1994). These results could reflect the lessons from major incidents such as Flixborough, Seveso, Piper Alpha, Bhopal, Pasadena and Texas City, which highlight the severity of hazards in these sectors.

These results from the Sweeney survey indicate that on 1 July 2000 different starting points existed for Victorian MHFs, some needing to focus their efforts on designing the SMS from scratch.

### 5.3 Factors Influencing Voluntary SMS Implementation in Victoria prior to 2000

Figure 5.2 showed that the four industry sectors had different voluntary rates of SMS implementation before 2000. Further analysis of the Sweeney Research results\(^{91}\) (Sweeney 2003) and site information in Appendix L suggests four factors may have impacted prior readiness:

- complexity of operations;

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\(^{91}\) Made available to the researcher by Sweeney Research Pty Ltd. Further information regarding the Sweeney Research study is contained in Chapter 4.
• length of time the MHF had been operational;
• size (measured by the number of employees), and
• level of corporate support.

These four factors will now be considered.

Complexity of Operations
The relative complexity of MHF production processes and activities was recorded in Appendix L, based on notification data provided by the MHF. These data are presented by industry sector in Figure 5.3.

Figure 5.3 illustrates that the majority of MHFs in the Petroleum and Plastics & Chemicals Sectors are of high or very high process complexity. SMSs were adopted by all Petroleum sites and the majority of Plastics & Chemical sites prior to the MHF Regulations. Conversely, lower process complexity in the Utilities and Logistics Sectors correlates with the lower voluntary uptake of SMSs.

Age of Operation
The Sweeney Research survey asked how long the facility had been in operation (Figure 5.4).

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92 All low complexity Petroleum sites are storage facilities associated with refineries.
Comparison of Figures 5.2 and 5.4 suggests that while the operational age distribution of the Petroleum and Utilities Sectors’ is similar, their SMS implementation rates prior to the MHF legislation were different. These data suggest that age of operation does not influence voluntary SMS implementation.

**MHF Size**

Table 5.1 shows the mean and median number of employees per site by industry sector. The Plastics & Chemicals Sector mean is skewed by one site with over 900 employees. The Utilities and Logistics Sectors have a small number of employees per site.

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Petroleum</th>
<th>Plastics &amp; Chemicals</th>
<th>Utilities</th>
<th>Logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>206</td>
<td>207</td>
<td>40</td>
<td>26</td>
</tr>
<tr>
<td>Median</td>
<td>250</td>
<td>110</td>
<td>40</td>
<td>23</td>
</tr>
</tbody>
</table>

There may be some correlation between the significantly larger number of employees per site in the Petroleum and Plastics & Chemicals Sectors, process complexity, and the higher voluntary introduction of SMSs. From the researcher’s observations at MHFs, the need to direct a large number of personnel and maintain product quality are each likely to be the drivers behind the introduction of a management system in general, and hence
also an SMS. At the facilities with a smaller number of personnel, more direct supervision of activities and informal processes\textsuperscript{93} are possible.

The data demonstrate that MHFs with a large number of employees are more likely to have voluntarily implemented an SMS than an MHF with a small number of employees. This finding is supported by a European study of SMSs for major accident hazards in small and medium enterprises, concluding that ‘small and medium sized enterprises have not been as quick to develop SMSs as larger companies’ (Papadakis 2001:1). This study also concluded that ‘the size of a company is a prevailing factor to the adoption and implementation of an SMS’ (Loupasis et al. 1999:2). Robson et al. (2007:332) also report voluntary SMSs are ‘most frequently observed in large companies’.

Corporate Support
Data in Appendix L indicate the level of corporate support potentially available to each Victorian MHF. The majority of MHFs had significant corporate support, meaning that their organisation had resources available to assist with the Safety Case (often including access to other MHFs with MHF regulatory experience), knowledge existed within the organisation regarding SMSs and there was often a corporate SMS.

Data analysis shows Petroleum and Utilities Sectors to all have significant corporate support. These results reflect the homogenous ownership of multi-nationals in the Petroleum Sector and privatised (previously state owned) utility companies in the Utilities Sector. In contrast, the Plastics & Chemicals and Logistics Sectors had a range of corporate support levels, reflecting the variety of ownership models in these sectors.

The three sites without any corporate support were in the Logistics Sector. These sites, and a further three with limited corporate support, did not have an SMS in use prior to the MHF Regulations. It is also noted that these six sites each had a small number of employees. The significance of corporate support on SMS implementation seems to be important. However corporate support may not always be significant or appropriate for an effective SMS. Significant corporate support did not necessarily mean that knowledge was always accessed, as demonstrated in some case studies. Kletz (2001:271) develops this idea by asking ‘Was Longford a small plant in a distant country that fell below the company’s usual standards...?’ The Longford disaster also demonstrates very clearly that the existence of an elaborate corporate SMS will not

\textsuperscript{93} Such as word of mouth or “this is the way it has always been done”.

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prevent a major incident if the SMS is not effectively implemented at the local site and maintained.

Corporate support may not guarantee an SMS suitable for the local site, however without corporate support, it is unlikely that an SMS will be voluntarily implemented. A corporate driver for implementing an SMS may include performance monitoring and reporting to head office.

**Findings on Factors Influencing Voluntary SMS Implementation**

Some sectoral differences existed in the voluntary implementation of SMSs prior to the introduction of the MHF Regulations. Factors apparently influencing the voluntary implementation of SMSs included the process complexity of the facility, the size and corporate support. Age of operation was not shown to influence voluntary SMS implementation.

These findings align with Frick’s (2011:975) comments on the voluntary introduction of SMSs in large firms with high risks, and are supported by the Canadian review following Bhopal, which identified that the petroleum refining industry had safety and loss prevention programs in place for some time, due mainly to the size of its operations and corporate structure (Environment Canada 1986:8). Karageorgiou et al. (2000:283) report that it is only the very motivated, often larger firms in the UK that develop SMSs voluntarily.

Analysis has suggested there are various reasons why some sites had SMSs in 2000 and some did not. If MHF starting points are different, are there subsequent developmental differences? In the following sections the inter-sectoral variations in SMS design, implementation, operation and maintenance will be investigated to track the impact of the new regulations.

**5.4 SMS Design**

Data on SMS design were not available at a sectoral level and are not reported here. However another design issue is pertinent to the argument. This concerns the requirements of the regulations. For those MHFs without an SMS in July 2000, nothing existed at the SMS design stage other than the requirements of the MHF Regulations. Did the MHF Regulations provide a suitable basis to design the SMS and achieve
compliance with the MHF Regulations? This question will now be examined, with reference to the broad theoretical principles of SMS design outlined in Chapter 2.

The design stage is critical to form the foundations for later implementation, operation and maintenance. The MHF Regulation’s SMS requirements are contained in Regulation 301 and reproduced in Appendix K. The first three parts of Regulation 301 provide high-level information regarding how comprehensive the SMS must be, how it must be used and broadly how it must be presented. The fourth part, Regulation 301(4) which includes Schedule 2 (Appendix K), provides some detail regarding what an SMS should contain and hence its design. Figure 5.5 shows how these regulations compare with the general theoretical design principles set out in Chapter 2 and incorporated in Australian Standards (AS4801).

This comparison reveals that the core elements of risk management (hazard identification and safety assessment), are missing from both the planning and implementation stages. Planning for control measures is also missing. These important elements of risk management have not been completely omitted by the MHF Regulations, but are listed separately to the SMS. This may have suggested the risk management steps are separate and distinct from the SMS (as shown in the regulator’s guidance note, reproduced in Figure 5.6), rather than an integral part of the SMS (Figure 5.7). From a planning perspective, the regulator’s guidance (Figure 5.6) thus suggests the SMS should be developed after HAZID, safety assessment and control measures. This order of activities was followed by many of the case studies.

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94 R301 (1) & (2) require an SMS to be established, implemented and used. R301(3) states that the SMS must be comprehensive and integrated, and requires the SMS to be documented, laid out and written in a manner that its contents are accessible and comprehensible to people who use it.

95 Hazard identification (Regulation 302), safety assessment (Regulation 303) and control measures (Regulation 304).
### Framework (AS4801) vs MHF Regulation SMS Requirement

<table>
<thead>
<tr>
<th>Framework (AS4801)</th>
<th>MHF Regulation SMS Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OHS Policy</strong></td>
<td>R301(4)(a)</td>
</tr>
<tr>
<td>State OHS objectives</td>
<td>R301(4)(b)</td>
</tr>
<tr>
<td>Commitment to improving OHS performance</td>
<td>Sch 2-1.2</td>
</tr>
<tr>
<td><strong>Planning</strong></td>
<td></td>
</tr>
<tr>
<td>Planning identification of hazards</td>
<td>limited - MoC Sch 2 – 5.1</td>
</tr>
<tr>
<td>safety assessment and control measures</td>
<td>none</td>
</tr>
<tr>
<td>consultation</td>
<td>none</td>
</tr>
<tr>
<td><strong>Legal</strong></td>
<td>Sch 2 – 4.2</td>
</tr>
<tr>
<td>and other requirements</td>
<td>Sch 2 – 4 (MHF legal requirement only)</td>
</tr>
<tr>
<td>OHS objectives and targets</td>
<td>design principles &amp; eng standards Sch 2 – 6</td>
</tr>
<tr>
<td>OHS management plans</td>
<td>Sch 2 – 7.1</td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td></td>
</tr>
<tr>
<td>Structure and responsibility</td>
<td>Sch 2 - 2.1, 3.4</td>
</tr>
<tr>
<td>Training and competency</td>
<td>Sch 2 – 2.2</td>
</tr>
<tr>
<td>Consultation, communication and reporting</td>
<td>none</td>
</tr>
<tr>
<td>Document and data control</td>
<td>none</td>
</tr>
<tr>
<td>Hazard identification, safety assessment and control measures</td>
<td>none</td>
</tr>
<tr>
<td>Emergency preparedness and response</td>
<td>Sch 2 – 3.1, 3.2, 3.3, 3.5</td>
</tr>
<tr>
<td><strong>Measurement &amp; Evaluation</strong></td>
<td></td>
</tr>
<tr>
<td>Monitoring and measurement</td>
<td>Sch 2 – 7.2 performance stds to be met</td>
</tr>
<tr>
<td>Incident investigation, corrective and preventative action</td>
<td>none</td>
</tr>
<tr>
<td>Records and records management</td>
<td>none</td>
</tr>
<tr>
<td>Audit program</td>
<td>Sch 2 – 8</td>
</tr>
<tr>
<td><strong>Management Review</strong></td>
<td></td>
</tr>
<tr>
<td>Review all elements at defined interval for suitability, adequacy and effectiveness</td>
<td>R301(5)</td>
</tr>
</tbody>
</table>

Figure 5.5: Comparison of SMS Requirements (Reg 301) of the MHF Regulations with the SMS Conceptual Framework Presented in Figure 2.1
The Regulations (301(3)(a) and 402(2)(a)) require the SMS to be for ‘the management of all aspects of control measures’. This could be narrowly interpreted to include the process once the control measures have been identified and adopted, as presented initially by the regulator (Figure 5.6). Alternatively a broad interpretation would include the initial hazard identification and safety assessment steps necessary to determine where control measures are necessary and the level of protection required from the control measure.

Part 3 of the MHF Regulations (Safety Duties of Operators) begins with the SMS and then requires hazard identification, safety assessment, etc. This suggests the regulation drafters intended the SMS to be an overarching framework, as represented in Figure 5.7, rather than a single (and later) step in the process as per Figure 5.6.
A lawyer involved in drafting the MHF Regulations stated that the drafters carefully followed the recommendations of the Longford Royal Commission, focusing on the inclusion of major incident prevention elements (O’Farrell 2004). It was assumed that MHFs already had SMSs designed for general occupational health and safety management (O’Farrell 2004). This is a further flaw in the SMS design requirements of the MHF Regulations, as integration with other OHS issues is not considered. Due to this drafting assumption, key elements that are critical for the implementation and operation of the SMS, such as documentation, document and data control, consultation, communication and reporting have been omitted from the SMS requirements in the MHF Regulations (Figure 5.5).

From this analysis, with reference to Figure 5.5, it can be demonstrated that the MHF Regulations in themselves, do not provide a complete framework for SMS design. The lack of a complete SMS framework in the MHF Regulations is, in itself, not a significant problem if sites without an SMS are aware of this fact. But this was not made clear in the regulator’s guidance material (VWA 2001e).

Some operators (without an existing SMS on 1 July 2000) set about developing an SMS to meet the exact requirements of the MHF Regulations. They designed their SMS to consist of only the requirements listed in the MHF Regulations, demonstrating a lack of understanding of the need for an initial SMS framework, as described in Figure 2.1.
These SMSs later proved to have a flawed design as they were missing many fundamental system elements such as document control and planning. Hence personnel could not determine if they had the latest version of a procedure.

In summary, the SMS design faults of the MHF Regulations are:

- The MHF Regulations do not provide a complete framework necessary for the design of an SMS;
- The MHF Regulations do not consider integration of major incident aspects of the SMS with more general OHS issues, and
- Guidance material provided by the regulator reinforced the SMS being a separate (and later) step in the risk management process, rather than an over-arching framework.

5.5 SMS Implementation

The importance of SMS implementation was reinforced by the prosecution counsel in the Esso Longford trial (Hopkins 2002:44):

“what this case highlights is that one cannot discharge one’s duty by creating a monumental paper structure and then not implementing it.”

Regulation 301(1) requires that an MHF operator must establish and implement an SMS. Hence SMS implementation is a key focus of WorkSafe’s assessment, which includes verifying the actual extent of SMS implementation.

Determining Extent of SMS Implementation post 2000

During Safety Case assessment, the regulator performed on-site verification to determine the extent of SMS implementation. The exercise revealed a significant shortfall. In 17 out of 39 MHFs (more than 40%), verification found that the operator was not implementing its SMS or control measures as described in the Safety Case. Gaps were significant enough to warrant rapid remedial action, with enforcement directions issued by the regulator. Approximately 20% of sites received one enforcement directive and about a further 25% of sites received two or more directives (WorkSafe 2004b:7 and 33). The Logistics and Utilities Sectors were subject to the most enforcement directives. Referring back to Figure 5.2 reveals that these sectors also started with the lowest level of voluntary SMS implementation.

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96 As documented in the verification reports for each MHF.
The verification results re-enforce the need for documented practices to be checked against actual practice. A study of 12 French companies, with substantial SMS experience under Seveso II, also determined the importance of the inspectorate verifying what is stated in company documentation (Mitchison & Papadakis 1999:45). President Obama echoed these sentiments following the BP Deepwater Horizon oil spill, requesting government agencies ‘trust but verify’ that oil companies were acting appropriately (Hopkins 2011:9). The verification results and the Longford Royal Commission findings illustrate Hudson’s (2008:35) findings that ‘a major characteristic of organisations is the tendency to plan, but not to implement’.

Deficiencies in SMS implementation in early Safety Case assessments provided evidence that VWA may not be satisfied that a licence could be granted within the allowed time97 (Cooke & Sheers 2003:610). In March 2002, the MHF Regulations were amended98 to provide for a maximum of six months additional assessment time99. Should the operator appeal the licence decision to VCAT, further extension to the registration period was provided. Nineteen of the 39 Safety Case assessments required an extension (WorkSafe 2004b:31). The distribution of extensions by industry sector is presented in Figure 5.8.

![Figure 5.8: Distribution of Assessment Time Extensions by Industry Sector: Percentage of Total Cases in Each Sector](image)

The Petroleum Sector had the smallest number and percentage of extensions, perhaps as a result of the longer-established SMSs in this sector. Given the commercial

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97 The tight regulatory timelines for Safety Case assessment were outlined in Figure 5.1.
99 Accompanied by additional time as a registered MHF.
imperative for an MHF to be successfully licensed to continue operation, it is unlikely that the person responsible for the Safety Case development was deliberately misleading the regulator when discussing or documenting the SMS status. The lack of alignment between the Safety Case, SMS documentation and practice, suggests some Safety Case Managers were not aware of the extent of the SMS’s actual implementation. This suggests a disconnect between managerial and operational staff regarding SMS knowledge and understanding. This will be explored in the case studies. This disconnect was not unique to the Victorian MHF regulatory situation and had been identified by the Longford Royal Commission.

All assessment time extensions were granted due to SMS deficiencies, which ranged from the easily remedied need for ‘annotation or cross-reference identifying the specific provision of these Regulations being complied with’ (Schedule 2 4.1), through to ‘as the Safety Management System (as described in the Safety Case) is not yet fully prepared or implemented on the facility in a format that meets the requirements of the Regulations, it has not been possible to conduct a full technical assessment using the Safety Case Assessment Framework (SCAF)’ (VWA correspondence). In all cases extensions were granted. However the latter deficiency required significant work to achieve compliance. Almost half (48%) of all extensions had a combination of issues including SMS deficiencies (Part 3 Safety Duties of Operators), Consulting, Informing, Instructing and Training (Part 5 of the regulations) and content of the Safety Case (Regulation 402) highlighting broader concerns with the development of the Safety Case and SMS. No sectoral trends could be identified regarding the reasons for extension.

Verification during the Safety Case assessment process revealed nearly 50% of MHFs had SMS implementation deficiencies. Yet, full-term licences were granted to the majority of operators who initially required an assessment extension, because the revised Safety Case was of a high quality and no issues were detected with the SMS upon re-verification (WorkSafe 2004b:37). Five reduced-term licences were initially granted to operators that required extensions, that is, SMS implementation issues had initially been detected. Four of the reduced-term licences were in the Plastics and Chemicals Sector, and one was in the Utilities Sector. Two additional sites (Utilities Sector) were refused a licence due to significant SMS implementation deficiencies. Following rectification activities and a VCAT appeal, one refused site was granted a reduced-term licence, giving a total of six reduced-term licences. The ‘lagger’ case studies will examine the processes undertaken by sites receiving reduced-term licences and the refused licence in more detail.
This section has highlighted the importance of SMS implementation, and more generally SMS development, in achieving MHF compliance.

**Operator Observations on SMS Implementation**

OHS policies and practices are a fundamental part of the SMS. Sweeney Research (2003) asked ‘how much of an improvement was necessary in your organisation’s OH&S policies and practices to become licensed?’ Responses to this question can be used to gauge the amount of improvement operators thought was necessary in their organisation’s SMS to become licensed. The results are shown in Figure 5.9.

![Figure 5.9: Extent of Improvement Necessary in OH&S Policies and Practices to Become Licensed](Sweeney 2003 Q19)

Figure 5.9 indicates clear sectoral variations:

- Petroleum: responses are bunched around moderate and small improvement – reflecting the strength of prior SMS practice. Few believed major changes were needed, although none were complacent enough to reject the need for improvement;
- Plastics & Chemicals: in contrast, has more outliers who either accept the need for major change or are complacent;
- Utilities: similar to Plastics & Chemicals has more respondents indicating no or almost no improvement was necessary, and
Logistics: is the most complacent sector with the largest percentage of respondents believing no improvement was necessary. This possibly reflects this sector’s lack of openness to change, as was evident in a number of the case studies. In contrast, this sector recorded the largest response to ‘quite a large improvement’, suggesting some sites recognised the need for significant improvement.

Overall, these results show respondents generally recognised that improvements were needed to the majority of SMSs to achieve an MHF licence. However as it has been identified that not all MHF SMSs were at comparable developmental stages when the MHF Regulations were introduced, the actual type and extent of SMS improvements are likely to vary significantly. It is suggested that the Petroleum Sector coming from an established SMS base, made planned rational decisions regarding SMS improvements using tools such as gap analysis (Franks et al. 1999) to make incremental improvements. In contrast to the Petroleum Sector, the Logistics Sector generally had a reactionary response to making improvements in the SMS with a number of personnel (13% of respondents) in denial that any improvement was necessary or justified despite, as the case studies will indicate, the rudimentary nature of SMSs in this sector.

SMS Implementation Post Licensing

Verification of SMS implementation did not end at the point of licensing. Throughout the licence term, WorkSafe monitored MHFs for their continued implementation of SMSs using the Annual Inspection process. The researcher had access to the regulator’s Annual Inspection Reports for each Victorian MHF (as listed in Appendix L) and has aggregated the data into industry sectors for analysis in this study. The ratings (described in Chapter 4) of ‘fully met’, ‘partially met’ or ‘not met’ refer to how VWA observations aligned with the information and criteria provided in the site’s Safety Case or on-site documentation. Figure 5.10 contains the SMS element implementation results for each of the sectors for their first Annual Inspection.
Figure 5.10 shows significant sectoral differences, with the Petroleum Sector strongest at fully implementing their SMS elements, followed by the Plastics and Chemicals and then the Utilities Sectors. The Logistics Sector was significantly different from the other three sectors, achieving only 25% fully implemented. The Logistics Sector had significant development work ahead to establish effective operational SMSs; a finding also supported by a study of French MHFs (Mitchison & Papadakis 1999:45). All four sectors recorded low rates of ‘not implemented’.

**SMS Implementation and Control Measures**

VWA’s Annual Inspections also examined control measures. Both control measures and the SMS provide protection, either preventative or mitigative against potential major incidents. As stated in Regulation 301(3)(a) of the MHF Regulations, ‘the SMS is to provide a comprehensive and integrated management system for all aspects of control measures’. Clearly there must be a linkage between the SMS and control measures.

In Chapter 2, control measures were described as barriers of defence between the hazards and the major incident in Reason’s *Swiss Cheese Model* (Figure 2.3). Analysis of major incidents, contained in Chapter 2, indicated that they are commonly caused by a series of simultaneous failings, initiated by a single trigger event. Mitchison & Porter (1998:i) found that failures of the SMS contributed to the cause of over 85% of the accidents reported since the introduction of Seveso I. If the SMS sits across all aspects of operation and maintenance activities at the site, it should prevent both latent failures and major incident triggers. But what, if any, is the linkage between SMS elements and control measures?
The definitions for control measures and SMS elements, which include the important linkage between the two, were discussed in Chapter 4. These definitions were applied to the Annual Inspection process. To illustrate this linkage, a ‘bow-tie’ diagram is helpful. The ‘bow-tie’ diagram, initially developed by Royal Dutch Shell plc, is a method of graphically presenting the relationship between various control measures, both preventative and mitigative and the hazards, major incident and consequences (Philley 2006:29). Fundamentally the bow-tie contains the fault tree analysis on the left hand side, the top event being the major incident (placed in the middle of the bow-tie) and the event tree analysis on the right hand side. No quantification is performed, with the focus being on the structure of the trees (Pitblado & Smith 2000:11). The bow-tie diagram is a further development on Reason’s (1997:9) Swiss Cheese model, illustrating barriers between the hazards and major incidents. Figure 5.11 includes a bow-tie diagram, which the researcher has overlaid with the key building blocks of the Safety Case that help generate the bow-tie, these being, hazard identification (HAZID), safety assessment and control measure review. As presented in Figure 5.7, the SMS provides an encompassing framework around these activities. The SMS is included in Figure 5.11 to illustrate the overall SMS framework (indicated as ‘Level 1’) which then contains specific procedures and practices (indicated as ‘Level 2’) that determine or guide the activities at Level 3, which include control measures. This includes the maintenance and testing of control measures.

100 Previously discussed in Chapter 2.
The importance of the linkage between the **SMS element** and **control measure** was re-enforced to the researcher through the verification and Annual Inspection processes of Victorian MHFs. The SMS element must support the control measure, otherwise the control measure’s performance cannot be guaranteed. This is the requirement of Regulation 301(3)(a) of the MHF Regulations. If the performance of the control measure is not supported by the SMS, the operation of the SMS will fail to prevent or control major incidents. Hence while the linkage between the control measure and the SMS can be initially implemented, it is only operation over time that will determine the sustainability of the implementation and the strength of the linkage between the SMS and the control measure.

**The Regulator’s Understanding of the Control Measure/SMS Linkage**

Initially the important linkage between a control measure and the SMS element was not actively identified or tested by WorkSafe. Often only the control measure or only the SMS element was verified, not both, hence the linkage between the two was not examined (Yeoman 2003). It may be hypothesised that this ‘unlinked’ inspection approach was not peculiar to Victoria, and would be widely practiced around the world. Karageorgiou *et al.* (2000:280) report the inspection and enforcement practices of the Danish Labour Inspectorate\(^{101}\), consist of ‘two rather separated aspects, that is, the

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\(^{101}\) Under Adopted Inspections (discussed further in Chapter 9).
correction of shop floor irregularities [this may be control measures] on the one hand, and of system irregularities [SMS elements] on the other hand’.

SMS elements for Annual Inspection were initially selected without consideration of the associated control measures (Quake 2003). VWA trialled utilising the linkage between control measures and SMS elements in the Annual Inspection simultaneously at MHF sites P&C4 and P&C11102 in January 2004. Both Annual Inspection teams at P&C4 and P&C11 reported benefits in time, resource efficiency and usefulness of findings through using the linked approach to examine control measures and SMS elements (trial debrief meeting minutes 22 January 2004). Based on the positive findings of this trial, all subsequent Annual Inspections selected and verified the control measure and associated SMS element as a ‘pair’. This clearly identified SMS weaknesses and gained operator support, as concrete examples were provided of a specific control measure observation and then how the SMS element was not being fully supportive.

**MHFs’ Understanding of the Control Measure/SMS Linkage**

From the researcher’s observations, the relationship between control measures and the SMS was the most difficult linkage for the majority of MHF personnel to understand and appreciate. The building blocks of the Safety Case (HAZID, safety assessment and control measure review) had clear linkages as the output of one activity was required as the input for the next activity. However, as the SMS at the majority of MHFs was already in existence prior to the Safety Case building block activities being conducted, a clear method for linking the control measures and the SMS was not always apparent, and in many instances did not exist. As noted above, deficient SMS design guidance from the regulations amplified this tendency.

Sometimes SMS elements were shown on bow-ties in the line of related control measures, for example ‘PRV-123’ was the control measure, followed by ‘Procedure XYZ – maintenance of PRVs’. But the researcher observed that the inclusion of SMS elements on bow-ties was not systematically evident. The diagram provided in WorkSafe’s Guidance Note 3 (VWA 2001c), replicated in Figure 5.6, shows the Safety Case building blocks followed by the SMS and then Emergency Planning. It is unlikely that this diagram aided MHFs’ understanding of the linkage between the SMS and control measures.

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102 The first scheduled Annual Inspections for 2004.
Many SMS deficiencies that required assessment extensions and/or resulted in reduced-term licences stemmed from the MHF being unable to detect areas where the SMS was not supporting the control measure. In most instances, it was the regulator who identified this issue during either Safety Case assessment or verification, when little time remained for the MHF to rectify the situation. This fact suggests that the MHF did not have a good understanding of the linkage between the SMS and control measures, nor how to detect problems in this linkage. These issues will be explored further in the Case Studies.

**Control Measure Implementation**

Once the linkage between the SMS and control measures was established, what did Annual Inspection results for control measure implementation indicate? Did they follow a similar pattern to SMS implementation? Figure 5.12 shows control measure implementation by sector for the first year of Annual Inspection.

![Control Measure Implementation by Sector in First Year of Annual Inspection](image)

Control measure implementation (Figure 5.12) is similar to SMS element implementation (Figure 5.10) showing a sector hierarchy with strongest performance in the Petroleum Sector and weakest results in the Logistics Sector. Once again this may be linked to the different voluntary rates of SMS implementation prior to 2000. If SMSs have been in place for a longer period of time, better overall support for control measures might be anticipated and hence stronger control measure results would be observed.

At the end of the first year of Annual Inspections, there was room for improvement in the level of control measure implementation in all sectors, particularly in the Logistics Sector. As a result, the Logistics Sector was given focused attention by the regulator, receiving more frequent visits from Inspectors and Safety Analysts. Were there any significant changes in the second year of Annual Inspection data?
Figures 5.13 and 5.14 compare SMS and control measure implementation across the four sectors for the second year of Annual Inspection.

Some sectoral variance was observed. Like the previous year’s results, the Petroleum Sector demonstrated strong SMS implementation. However the Plastics and Chemicals Sector recorded the worst ‘fully implemented’ results and the Logistics Sector showed significant improvement. Why was there such a difference in results across the two years? Potential selection bias was discussed in Chapter 4. It is possible that the increased attention from the regulator in the Logistics Sector led to SMS improvements. Did the regulator’s reduced visit frequency and comfort from being licensed also cause lapses at Plastics & Chemical Sector sites? Or were Plastics & Chemicals sites making changes to their SMS at the time of the Annual Inspection and hence the increase in ‘partially met’ ratings as the revised procedure and practice were brought into alignment?

Did the control measure results show a similar improvement in the Logistics Sector and decrease in the Plastics and Chemicals Sector?
Figure 5.14: Control Measure Implementation by Sector in Second Year of Annual Inspection

Figure 5.14 shows there was little sectoral difference in the ranking of control measure results for the second year of Annual Inspection. While the Logistics Sector showed a significant improvement on its previous year’s results, the Plastics & Chemicals Sector’s control measure results did not mirror the significant decrease observed in SMS implementation results. This favours the argument that the Plastics & Chemicals Sector was revising their SMSs at the time of Annual Inspection rather than allowing SMS deterioration. The overall strong control measure implementation results suggest that the Safety Case process encouraged MHFs to return to the basics of ensuring control measures were implemented and then supported with an SMS element.

Over the two years of Annual Inspection at licensed MHFs, SMS and control measure implementation results indicate less than perfect (100%) levels of implementation. If SMS implementation provides a foundation for on-going operation of the SMS, it is anticipated that operation results will also be less than perfect. The next section investigates SMS operation.

5.6 SMS Operation

As defined in Chapter 4, the operation stage is the actual performance and discharge of functions following implementation of an SMS. Implementation is commonly associated with new activities, or putting components into place for the first time. Operation can be viewed as on-going, or sustained, implementation where any initial novelty has passed and the activity or process becomes part of the system status-quo.
The Longford Royal Commission noted the lack of attention given to the actual operation of the SMS:

*The Commission gained the distinct impression that there was a tendency for the administration of OIMS to take on a life of its own, divorced from operations in the field. Indeed, it seemed that in some respects, concentration upon the development and maintenance of the system diverted attention from what was actually happening in the practical functioning of the plants at Longford.* (RLRC 1999:13.40)

Figures 5.15 and 5.16 display the SMS element and control measure operability results for each of the sectors for their first Annual Inspection.

![Figure 5.15: SMS Element Operability by Sector in First Year of Annual Inspection](image1)

![Figure 5.16: Control Measure Operability by Sector in First Year of Annual Inspection](image2)

The sector hierarchy, observed in the first year implementation data (Figures 5.10 and 5.12) is replicated here (Figures 5.15 and 5.16). However the spread of results for SMS
operability between the sectors is not as great as it was for implementation. Also control measure results are stronger than SMS results.

Figures 5.17 and 5.18 display the SMS element and control measure operability results for each of the sectors for their second Annual Inspection.

**Figure 5.17: SMS Element Operability by Sector in Second Year of Annual Inspection**

The Logistics Sector was the only sector to record an increase in SMS element operability across the two years of Annual Inspection, however the magnitude of the rise was not as large as for the second year of implementation. This suggests a time lag exists between SMS implementation and operation. The Utilities Sector recorded similar results to the previous year. Both the Plastics & Chemicals and Petroleum Sectors had reduced SMS element operability from the previous year.

**Figure 5.18: Control Measure Operability by Sector in Second Year of Annual Inspection**
As with implementation, control measure operability increased significantly in the Logistics Sector possibly due to increased attention from the regulator. The Petroleum Sector recorded the largest decrease in operability across the two years, attracting the attention of the Major Hazards Advisory Committee (MHAC 2005). MHAC required the apparent decrease in the Petroleum Sector’s performance be investigated, with WSV concluding two issues were present:

1. Petroleum was the first sector to undergo Annual Inspection, suggesting some potential leniency in the initial application of ratings versus strict application by the second year due to developing experience of the regulator in performing Annual Inspections.

2. Decreased operability was primarily due to a lack of follow-up and close-out of action items. (MHAC 2005)\textsuperscript{103}

**Comparing Operability with Implementation**

The difference between implementation and operability results indicates that the SMS elements are not fully effective and are not providing the maximum protection against major incidents.

Comparison of Figures 5.10 with 5.15, and 5.13 with 5.17, shows SMS operability results are lower than implementation results, except in the Logistics Sector in the first year.

The results in the Logistics Sector were an anomaly, recording 11% greater operability than implementation. This was due to the definition established prior to the inspection for ‘implemented’ and ‘operational’. The specific instances where operability was rated higher than implementation included items such as ‘contractor management’ where the selection and appointment of the contractor did not follow the procedure due to poor implementation (hence ‘partially implemented’); however all contractors had received the necessary site inductions. This provided operability against the identified hazard of contractors not being aware of the site operations and potential hazards around their work area. Contractor’s reports were regularly reviewed by the operating company, appropriate corrective action taken and non-conformances with contractor activities were addressed with the contractor (hence ‘fully operable’).
Further examples from the Logistics Sector indicate informal methods existed. Limited formalisation of safety management in small and medium enterprises (predominantly logistics MHFs) in Europe was also reported by Papadakis (2001:5).

The Petroleum Sector had some ‘not implemented’ SMS elements in the first year (Figure 5.10). However these SMS elements achieved ‘partial operability’, rather than ‘no operability’. The ‘not implemented’ SMS elements had been recently revised and approved, but had not been implemented. That is, a previous version of the SMS element was still in operation, despite a better process being available. Unlike the Logistics Sector where informal processes existed, the Petroleum Sector displayed aspects of corporate continuous improvement, however the on-the-shop-floor implementation was not always moving forward at the same pace.

Control measures also had reduced operability compared with implementation results, indicating that control measures were not operating effectively and that maximum operability was not being achieved. Deficient operability results indicated that the day-to-day operation of the control measure was being compromised and hence the barrier it provided between the hazard and major incident was not complete.

However, for all sectors, the control measure results were stronger than the corresponding SMS results. These observations suggest that MHFs are better at identifying the need for a control measure to be implemented, than checking that it is achieving its intended purpose and supporting it with an SMS element to ensure the control measure continues to operate as required. An example is confirming that the temperature controller (control measure) is set at the correct temperature and that any interlocked actions are correct to prevent a reaction runaway.

These results indicate that the SMS was operating at a less than optimal level, possibly giving the operator a false sense of safety, believing the SMS was implemented, but not being aware of its lack of operability. These results suggest the presence of latent failures (as described in the Swiss Cheese Model in Figure 2.3). If a control measure is called upon in an emergency, its level of operability cannot be guaranteed if there are failures in the operability of its supporting SMS element.

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104 Except for the Petroleum Sector’s SMS implementation results which were 1% greater than the control measure implementation results, 93% and 92% respectively. Given the very small sample size, this 1% difference is considered insignificant.
105 Through the risk management process of hazard identification, safety assessment and control measure review.
Overall, the data suggest that at the time of the research, licensed MHFs had SMSs in place that were – to a significant degree - inoperable. However as no clear sectoral trends are evident, a deeper understanding of the MHFs and their SMS is sought, which will be achieved in the case studies.

**Incident Data**

A further indicator of SMS operation for the whole MHF population (all four sectors) is incident data (Mitchison & Papadakis 1999:46). Figures 5.19 and 5.20 contain reported incidents\(^{106}\) from MHFs to VWA for October 2002\(^{107}\) – December 2004 and January 2005 – December 2005 respectively\(^{108}\).

![Figure 5.19: Incidents at Victorian MHFs – October 2002 to December 2004 (after WorkSafe 2005:3)](image)

From Figure 5.19, total reported incidents decreased from an average of 17 per month in October 2002 to 11 incidents per month in December 2004. While this overall decreasing trend continued in 2005 (Figure 5.20), the 12-month average is distorted by May, with the post-May data being below the pre-May data. The number of serious and significant incidents also decreased over the same period. While there are many potential variables influencing incident data, which have not been measured nor included in this study, it is suggested that the observed decreases may well be due to the focus on implementing control measures (from risk management activities) and SMS elements due to the introduction of the MHF Regulations.

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\(^{106}\) Categories and definitions of reported incidents are listed in Table 4.4.

\(^{107}\) Data prior to Oct 2002 is not available.

\(^{108}\) To date, VWA has not published further incident data suitable for further longitudinal analysis.
Figure 5.20: Incidents at Victorian MHFs – January 2005 to December 2005 (after WorkSafe 2006:4)

Figures 5.21 and 5.22 show the root causes of enforcement notices issued on defective control measures and SMS elements respectively at Victorian MHFs in 2005.

Figure 5.21: Root Causes of Enforcement Notices Issued to MHFs with Control Measures Not Adopted in 2005 (after WorkSafe 2006:3)

Figure 5.22: Root Causes of Enforcement Notices Issued to MHFs with SMS Deficiencies in 2005 (after WorkSafe 2006:3)
‘Auditing & monitoring’ and ‘Inspection & testing’ account for 60% of enforcement notices on control measures and 43% of enforcement notices on SMS elements. ‘Procedural’ issues for both control measures and SMS elements suggest that there is a divergence between observed operation and documented practice. Birkmire et al. (2007:580) suggest this divergence could be as a result of employees not having a full understanding of process safety requirements and why these perceived ‘barriers’ (control measures and SMS elements) to productivity are in place. This is often due to information being provided on a ‘need to know’ basis, rather than a complete training program. Birkmire et al. conclude that the best SMS on paper won’t be successfully implemented if it is not understood by those charged with performing the daily operational requirements. This supports the Longford Royal Commission’s finding regarding the importance of training (RLRC 1999:15.17).

Overall, the reported incidents from MHFs suggest an increase in focus on preventing major incidents, through the introduction of the MHF Regulations in Victoria, is having beneficial results in reducing reportable incidents. However more gains can be achieved in reducing the incident rate, and it is possible that this may be achieved through a greater understanding of the linkage between control measures and SMS elements and the overall operational health of the SMS. Mitchison & Papadakis (1999:46) report that the SMS ‘can fully operate only when a number of control loops integrate effectively all relevant system elements at all levels of operation. Such control loops will include some fundamental elements such as: policy setting and standards drawn by regulations and norms; implementation procedures and training; operator and equipment reliability; and monitoring, control and revision.’ Monitoring and revision will be considered next in ‘maintenance’.

5.7 SMS Maintenance

The maintenance stage is the facilitation of the continuation of existing operational functions and systems, as defined in Chapter 4. The maintenance stage both supports and follows the operational stage and includes continuous improvement of an SMS.

To maintain an SMS implies that the operator first needs to understand if, and where, the operation of the SMS is lacking or not achieving its intended purpose. Examining the linkage between control measures and SMS elements may hold the key to this understanding. This is a form of auditing. Auditing is the formal process of testing the
operation of the SMS and identifying areas requiring improvement. According to Hoyle (2003:8), an audit is ‘an examination of results to verify their accuracy by someone other than the person responsible for producing them. Audits are a means of verification and, as such, involve monitoring and measurement’. According to ISO 9000 (2005:3.9.1) the definition of an audit is the ‘systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which audit criteria are fulfilled’.

As auditing is conducted on a live system, the SMS must be operational before meaningful auditing can give feedback on the operation of the SMS. Auditing is the first step in maintaining the SMS. The second, and most crucial, step in SMS maintenance is taking action to implement the improvements identified during audits. This is the closure of the circle in the SMS Development Model linking ‘maintenance’ back to ‘design’ as improvements should be designed, implemented, operated and maintained. SMS maintenance must therefore be viewed as an integrated and continual process dedicated to the safe operation of the system, and not a discrete process set apart from the operation of the system, and performed only at specific times.

During the MHF licence term, VWA used Annual Inspections as the key activity to monitor the maintenance of SMSs, in a similar manner to SMS implementation and operation. Each SMS element examined during Annual Inspection for implementation and operability, was also inspected for maintenance by examining the audit process for that SMS element. Figure 5.23 displays the SMS element auditing results for each sector for their first Annual Inspection.
Figure 5.23 shows that the Petroleum and Plastics & Chemicals Sectors have similar auditing results with approximately two-thirds of inspected SMS audit activities being performed as described by the site. The Logistics Sector recorded the weakest auditing results, with only one-third of auditing requirements being fulfilled.

These results show similar trends to SMS element implementation and operability displayed in Figures 5.10 and 5.15, with the exception of the Petroleum Sector not achieving significantly greater results for ‘fully met’ than the Plastics & Chemicals Sector.

Poor internal auditing indicates an inability to self-identify deficiencies, hence deficiencies are more likely to be identified by third-parties, such as the regulator. Hence it is anticipated that MHFs with poor auditing results would be more likely to receive a higher number of regulatory interventions/enforcement actions. This was evident in the Logistics Sector. These results may also suggest that sites with poor auditing results haven’t yet reached the ‘maintenance’ stage of the SMS Development Model, as their attention is still focused on either SMS implementation or operation.

Figure 5.24 displays SMS element auditing results for each sector for their second Annual Inspection.

![Figure 5.24: SMS Auditing by Sector in Second Year of Annual Inspection](image_url)

In the second year of Annual Inspection, the Petroleum Sector demonstrated some improvement. The Logistics Sector showed the greatest improvement which was accompanied by significant improvement in control measure and SMS operability results. The Plastics & Chemicals and Utilities Sectors’ results indicate a deterioration from the previous year. The Utilities Sector recorded just over one-third of SMS elements examined as ‘not met’.
**Second Year Bias and Common Failings**

Detailed examination of the Second Year’s Annual Inspection reports for the Plastics & Chemicals, Utilities and Logistics Sectors reveal WorkSafe included SMS elements that relied on a third party to deliver the service, and the emergency response plan. It was in both these areas that the sectors performed poorly in auditing. These SMS elements were not a focus of the Annual Inspection in the Petroleum Sector. Hence this inspection focus may have introduced negative bias to the three worst performing sectors, which was partially overcome in the Logistics Sector by increased regulatory assistance at the sites.

On average only three SMS elements were sampled for auditing at each MHF. Hence it cannot be conclusively stated, based on these data alone, that the individual MHF’s SMS, or the sector, has deteriorated from one year to the next. The sample is too small. However, the results do suggest there is significant opportunity for improvement in SMS maintenance.

Common maintenance failings identified during the Annual Inspections were lack of MHF resources to conduct the audits to schedule, no follow-up on the actioning of audit recommendations, and no recognition that the service provided by a third-party needed auditing. Of the 89 SMS elements involving third-party contractors examined in the two years for all sectors, only 46% were fully audited and 38% of the total were fully operational.

Annual Inspection results for the second year (Figure 5.24) show around 30% of auditing activity achieved ‘partial’ rating for all sectors. In many instances audits were occurring, that is, site personnel were going through the motions of conducting the scheduled audits, however they were not looking for the vital things that make the audit effective.

These observations are supported by Kletz, reporting on the aftermath of Piper Alpha:

> Clearly, there was no shortage of auditing of the Piper platform and the way it was being operated. What was deficient was the quality of that auditing. Not only were departures from laid-down procedures not picked up, but the absence of critical comment in audit reports lulled the senior management into believing that all was well. (Kletz 2001:203)
Detecting SMS Deficiencies

The aim of maintaining the SMS is to ensure practice and procedure align, so that safety is being achieved at the MHF in the manner designed or intended. Hence maintaining the SMS is undertaken to support and ensure the safe operation of the SMS and the delivery of safe work practices and equipment at the MHF.

A key tool to maintain an SMS is an active auditing process that can detect deficiencies in the SMS, and then an active action close-out process that monitors the progress of actions raised during audits and ensures their successful close-out. Ensuring the action items themselves go through the SMS Development Model of design, implementation and operation is necessary to achieve sustainable improvement.

Following WorkSafe’s Annual Inspections at Victorian MHFs the operator of the facility was often interested to know how the regulator was able to find deficiencies in their systems that their own personnel or external auditors had not detected. Contrary to some opinions, the regulator did not receive ‘tip-offs’ from disgruntled employees on where to look! The strength of the Annual Inspection program came from systematically approaching a Safety Case with the following key objectives:

- control measures were selected across the range of risk scenarios (operators often focus on the high risk areas and miss other aspects of the plant. This approach also checks that the systems are implemented across all risk scenarios of the site).

- preventative and mitigative control measures were both selected (organisations often have a corporate focus on just one aspect and are weak at the other: major incident prevention requires both preventative and mitigative control measures, as illustrated in the bow-tie diagram (Figure 5.11). For example, some operators pride themselves on engineering control measures, but may be weak on emergency response.

- a range of control measures covering procedural and engineering controls was selected (procedural controls require training, whereas engineering controls require maintenance and testing).

This systematic and targeted approach differs from the common auditing approach of ‘random sampling’ from the SMS (Birkmire et al. 2007:575). This targeted approach is the key to auditing the SMS from a major incident perspective and requires the regulator’s Safety Analyst to exercise technical judgement to detect areas of significance.
In turn, this gives the regulator some credibility with the operator for examining areas of major incident significance, rather than peripheral aspects of the SMS such as office furniture purchasing (which had been included in an earlier WorkSafe audit at a Petroleum Sector MHF, with site feedback being that the regulator did not understand their main issues).

Annual Inspection (and verification) included both conformance verification and effectiveness confirmation as described by Kausek (2006:4). The selected control measures were used to provide an introductory point to start examining the SMS element based on the linkage between the control measure and SMS. For example, rather than discussing training in general, the specific procedural control in the training program was found and then this specific training was found in the training records. Another example is identifying a specific high level alarm in the maintenance work requests, and then tracing it through the inspection history database or files.

Checking the operability of a control measure or SMS element and then taking action to improve its operability should be undertaken as part of an active internal auditing process. Results above showed that internal auditing was poorly implemented, with only approximately 60% of auditing occurring in the Petroleum and Plastics & Chemicals Sectors, and substantially less in the Utilities and Logistics Sectors. It is suggested that the lack of effective internal auditing contributed to the poor operability results for control measures and SMS elements. In terms of the SMS Development Model, it is possible that many MHFs were not yet at the ‘maintenance’ stage and were therefore not yet fully able, or capable, of focusing on auditing. These sites need to expend time and resources on ensuring implementation and operation stages are complete. This is explored in the case studies and discussed in Chapter 8.

The U.S. Refineries Independent Safety Review Panel, following the BP Texas City refinery incident urged:

…companies to regularly and thoroughly evaluate …the performance of their process safety management systems, and their corporate safety oversight for possible improvements. (Baker 2007:i)

From analysis of Annual Inspection SMS auditing results, common deficiencies were identified across all sectors regarding:

- **contractor management**: 89 of the 231 SMS elements inspected over the two-year period involved contractor management. Of these 89 contractor management-related SMS elements, 22% were not audited (compared with 14%
of all SMS elements), 32% were partially audited (same percentage for all SMS elements), and only 46% were fully audited (compared with 54% of all SMS elements). With reference to the SMS element/control measure linkage, these poor SMS results suggest that the associated control measures will also be poor due to the lack of effective support from the SMS elements. Across the same period, 223 out of 658 control measures inspected involved contractor management. Of these 223 contractor management-related control measures, 12% had no operability (compared with 7% for all control measures), 36% had partial operability (compared with 31% of all control measures), and only 52% had full operability (compared with 62% for all control measures). Overall these data paint a damning picture of control measures and SMS elements that are in-principle managed by experts in their field.

- **critical function testing**: The testing of trips, interlocks and shutdown systems to ensure operability is often referred to as critical function testing (CFT). While being part of the SMS, CFT is often the responsibility of the maintenance department, and as such often resides in the maintenance management system, which may or may not be an integral part of the SMS. CFT is an important activity for maintaining control measure operability, however WSV identified deficiencies in CFT across all sectors.

- **performing effective safety audits**: WorkSafe’s Annual Inspections and verification activities are examples of third-party audits (Hoyle 2003:8). In contrast, internal audits are conducted by the organisation’s own personnel (Hoyle 2003:8). Effective internal audit processes should be capable of identifying all systematic weaknesses before they are found by a third-party (Kausek 2006:40). WorkSafe’s identification of systematic weaknesses in some SMSs in areas previously examined by internal auditors, indicates the internal audit program at those MHFs is not fully effective.

All of these areas will be explored further in the case studies.

Birkmire et al. (2007:597) noted similar common auditing deficiencies in Process Safety Programs under OSHA, including ‘no periodic contractor evaluation’, ‘ineffective inspection and test program’ and ‘ineffective compliance audits’ and ‘unresolved action items’.

Overall auditing results were poor for all sectors over the two-year period. It can be suggested that poor auditing leads to overall poor maintenance of the SMS, which results in deterioration or incomplete implementation. Maintenance is an area where
significant improvement needs to be achieved at Victorian MHFs. The case studies will examine SMS maintenance practices and the cross-case analysis will highlight positive and negative SMS maintenance practices.

5.8 The SMS Development Model: Conclusions from the Sector Analysis

Overall the Sector Analysis has shown that all four stages in the SMS Development Model are not as effective as intended, and that the stages differ in their degree of strength. Differences in the strength of each stage are shown in Figure 5.25. One important initial finding is that MHFs were generally licensed after they had passed the implementation stage. But many MHFs needed assessment extensions to get to this point. Also their SMSs generally remained deficient in terms of the Operation and Maintenance stages. Inspection data after licensing revealed flaws that licensing alone may not have.

![Diagram of SMS Development Model Stages]

**Figure 5.25: Relative Strength of SMS Development Model Stages**

The Sector Analysis has identified weakness in the four stages of the SMS Development Model, including the importance of the SMS/control measure linkage. The range of data examined in the Sector Analysis suggests that not all sites are the same, and that detailed case studies would be beneficial to understand the individual journey taken by some MHFs to achieve compliance with the MHF Regulations, and what influencing factors can be induced and how these relate to the SMS Development Model.
Design
Sectoral differences are apparent in the readiness level of MHFs when the MHF Regulations were promulgated. The Petroleum Sector MHFs all had existing SMSs, however the other three sectors had some MHFs without existing SMSs. Examination of the voluntary introduction of SMSs showed process complexity, number of employees and level of corporate support, to be influencing factors. By their very nature, greater levels of these factors are found in the Petroleum and Plastics & Chemicals Sectors, compared with the simpler and smaller Utilities and Logistics Sectors. However the SMS requirements in the MHF Regulations were shown to provide an incomplete framework for SMS design. This was exacerbated by the regulator’s guidance material, showing the SMS as a single step after hazard identification, safety assessment and control measures, rather than an encompassing framework. These short-comings in the MHF Regulations are unlikely to be a problem for sites with established SMSs, however they may pose a problem for sites designing an SMS from scratch. From these findings it has been induced that an MHF’s background readiness and the initial status of the SMS could be influencing factors which should be considered in the cross-case analysis.

Implementation
Safety Case assessment revealed nearly 50% of Safety Cases needed time extensions, all of these extensions were due to SMS implementation deficiencies. The Petroleum Sector required the least number of extensions, with the other three sectors each accounting for nearly one-third of extensions granted. The Plastics & Chemicals Sector was over-represented in the reduced-term licences and both the refused licences were in the Utilities Sector (one later granted following rectification work and a VCAT appeal). Inductively these findings suggest SMS deficiencies can potentially impact the licence process and ultimately the licence outcome. Both these factors will be considered in the case study analysis.

The Sector Analysis concluded improvements were made to the majority of SMSs to achieve a licence. What is not clear, is what the type and extent of these improvements (and initial deficiencies) were, how they were achieved and whether they were successful. The role of management and employees in this improvement is also not evident from the Sector Analysis. This will be further explored in the case studies.

In considering SMS implementation, the disconnect between managerial and operational staff regarding SMS knowledge was identified, as well as a lack of openness to change,
particularly in the Logistics and Utilities Sectors. These issues will be examined in the case studies.

Annual Inspection results initially suggested a sector hierarchy of performance with the Petroleum Sector obtaining the strongest results, down to the Logistics Sector with the weakest results. However this trend did not hold across the two-year period of observations. The Logistics Sector appeared to improve significantly, but the Sector Analysis does not illuminate how this occurred and what the influencing factors were. This will be examined in the case studies. Overall, control measure implementation results were stronger than SMS element implementation results for all sectors.

**Operation**

Operability results were weaker than implementation results for both control measures and SMS elements. Also SMS element results were weaker than control measure results, suggesting sites are better at identifying the need for a control measure and implementing it, than checking that the control measure remains operable and supporting it with an SMS element. This suggests that there is more focus on initial implementation than ongoing operation, and more focus on control measures than SMS elements. It also suggests weak ‘checking’ or auditing practices.

Incident data shows a downward trend following SMS implementation, suggestive of improvement. However these data are not very conclusive, and incident trends may have extraneous causes. Enforcement notices issued by the regulator in 2005 suggest weaknesses in ‘auditing and monitoring’ and ‘inspection and testing’, which impacts the system’s operability.

**Maintenance**

Annual Inspection data showed auditing was never fully effective in all sectors. WSV inspectors found deficiencies following internal audits of the same item, suggesting an inability of some sites to detect SMS deficiencies through current internal auditing practices. Deficiencies with contractor management were identified across all sectors.

The Sector Analysis suggested weak auditing during the Operation stage and confirmed weak auditing in the Maintenance stage investigation. Hence it was inferred that auditing may be a factor influencing SMS development to be followed up in the case study analysis.
The sector analysis also suggests where deficiencies may exist in the four stages of the SMS Development Model, albeit not necessarily driven by sectoral differences. However, what the Sector Analysis has not been able to capture is the dynamic processes impacting the development of SMSs and more broadly the Safety Case as MHFs apply to be licensed and attempt to retain it. Monitoring case study MHFs through the Safety Case life-cycle (Figure 4.6) may assist in inducing key influencing factors.

5.9 Criteria for Case Study Selection

The Sectoral Analysis reveals (at an aggregate level) deficiencies in all four stages of the SMS Development Model, however not always clearly attributable to sectoral differences. A key finding, impacting the Plastics & Chemicals and Utilities Sectors, is that the SMS deficiencies can negatively impact the licence process and ultimately the licence outcome. Hence it is important to understand SMS deficiencies and how they can be prevented to assist in achieving maximum licence outcomes. According to findings in Chapter 2, this would also minimise the likelihood of major incidents. By probing both ‘leaders’ and ‘laggers’ in more depth, the factors which may have contributed to sub-optimal SMS development will be interrogated, and any consequences or lessons identified. To achieve this, case study selection will be based on findings from the Sectoral Analysis.

Case study sites were selected to provide a range of instances from ‘Leaders’ (who might illustrate in-depth the processes of successful SMS implementation and MHF compliance) and ‘Laggers’ (who can expose the pitfalls in reaching this objective). Criteria for selection included:

- Background readiness factors (reflecting some sites had experience pre-2000 with SMSs) of process complexity, number of employees and corporate support;
- ‘Leader’ indicators (variables demonstrating successful milestone achievements) such as chosen to be an ‘Exemplar’, awarded a full-term licence, and established SMS auditing practices,

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109 SMS deficiencies were shown to contribute to major incidents.
110 The regulator sought three MHFs (two Utilities sites and one Plastics & Chemicals site) to volunteer to be ‘Exemplar’ sites to fast-track the development of their Safety Case to assist the regulator trial their assessment process and share their learning experiences with industry. Being ahead of peers and receiving feedback on the Safety Case prior to the regulated submission deadline, may be viewed as an advantage.
‘Lagger’ indicators (variables exposing failure to demonstrate milestone achievements) such as assessment extension, reduced-term licence and no established SMS auditing practices.

Table 5.2 describes the seven Victorian MHFs selected for the Case Studies and shows the criteria for their selection.

Table 5.2: Victorian MHFs chosen for Case Studies

<table>
<thead>
<tr>
<th>Case</th>
<th>‘Laggers’</th>
<th>‘Leaders’</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHF Name</td>
<td>SU1&lt;sup&gt;112&lt;/sup&gt;</td>
<td>P&amp;C2</td>
</tr>
<tr>
<td>Process complexity</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Number of employees</td>
<td>1 (+ 15 contractors)</td>
<td>70</td>
</tr>
<tr>
<td>Level of corporate support</td>
<td>Significant</td>
<td>Limited</td>
</tr>
<tr>
<td>Exemplar</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Assessment extension</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Length of licence</td>
<td>0</td>
<td>1.5 yrs</td>
</tr>
<tr>
<td>Licence condition</td>
<td>-</td>
<td>Yes</td>
</tr>
<tr>
<td>SMS auditing established</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Reading across the rows in Table 5.2 illustrates that Case Studies 1 to 7 have been selected based on their individual characteristics which provide an overall range of results as discussed above. Unlike in the Sector Analysis, an MHF’s sector grouping is no longer a focus for the case studies.

The ‘lagger’ and ‘leader’ case studies are presented in Chapters 6 and 7 respectively.

<sup>111</sup> From Appendix L.
<sup>112</sup> SU1 is the sister site to U1 and does not appear in Appendix L as it was not an MHF in 2003.
5.10 Conclusions

The Sector Analysis began by showing many Victorian MHFs had voluntarily implemented SMSs prior to the MHF Regulations requiring an SMS; all Petroleum Sector MHFs had SMSs, whereas the other three sectors all had some sites without an SMS in existence. Factors influencing voluntary SMS implementation were the complexity of the facility, the number of employees and the level of corporate support. Hence, Victorian MHFs were at different starting points on 1 July 2000 in their journey to being compliant with the MHF Regulations.

The remainder of the Sectoral Analysis was structured around the four stages of the SMS Development Model (Design, Implementation, Operation and Maintenance). Where possible, data from the 39 Victorian MHFs were analysed in industry sectors. Where this was not possible, more general findings were made for the entire MHF population. A comparison of the MHF Regulations’ SMS requirements with the SMS framework (Figure 2.1) showed that the MHF Regulations do not provide the complete framework for an SMS as they are focused on ensuring specific major incident learnings from the Longford incident are incorporated into SMSs.

SMS implementation was examined by the regulator during Safety Case verification and following licensing, in the Annual Inspection process. During verification 17 out of 39 MHFs were found to have SMS implementation deficiencies requiring enforcement action. Time extensions were issued for 19 out of 39 Safety Cases, all of which involved SMS deficiencies. All sectors had sites requiring extensions, although the Petroleum Sector had a small number compared with the three other sectors which were almost evenly represented. No sector trends could be determined regarding the reason for extensions.

In the majority of MHFs, significant improvement was made to the SMS prior to licensing. Reduced-term licences were granted to MHFs in the Plastics & Chemicals and Utilities Sectors and some licence refusals occurred in the Utilities Sector. The Sector Analysis suggests the established nature of SMSs in the Petroleum Sector and their generally high level of corporate support – as was the perception of Longford prior to the major incident of 25 September 1998. However what is not clear from the Sector Analysis, is why the Plastics & Chemicals and Utilities Sectors comprise the ‘laggers’ group (reduced-term licences) while the Logistics Sector does not – despite the apparent
similar starting positions of the absence of documented SMSs (Figure 5.2). This will be of interest in the case studies.

While all sectors had a range of responses to the question ‘how much of an improvement was necessary in your organisation’s OH&S policies and practices to become licensed?’, the Petroleum Sector results may indicate a continuous improvement focus, whereas the Logistics and Utilities Sectors had a number of respondents indicating that no improvement was necessary, suggesting that some sites in these sectors were neither open to change, nor encouraging of continuous improvement. This will be explored in the case studies.

Annual Inspection data does not yield conclusive sector trends, however it demonstrates SMS implementation levels to be less than expected by the MHF i.e., not achieving 100% implementation. Control measure implementation results were also shown to be less than optimal. The linkage between the SMS and control measures was identified and used to advantage in detecting SMS and control measure implementation deficiencies.

As implementation forms a foundation for operation, deficient implementation is likely to lead to operational deficiencies. This was observed through Annual Inspection data and will be investigated in the case studies. Significant decreases in operability results, compared with implementation, were observed for both SMS elements and control measures. The difference between control measure implementation and operability data suggests that MHFs are better at identifying the need for a control measure, and implementing it, than actually checking that the control measure is achieving its intended purpose, i.e., is operational. Operability deficiencies indicate that the day-to-day operation of the control measure is being compromised and hence the barrier it provides between the hazard and major incident is not complete.

These results indicate that many SMSs were operating at a less than optimal level, possibly giving the operator a false sense of safety thinking their SMS was implemented, while not being aware of its lack of operability. These results suggest the presence of latent failures (as described in the Swiss Cheese Model in Figure 2.3) as should a control measure be called upon in an emergency, its level of operability cannot be guaranteed due to failures in the operability of the SMS element that should be supporting it.
Maintenance of an SMS was shown to include both auditing and the actioning of identified improvements. An SMS cannot be maintained or improved until deficiencies are identified and understood. The broad approach to identifying control measures of interest in a Safety Case was discussed and the linkage to the associated SMS element was identified as providing a focus for the audit. While focusing on the control measure/SMS linkage does not address the full scope of an audit such as policy and objectives, etc., utilising this methodology strengthens the audit and provides a process and outcome focus which has benefits to the control measures and SMS elements, and ultimately to the prevention and mitigation of major incidents. Common SMS deficiencies of contractor management, critical function testing and ineffective audits, were identified across all industry sectors.

It was suggested that a lack of effective SMS auditing contributes to poor control measure implementation and operability. This was supported by significant improvements recorded in the Logistics Sector over the two-year period through increased auditing activity.

Overall the Sector Analysis revealed that not all stages in the SMS Development Model are as effective as intended, and that the stages differ in their degree of strength. This Sector Analysis has shown SMS implementation is stronger than operation and auditing at Victorian MHFs. While the Sector Analysis has provided some insight into the SMS Development Model, further detail is required to gain a greater understanding of the influences on MHF regulatory compliance and the important role of SMS development. This detail will be gained through the case studies.

At this point it is useful to contrast licensing outcomes under the new regulations with performance pre- and post-licensing under the SMS Development Model. Were licensed MHFs delivering on all four stages of the SMS Development Model or not? Clearly the data show two main points:

1. Licensing accelerated (even with a six-month extension) SMS development, and also achieved an initial cull (five deregistered and two licence refusals) whilst warning five others (with a reduced-term licence). But the majority (73%113) of the initial MHFs achieved a full-term licence. The case studies will analyse three of the ‘leaders’ and contrast them with four ‘laggers’ who struggled to gain a licence.

2. Subsequent performance under the SMS Development Model – according to inspection results – was much more problematic. Also at the design stage the

113 32/44 (44 rather than 47 has been used to account for the amalgamation of 4 sites into 1).
new regulations misled those without an SMS, causing delays. Subsequent inspection found a significant shortfall in on-going SMS effectiveness.

The contrast between these findings raises several questions about the new regulations. First, was the mandatory licensing process 'softened' to accommodate MHFs – at least in contrast to the tougher inspection process which continued to find fault? Second, is inspection inherently more appropriate to the full operation and maintenance of an SMS – because it is a better fit to the dynamics of change and possible decay?

In the three chapters that follow, licensing outcomes will be used as criterion to select seven ‘leaders’ and ‘laggers’ which will be examined in greater depth through case study analysis. In that examination, the rigour of the licensing process will be tested and contrasted with the utility of periodic inspection.
CHAPTER 6

‘LAGGER’ CASE STUDIES

6.1 Introduction

Four ‘lagger’ case studies were selected from the 39 Victorian MHFs based on the findings of the Sector Analysis in Chapter 5. ‘Laggers’ were selected on an ‘ex post’ basis by looking at their performance after the regulations were introduced in 2000. Specifically they were categorised by their licensing outcomes in terms of receiving a reduced-term licence to operate their MHF, or licence refusal. The case studies presented in this chapter will recount the story of how the four sites attempted to comply with the MHF Regulations to obtain a full-term MHF licence and retain it. None achieved this aim in the first round of licensing, however two received full-term licences for their second licence, but one was refused at licence renewal.

Each case study follows a chronological format beginning with Safety Case preparation followed by a discussion of development, assessment, licensing decisions, and responses to challenges from the regulator. The shortest case (Case Study 1) had the simplest story to tell because it gave up licence pursuit quite quickly. The other three cases are longer and more complex, although not necessarily more successful.

6.2 Case 1 - An Exemplar Without Commitment - A ‘Lagger’ that Gave Up

Facility Overview

A joint-venture between a large German company with world-wide operations and an Australian company, it operated a number of depots throughout Australia, providing a distribution network for flammable gases to both industrial and domestic consumers. At the depots, large quantities of the flammable gas were delivered and stored, to then be decanted into smaller cylinders for distribution to end-users. The individual terminals were often unmanned, with both delivery and pick-up drivers having 24-hour security access to the site without direct supervision from the operating company. Management, technical and maintenance support, were located at a head office in the suburbs of
Melbourne and also in Sydney. Management did not regularly attend the site. Case 1 was located approximately 40 kms from head office and had been operated since 1993 (SU3 correspondence 2003).

Case 1 owns the equipment and contractors provide labour and deliveries, with a maximum of 15 contractors on site from 6am to 3pm (weekdays) filling small cylinders. One person is directly employed on site from 8am to 5pm (weekdays), sometimes including an office assistant. There was no Case 1 HSR for the facility (SU3 AFR 2003:81), however there was a HSR for the contract employees (SU3 AFR 2003:88).

This case study shows management determined to prove their existing situation was safe and that no further assessments or improvements were warranted. Managing flammable gas depots remotely was undertaken with an SMS which was poorly implemented, although lax auditing techniques falsely reassured that everything was operating effectively. It wasn’t until WorkSafe inspectors performed verification activities that the poor state of SMS implementation became apparent. Without significant management commitment to improve the situation, Case 1 was unable to demonstrate a long-term commitment to the SMS and the safe operation of the facility. Despite an assessment extension being granted, WorkSafe refused to licence this facility. Case 1 did not appeal the decision and removed inventory from the site, deregistering as an MHF.

**The Exemplar- of ‘Best Practice’?**

Initially Case 1 was one of three Exemplar sites for the Victorian MHF Regulations, preparing a partial Safety Case on a fast-tracked timeline. This allowed WSV to test their assessment processes, and to provide feedback to industry on the Safety Case development process (SU3 exemplar report 2001:1).

WSV had not performed a scoping audit on Case 1, however scoping audits were performed on two other Victorian sites under the same ownership. Both these audits concluded there was an SMS in place (scoping audit U3 1999:2 and scoping audit S2U3 1999:2). Case 1 stated they had ‘an SMS in place that through a series of function specific manuals, and the main operating manual, guides staff through the management of the MHF’ (SU3 Exemplar SCO 2000:10). ‘To ensure that this SMS is operational on each site, an Audit is carried out annually [by Technical personnel] that reviews not only

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114 Seasonal variability.

115 AFR is the Assessment Findings Report.

116 WSV was not initially aware that Case 1 stored sufficient quantities of Schedule 1 materials to be an MHF.
the condition of the site equipment but concentrates on the operating procedures and the recording of the actions required by the SMS’ (SU3 Exemplar SCO 2000:10).

As Case 1 did not have any complex processing on site, management believed the MHF Regulations should not apply to them. Like Case 5, management used their influence in various industry groups to lobby against the MHF Regulations. Their main argument centred on compliance with Australian Standards (AS) for their industry. Case 1 began the exemplar process with the belief that AS alone were sufficient and that ‘the facility risks are already 100% controlled’ (SU3 exemplar report 2001:1). Thus Case 1 would not conduct hazard identification workshops, because that was what the AS were based on (Principal Safety Analyst 2005). In December 2000 a meeting was held between the regulator and Case 1 management to discuss the regulator’s concerns that Case 1 had no methodology, and it appeared that there was no linkage between hazard identification, safety assessment, control measures and the SMS (Minutes of meeting SU3 Dec 2000). Case 1 management responded by stating they had a ‘good understanding of the processes and they didn’t need any detail in their documentation as it was a waste of time’ (Minutes of meeting SU3 Dec 2000). Case 1 management were attempting to create a generic Safety Case which could apply to all their depots across Australia. Case 1 submitted their Exemplar Safety Case in April 2001, several months later than the agreed submission date (SU3 AFR 2003:21).

Exemplar verification became a trail of denial, with site personnel being quite ‘open in showing how little of what was claimed in the Safety Case could be evidenced’ (email from lead verifier to WSV Field Manager 2001). The Case 1 Management Representative spent at least half a day of verification ‘discussing why the Safety Case was not accurate’ as it was written by someone in Sydney (email from lead verifier to WSV Field Manager 2001). Not only was the Exemplar Safety Case incorrect; there was no local site ownership of the document.

The SMS was not submitted for assessment during the Exemplar process (SU3 exemplar report 2001:8). The Exemplar Safety Case described the SMS as a ‘series of books’ and suggested that the hazard identification, safety assessment and control measures were not linked (file note SU3 assessment meeting June 2001).

**Safety Case Preparation**

In preparing their full Safety Case, Case 1 management were expecting to change their SMS to that of one of its joint owner’s SMS (which also operates 100% of sites U1 and U2) (SU3 Exemplar report 2001:4). Case 1 management were concerned that if they described their current SMS then there would be extra work to modify the SMS

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description at a later point when the new SMS was implemented. Equally if they described the new SMS and it was not implemented at the time of licensing, they would need to describe the old SMS (File Note meeting 24 January 2001). The SCO Gantt Chart shows the SMS as the last item, in December and January, prior to Safety Case submission in February (SU3 Exemplar SCO 2000:attachment). By contrast, emergency planning was allocated 6 months (SU3 Exemplar SCO 2000:attachment). The main SMS activity was to ‘develop systems as required’ – a broad and meaningless statement (SU3 Exemplar SCO 2000:attachment).

Despite being part of the exemplar Safety Case process, Case 1 management ‘never embraced the performance based regulations’ (Principal Safety Analyst 2005). The Lead Assessor described Case 1’s management as ‘fairly aggressive’, with meetings beginning aggressively and ending ‘more amicably, although without any meeting of minds’ (Lead Assessor email 27 May 2002). Case 1 examined redistribution of their product in an attempt to fall below the threshold quantity of chemicals which determined them to be an MHF (Lead Assessor email 27 May 2002). Assessment of the full Safety Case was similar to that of the Exemplar with little, if any, improvement or learning being demonstrated by Case 1 (WSV correspondence 29 May 2002:2).

WorkSafe submitted oral and written requests for information about deficient aspects of the Safety Case, however Case 1 personnel made no attempt to provide further information (WSV correspondence 29 May 2002 and SU3 AFR 2003:21). A 24-page summary of ‘significant concerns’ which could ‘lead to the ultimate finding’ of non-compliance with the MHF Regulations was sent to Case 1 senior management (WSV correspondence 29 May 2002:1). It included the statement that the SMS ‘does not appear to be implemented on the [Case 1] facility and does not meet the requirements of the MHF Regulations’ (WSV correspondence 29 May 2002:6). The Lead Assessor noted ‘our findings are numerous, negative and significant. They mostly repeat things we have stated before, in writing’ (Lead Assessor email 27 May 2002). A damning Assessment Findings Report was then issued to Case 1 representatives, which was returned to the regulator without comment (SU3 AFR 2003:21). In June 2002, Case 1 requested an assessment extension to improve their Safety Case. This extension was granted (SU3 AFR 2003:22).

During the verification in January 2003, five enforcement notices were issued for failure to implement controls as stated in the Safety Case, which demonstrated SMS failures (SU3 AFR 2003:67). A further two dangerous goods directions were issued117 and three

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117 Due to an incorrect manifest and the lack of appropriate hazardous zones.
voluntary compliances\textsuperscript{118} were achieved (SU3 AFR 2003:24). Examples of the very poor implementation of SMS and control measures discovered during verification include:

- Management of change was not being undertaken (SU3 AFR 2003:43).
- Case 1 personnel did not fully understand the operation of the fire system, particularly regarding testing of break glass alarms. It was not understood that the system was disabled if the fire indicator panel door was open (SU3 AFR 2003:43).
- A recent weekly check to determine the currency of the Emergency Plan (EP) was marked ‘OK’. However, no copy of the EP could be located by the person who had conducted that check. When found, the EP was not current (SU3 AFR 2003:44).
- The annual audit for 2002 had not been conducted. This questions whether the audit process described in the Safety Case was actually functioning (SU3 AFR 2003:44).
- A contractor supervisor was unaware of the site’s permit to work procedure. Work had been undertaken without a valid permit and a review of the small number of permits on file showed significant inconsistencies (SU3 AFR 2003:44).
- Site access was not controlled as described in the Safety Case and verifiers found access was not adequately controlled. Drivers untrained in the safe loading of the flammable good were able to enter the unmanned facility and load their trucks (SU3 AFR 2003:44).

This list of verification failures clearly demonstrates poor SMS implementation. The significance of this finding, and its potential impact on the business, was conveyed to the Chief General Manager responsible for Case 1 by the Director of HMD in February 2003 (File Note 17 February 2003). To improve the situation, a contract engineer was employed, who had assisted the sister site U3 to develop their Safety Case and successfully obtain a licence. An inquiry was called by WSV into refusing a licence to Case 1, stating ‘extensive non-compliances’ with Part 3 (safety duties of operators) of the MHF Regulations, ‘particularly in relation to the SMS’ (SU3 Notice of Inquiry February 2003). During licence inquiry preparation, it was noted that further enforcement action was possible based on the information available, however such action ‘would not be in the benefit of safety on the facility as [Case 1] need to focus on improvements in R301, 

\textsuperscript{118} Addressed immediately while the inspector is on site, so an enforcement notice is not issued. Voluntary compliance was achieved for Management of Change with insufficient risk assessment, inadequate operation of fire deluges and lax procedures for visitors.
R305 and R502 as soon as possible. Additional enforcement action would detract from such improvements’ (HMD Director Brief on SU3 AFR February 2003).

While the contract engineer was able to implement enough specific improvements to achieve compliance with the many enforcement notices, he was unable, in the short timeframe, to achieve sustained improvement in SMS implementation across the site. Case 1 had ‘not provided assurance that recent improvements at the facility can be sustained, principally because these have been instituted by a short-term\textsuperscript{119} contract engineer (supervisor) installed at the facility to turnaround the situation’ (SU3 ministerial brief 2003). Case 1 was refused a licence to operate an MHF, effective from 15 May 2003 (Victorian Government Gazette 2003).

Case 1 decided to comply with the MHF licence refusal by reducing the inventory of Schedule 1 materials held on the site (SU3 letter to VWA May 2003). During this process, it became known to WSV that Case 1’s interstate supplier of flammable gas was due for closure shortly (SU3 deregistration brief 2003:3). Was it possible that this supplier closure was always known to Case 1 management and hence they did not want to expend any additional resources on achieving an MHF licence? The answer to this question is not known, however if this was the case, why was the contract engineer engaged to attempt to achieve compliance?

WSV supported deregistration as an MHF, however Case 1 would continue to be monitored by HMD inspectors, and it was decided the company’s other depots should be visited by WSV to check on corporate SMS implementation.

Conclusions

Case 1 was a simple site with simple processes. In theory, a compliant Safety Case should have been achievable, particularly with the opportunity of becoming an Exemplar Safety Case. However Case 1 could not make the necessary improvements to obtain a licence to operate. The final barrier to obtaining a licence was a poorly implemented SMS, coupled with a lack of management commitment to improving the SMS. The underlying issue from the beginning was insufficient management commitment to achieving compliance with the MHF Regulations, combined with their strong belief that safety at the facility did not need improving. Prima facie, WSV’s insistence that no licence be granted suggests that the licensing process was itself robust. However, this conclusion should be qualified by the facts that Case 1 was an extreme example in terms of management intransigence, combined with their eventual willingness to surrender to

\textsuperscript{119} 3 month contract (SU3 Safety Case Addendum 3 February 2003).
significantly scaling back their operation (by reducing inventory of Schedule 1 materials). Such circumstances were rare across the whole set of MHFs.

### 6.3 Case Study 2 – Licence Renewal Refused

**Facility Overview**

Case 2 (P&C2) is a chemical manufacturer producing several derivatives of a single chemical in various grades for use in the chemical and food processing industries. Case 2 imports raw material, as it is not available in Australia, and is the only manufacturer of this product in Australia. The operation was established in 1939 and at the time of the introduction of the MHF Regulations was a joint venture between a large French multinational chemical company (who purchased their share of Case 2 in 2000) and an Indonesian investment consortium (P&C2 VWA Report 2002:2). The French multinational intended to upgrade the Melbourne plant and its systems, however the other joint venture partner did not agree (P&C2 VWA Report 2002:2). There had been little capital expenditure for many years (P&C2 VWA Report 2002:2). The site was manned 24 hours a day by a shift crew consisting of a Shift Supervisor and six process operators, working 12-hour shifts. The workforce during normal office hours was about 70 (P&C2 AFR 2002:9). Case 2 is located in an industrial area of Melbourne with the most senior Australian manager on site.

This case study shows a site struggling to introduce an SMS with limited resources and little management focus on risk management. A legacy of inaction with regard to general OHS compliance and lack of risk management practice had first to be overcome before real gains in the Safety Case and SMS development could begin. A Safety Case extension was needed to provide more time for the basics to be completed, i.e., identify all hazards, put control measures in place, implement the SMS (found to be between 30 – 40% complete) and have an emergency plan which addressed all identified major incidents. A new team of skilled personnel was assembled to develop the Safety Case and SMS further. This effort was rewarded with an 18-month MHF licence. Despite management’s aim to continue SMS development, supply chain issues diverted focus from SMS improvements. WorkSafe then refused Case 2’s next licence application. Case 2 appealed to VCAT. In the additional time before the VCAT hearing, Case 2 provided enough evidence of improvement for WSV to provide consent orders for a three-year MHF licence, which was ultimately granted.
Initial Approach

Case 2's SCO was a simple 13-page document, which contained revealing statements regarding its poor starting position with regard to compliance with the MHF Regulations. Case 2 provided the following summary of their SMS prior to the MHF Regulations:

The site SMS was written in 1992. In its time it was an extremely comprehensive system. Unfortunately it has not been maintained or well implemented within the factory (P&C2 SCO 2000:4).

Case 2's Quality, Health, Safety and Environment (QHSE) Manager performed a gap analysis of current practices and procedures against the MHF Regulations (P&C2 SCO 2000:3). The gap analysis revealed that the SMS ‘was outdated and in need of review’ and the SMS review would occur ‘in parallel with the Safety Case preparation’ (P&C2 SCO 2000:3). Case 2 acknowledged that ‘this is an undesirable situation as the development of the safety case will have to parallel a complete rewrite of the SMS, rather than an existing system being modified to accommodate the additional requirements of the MHF Regulations’ (P&C2 SCO 2000:4-5). It stated ‘the review of the SMS is not limited to major incident prevention. The purpose of the SMS Review is to develop and implement a system which is the primary means of managing all health and safety issues on site’ (P&C2 SCO 2000:3). Case 2 was effectively beginning anew with the SMS, acknowledging that this was not ideal while simultaneously developing a Safety Case.

Other statements by Case 2 in the SCO relating to the SMS conceded:

- it does not currently have a system for formally identifying potential major incidents or the hazards that may cause them (P&C2 SCO 2000:5);
- it does not currently have a system in place to conduct a Safety Assessment (P&C2 SCO 2000:6);
- ...there is a general lack in experience amongst employees of the types of techniques used to complete Hazard Identifications and Risk Assessments (P&C2 SCO 2000:5), and
- ...training notes and operating instructions....do not reference back to any form of formal hazard identification or risk assessment process (P&C2 SCO 2000:4).

Despite this weak starting point, knowledge and skills were available within the European branch of one of the joint venture partners as they ‘have a number of sites...which are required to meet the COMAH regulations in the UK. Information from these sites along with our own incident history will be used in conjunction with site employee expertise’ (P&C2 SCO 2000:5). The site operated under an ISO 9002 Quality Management...
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System (P&C2 SCO 2000:4) and the QHSE Manager had 13 years experience in Quality Systems Management (P&C2 SCO 2000:13).

Case 2’s SCO Gantt chart shows the SMS as the last item, due for completion on the same day as the Safety Case submission (P&C2 SCO 2000:12). However the ‘implementation and Review of the SMS’ runs for 9 months, with a 2 month overlap with ‘gap closure’ which continues for a further 5 months (P&C2 SCO 2000:attachment). WorkSafe’s noted the SCO ‘does not provide evidence of how [Case 2] propose to demonstrate adequacy of controls nor the comprehensiveness and integration of the SMS. This is of particular concern as the SMS is proposed to be one of [Case 2’s] primary controls’ (VWA letter to P&C2 March 2001:1).

Case 2 had not indicated how, or if, the existing QMS would link, or combine with, the proposed SMS. However, Case 2 had access to European sites with COMAH compliance experience, and they previously had a comprehensive SMS (so perhaps a framework existed), a QMS was in place and Case 2 acknowledged that the SMS would be developed along-side the Safety Case, rather than leaving the SMS until the very last Safety Case activity. These aspects suggest that the weak starting point was not as weak as it may have seemed – or was it?

Safety Case Development

Case 2 management conceded that they had a lack of experience in risk management and a lack of systems (P&C2 SCO 2000:4-6). Yet there was no evidence that Case 2 consulted their European counterparts for assistance in developing a Safety Case. Also resources were not made available to support the Safety Case development. Rather individuals were to contribute to the Safety Case as well as continue their existing roles. The deficit of in-house risk management knowledge was addressed by engaging a consultant for hazard identification and risk management techniques (P&C2 SCO 2000:13) who had no previous Safety Case experience, and had ‘not demonstrated a good understanding of what is required by the MHF Regulations’ (VWA P&C2 SCO Peer Review Checklist Feb 2001). As employee training in hazard identification was ‘yet to be developed’ (P&C2 General Assessment Tool 2000:4) and no methodology existed in-house for conducting hazard identification (P&C2 SCO 2000:5 and P&C2 General Assessment Tool 2000:9), it is possible that hazard identification had not previously been performed in any systematic manner, if at all. As a result, some major incident scenarios identified at Case 2’s facility had little, if any, control measures in place to prevent the identified hazard becoming a major incident (P&C2 interim AFR 2002:14). Hence time
and resources were required to identify and implement control measures during Safety Case development.

In addition to these Safety Case driven tasks, WSV Field Officers had compiled a general list of areas of basic concern identified in early site visits including:

- Development of hazard identification, risk assessment and risk control is a priority [for all health and safety regulations];
- Monitoring of action plans;
- Monitoring of procedure development e.g., safe work, work at heights;
- Reviewing procedure implementation e.g., procedures for managing contractors;
- Tank inspections\(^{120}\);
- Reviewing training, including in hazard identification, and

This list is indicative of the workload imposed on Case 2 personnel on top of their normal operational roles, as well as Safety Case development tasks. It is perhaps not surprising that significant progress was not initially made in establishing an SMS, as identified during Safety Case Assessment.

**Safety Case Assessment**

Case 2 first submitted a Safety Case in December 2001. Case 2’s February 2002 assessment progress report listed in detail a number of ‘significant concerns that could, if uncorrected, lead to negative findings that [Case 2’s] operations and Safety Case are not in compliance’ with the MHF Regulations (P&C2 Progress Report March 2002). The March 2002 progress report paints a similarly damning picture and lists a number of documents needed for the SMS’s development and implementation which Case 2 had not provided to WSV (P&C2 Progress Report April 2002). In summary, the following serious deficiencies were identified in Case 2’s Safety Case:

- All major incidents (MIs) and hazards had not been identified,
- Control measures were not in place to address some hazards that could lead to identified MIs,
- Implementation of the SMS had only just begun, and
- The emergency plan did not address all the identified MIs (P&C2 AFR 2002:5).

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\(^{120}\) Few tanks had been inspected for ten years.
Of the SMS Schedule 2 requirements of the MHF Regulations, only five SMS elements were complete, two (auditing and organisation & personnel) were in draft and three (safety policy & objectives, means of compliance with Part 3 of Regs and performance monitoring of SMS and control measures) were only headings in the SMS with no content (P&C2 progress report April 2002:2). A further four aspects (mechanical integrity, means of isolation, means of compliance with Part 5 of Regs and principles & standards for design & operation) were not included at all (P&C2 progress report April 2002:2). Clearly this was a deficient submission and Case 2 was not ready to be licensed as an MHF.

In May 2002, the Lead Assessor concluded:

- **At the time of Safety Case submission, [Case 2’s] Safety Management System was only 30 to 40% complete. With significant gaps, the SMS could not be assessed as comprehensive and integrated. (Regulation 301)**
- **Several control measures did not appear to have any SMS support to ensure that they would operate effectively if or when required. (Regulation 402(2)(a))** (P&C2 Interim AFR 2002:4)

An extension to the assessment period was granted to give Case 2 personnel the opportunity to rectify these deficiencies (VWA letter to P&C2 May 2002). Case 2 responded by devoting a ‘large fraction of its technical and managerial resources to rectify these problems’, namely:

- Many additional hazard identification and control measure review workshops were conducted,
- A new intranet-based SMS was implemented and training sessions conducted, and
- The Emergency Plan was revised in conjunction with the Metropolitan Fire and Emergency Services Board (P&C2 AFR 2002:5).

The new SMS was an intranet-accessed system based on a generic system purchased from a safety consultancy (P&C2 Interim AFR 2002:8). Some key procedures were also available in hard copy (P&C2 AFR 2004:35). A consultant was employed for four months to establish the SMS framework.

The Lead Assessor noted in May 2002 that ‘the fundamental nature of many of the concerns raised during assessment suggests that there were systemic problems within the organisation prior to the introduction of the MHF Regulations’ (P&C2 Interim AFR 2002:18). ‘The staff were willing, but not able to develop the Safety Case due to a lack of resources, lack of experience with systems, lack of capability in risk management and

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systems development, and the general feeling of an organisation financially run into the ground” (Lead Assessor interview 2004). The work undertaken in 2000 and 2001 in response to the MHF Regulations began the process of addressing many of these problems (P&C2 Interim AFR 2002:18). However, as the Lead Assessor wrote in May 2002, ‘there is still a long way to go’ (P&C2 Interim AFR 2002:18). There were several personnel changes at Case 2 towards the end of 2001, including the dismissal of the initial consultant, and a new team was brought together to manage the Safety Case in 2002 (P&C2 Interim AFR 2002:18). The Lead Assessor noted Case 2 ‘have shown considerable willingness to address concerns raised during the assessment, and have committed both people (the Manufacturing Manager has been reassigned to lead a new team dedicated to ensuring a revised safety case will comply with MHF Regs) and money (contractors and capital improvements) to the task’ (P&C2 Interim AFR 2002:18).

Several new personnel with appropriate technical backgrounds and systems experience (including some from Case 7 – see ‘Leader’ Case Studies) were recruited (P&C2 Interim AFR 2002:18) as senior management were now seeing benefit in the Safety Case regime (Lead Assessor interview 2004). The increased effort yielded positive results, with real progress shown during the assessment period with implementation of the new SMS (P&C2 Interim AFR 2002:18). Two HSRs remarked to the Lead Assessor during private discussions at the end of site visits that there had been improvements at Case 2 since the safety assessment work had begun in 2001 (P&C2 Interim AFR 2002:18).

Case 2 then resubmitted their Safety Case in September 2002. Verification went smoothly and no major difficulties were encountered, and no major issues or deficiencies were identified (P&C2 AFR 2002:14). The assessment team concluded:

>[Case 2] has made very significant improvements in the past six months, but the amount of remedial work that was required was huge. The revised SC has addressed all the major concerns originally raised, and in general satisfies the four licence requirement tests of Regulation 803(1). However, because many controls, systems and procedures have only been recently introduced, or are still being introduced, there is much scope for improvement. (P&C2 AFR 2002:5).

‘The newly introduced SMS is comprehensive and integrated, but some systems and procedures are rather generic, and need further customisation’ (P&C2 AFR 2002:6). Not only did Case 2 need to customise their SMS, they also needed to commence auditing of the system, management review and performance monitoring. Case 2 management showed commitment to making the SMS work, however the lead assessor was concerned that Case 2 had underestimated the resource requirements for these tasks.
Hence the lead assessor believed ‘the full implementation of the SMS as the primary means for ensuring safe operation at the facility may be more delayed than Case 2 have initially estimated’ (P&C2 AFR 2002:33).

First Licence Decision

The concerns outlined above meant Case 2 was granted a reduced-term licence of 18 months – the shortest licence granted to an existing and fully operational MHF. The licence also contained a condition regarding immediate implementation of a particular control measure. The reasons for the short reduced-term licence were:

- The operator had made very significant improvements in the past six months, but the amount of remedial work that was required was significant.
- Many controls, systems and procedures had only been recently introduced, or were still being introduced, there was much scope for improvement.
- The SMS is immature, and key components such as performance monitoring and auditing are still in the implementation stages. Thus, the effectiveness of these processes cannot currently be determined. In addition, a number of the SMS procedures are still generic and require customisation to incorporate site-specific requirements. The operator is progressively reviewing the procedures, starting with the most important procedures such as the work permits, but this process will take some time. It is recommended that monitoring of the continued implementation and refinement of the SMS be a major component of WorkSafe’s post licence oversight. (P&C2 AFR 2002:7)

The HMD Director noted ‘Unlike other licence decisions, I believe you have substantial work before the improvements made at your facility can be regarded as sustainable. You will therefore be classed as a Focus MHF and receive maximum oversight from WorkSafe’ (P&C2 licence decision letter 2002). Case 2 needed to continue their implementation focus on the SMS and resubmit their Safety Case in just 12 months time. Was it possible to show further implementation in this short period of time?

Post licence

Case 2 underwent significant production uncertainty during its short licence period, due to interruption to their Schedule 1 raw material supply from overseas. This led to production stoppages and staff cuts, and diverted resources from the planned SMS implementation.

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121 Greenfield MHFs were initially granted one-year licences, while full operation was achieved.
122 The regulator must achieve a fine balance between providing a clear message to sites regarding the need for immediate and consistent improvement in their SMS and providing an appropriate amount of time for this improvement to occur in a sustainable manner.
improvements. Case 2 achieved improvements in only the areas initially examined by WorkSafe. Improvements across the entire SMS were unable to be implemented in the short time available and hence further problems were discovered during the second round licence verification activities.

Second Licence Decision

The lead assessor believed that despite making allowance for the short licence period, there were many instances where ‘advice [from WSV] that could easily have been implemented was not acted upon and many of the same deficiencies are apparent in this Safety Case as in the 2001 submission’ (P&C2 AFR 2004:8). One positive statement regarding the SMS was that procedures that had been revised by the operator, to meet their specific needs, were successfully implemented. However, verification indicated that the SMS had not been well-adopted by employees, who were more comfortable accessing hard copy procedures than the intranet system. Employees had received training in the SMS, its content and location, with training records to support this (P&C2 AFR 2004:35). However, this training was not effective as verification findings indicated that employees (operations and maintenance) did not have a good knowledge or uptake of the SMS (P&C2 AFR 2004:35). On-site assessment of the SMS showed that the menu structure was easy to use within a section on the intranet, however locating a specific item of information from the intranet main page was not intuitive. Verification found that operators and Shift Supervisors struggled to access specific information in the intranet system (P&C2 AFR 2004:39). Overall, the assessment team found a ‘Lack of commitment to the SMS by employees apart from a core group of management personnel’ (P&C2 AFR 2004:37). WorkSafe concluded that Case 2 ‘need to invest considerable effort into improving the uptake and commitment of the organisation as a whole to the SMS’ (P&C2 AFR 2004:38).

Some examples of verification issues include training not being given to maintenance employees on the hazards of using steam to unblock pipes (a control measure in the Safety Case) and a missing nozzle on a fire monitor (P&C2 oversight history report 2005:5). Enforcement notices were issued on both these items (P&C2 oversight history report 2005:5). Over an eight-month period, three fire system inspections were undertaken by an external fire system contractor. All three inspections indicated a monitor nozzle was missing, rendering the monitor ineffective. During the same period, Case 2 personnel conducted three-monthly inspections of the fire system and did not detect the absence of the monitor nozzle, nor did they review the contractor’s reports (P&C2 oversight history report 2005:5). Hence the missing nozzle was not replaced until detected by WorkSafe. The assessment team discovered a number of SMS procedures

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which remained generic, not implemented and possibly never going to be implemented as they were more appropriate to a larger and more complex facility\(^\text{123}\) (P&C2 AFR 2004:36). The assessment team believed this was symptomatic of Case 2 not critically reviewing their SMS requirements prior to establishing the off-the-shelf SMS (P&C2 AFR 2004:36).

Case 2 had a complex, multi-layered auditing structure consisting of both external and internal audits at varying frequencies (P&C2 AFR 2004:40). The auditing scope was extensive and required significant resources (P&C2 AFR 2004:41). In discussions with WorkSafe personnel on 7 April 2004, Case 2’s Production Manager stated that “the audit frequency was idealistic and beyond capacity” (P&C2 AFR 2004:41). He admitted that Case 2 lacked internal auditors. This was a concern raised in the previous, 2002, Assessment Findings Report. It was reasonable to ask whether Case 2 genuinely required such a complex auditing framework. The WorkSafe assessment team recommended that the auditing requirements be critically reviewed, with the aim of simplification (P&C2 AFR 2004:41). Verification found that there was no consistent audit methodology, no set schedule or sampling strategy being applied, and no consistent action item tracking process (P&C2 AFR 2004:42). The auditor was also unclear about the objectives of the audit (P&C2 AFR 2004:42). It became evident that unless improvements were made in the implementation of the auditing and review processes that the SMS would degrade over time (P&C2 AFR 2004:85).

The Director of HMD met with Case 2’s Managing Director, Chief Financial Officer & Company Secretary and General Manager, Manufacturing, to discuss the possibility of a licence refusal (P&C2 Ministerial Brief 2004:3). Case 2’s Managing Director stated that they intend to rectify the non-compliances as soon as possible, however they acknowledged that to demonstrate SMS implementation will require significant time possibly beyond their licence expiry date (P&C2 Ministerial Brief 2004:3). In addressing the licensing panel, the Lead Assessor commented “Case 2 have had to deal with practical safety improvements [implementing control measures] as a priority over SMS implementation. Case 2 seemed genuinely surprised when the assessment deficiencies were identified as ‘non-compliances’. Essentially Case 2’s perception was that broad improvement would be sufficient for detailed regulatory compliance.” (Lead Assessor licence panel notes 2004:6).

\(^{123}\) For example, Fire Risk Management, Performance Reporting, Project Hazard Studies and HS&E Resource Management.
The Assessment team concluded that the SMS had been established, but not fully implemented (P&C2 AFR 2004:34). As a result, WorkSafe refused to grant a licence to Case 2 (P&C2 AFR 2004:4). The reasons were:

- Auditing processes had only been partially implemented. Deficiencies were identified in action item monitoring, close out and review from a number of SMS processes including Change Management, Incident Investigation and Auditing.
- The health and safety objectives were not developed, monitored or reviewed consistently with the SMS procedures.
- A number of procedures were found to be in varying states of implementation (P&C2 AFR 2004:4).

The assessment team noted that the new SMS implementation schedule, provided in response to the licence refusal inquiry, was ‘aggressive’ and that Case 2 did not commit adequate resources to meet this schedule (P&C2 AFR 2004:37). “Case 2’s inquiry submission essentially assigned more duties to the same people who were doing the task previously” (Lead Assessor licence panel notes 2004:6), implying that since they were previously struggling to get through the workload, as evidenced by slow progress, so it will take extra time to progress more tasks without additional resources.

Case 2 appealed WorkSafe’s licence refusal to the Victorian Civil and Administrative Tribunal (VCAT). During this appeal period, Case 2 personnel were able to undertake further work and continue to implement their SMS and auditing program. WorkSafe continued to monitor progress at Case 2. In October 2004 the Lead Assessor believed that the recent work was of an appropriate quality, reviews were in place, line management were now doing the implementation, employees were engaged and the Safety Case was integrated into the business and fully supported by the new Operations Manager (Lead Assessor licence panel notes 2004:1). The following improvements were verified by WorkSafe:

- Audits had been completely reworked and improved, were consistent with the requirements of the MHF Regulations, and the company, and one Quarterly Review meeting had been held.
- Health, safety & environment objectives had been developed in accordance with a revised and simplified procedure. The objectives had been approved by Case 2's Board in July.
- Action items were now managed with a tracking database. Operations were accountable for item completion.
- Unnecessary procedures from the off-the-shelf SMS had been eliminated with the remaining deficiencies fixed (Lead Assessor licence panel notes 2004:1).
Based on this information, WorkSafe gave consent orders to VCAT for a three-year licence for Case 2 (Lead Assessor licence panel notes 2004:1) which was granted in February 2005 (VCAT B63/2004).

Changes Made by the Organisation

Management changes within Case 2 affected its SMS development. To start, Case 2 engaged a consultant for risk management expertise and eventually identified that this consultant was not providing the required support. After becoming aware of the magnitude of the work needed to address the concerns from the first Safety Case Assessment in 2002, Case 2 restructured a number of Management and Operations roles to allow the Manufacturing Manager and a team of health and safety professionals to devote themselves almost exclusively to bringing the Safety Case into compliance with the MHF Regulations (P&C2 Interim AFR 2002:22). Implementation of the SMS and Safety Case rested with the Manufacturing Manager who resigned in December 2003, however by this stage the Lead Assessor noted that the senior management team were fully engaged in the Safety Case (Lead Assessor licence panel notes 2004:5). A suitably qualified replacement for the Manufacturing Manager was appointed. Despite the positive changes these new individuals brought to the Safety Case and SMS development, the assessment team noted that from 2001 – 2004 the number of changes in management and technical personnel ‘may have been somewhat unsettling and has disrupted the implementation of some initiatives’ (P&C2 AFR 2004:83). The assessment team also stated that additional skilled technical resources were required to ensure the ongoing implementation of the SMS processes and review and improvement activities (P&C2 AFR 2004:83).

The French multinational owner purchased their share of Case 2 in 2000 with the aim of upgrading plant and systems at the aging Melbourne facility (P&C2 VWA Report 2002:2). However the Indonesian partner did not agree to these improvements (P&C2 VWA Report 2002:2). As a result of this impasse, the Indonesian consortium bought out the French joint-venture partner during the first licence term (P&C2 VWA Report 2002:2).

Unexpected Deregistration

The Schedule 1 material consumed by Case 2 was only available in China and consumed a large amount of electricity in its production. Due to significant energy shortages, the Chinese government decided to cut power to the mine, forcing the mine’s closure. Case 2 were unable to secure an alternative supply of the raw material, and in late 2006, requested deregistration as an MHF (P&C2 letter 3/10/06). The CEO’s letter to VWA stated ‘I would like to assure you of [Case 2’s] commitment to ensuring the SMS
will continue to be implemented and improved, and that controls associated with all hazardous materials on site will continue to be maintained' (P&C2 letter 3/10/06). The surrender of Case 2’s MHF licence occurred in early 2007 (VWA letter to P&C2 Feb 2007).

Conclusions

Like Case 1, Case 2 testifies to the stringency of the licensing process. Unlike Case 1, management intransigence was not an issue; rather the problem was distraction associated with turnover and disagreement between the French and Indonesian co-owners. Of importance was the nature of WSV’s concerns, which related substantially to the implementation and maintenance stages of SMS development. The maintenance stage, as was noted in Chapter 5, tended to be weak across the whole MHF population.

6.4 Case Study 3 – Candidate for Licence Suspension

Facility Overview

Case 3 (P&C9) manufactures chemicals, including toxic ones, in rural Victoria. The chemicals are sold direct to the consumer. Case 3 owns a large area of land, with the production facility only occupying one-tenth of the area. The production facility is located 200m from the local township. The site employs 13 people, all from the local area. Working at the chemical plant is viewed as a ‘job for life’. The manufacturing process is considered to be ‘bucket chemistry’ – simple mixing and batch reactor operations, with manual opening and closing of valves to control the process. To avoid undesirable environmental releases, the Environment Protection Authority (EPA) required Case 3 to install a Distributed Control System\(^\text{124}\) (DCS) to gain better control of the process. The DCS was installed during the preparation of the Safety Case Outline. Case 3 is a joint venture between two foreign multinationals, with senior management located inter-state.

Case 3 was not a significant operation to its multinational owners’, and received little corporate support. The site manager had no formal training and the Quality Manager’s strength lay in form administration, not system development or maintenance. A simple site, with a small stable workforce, it had operated largely informally until the MHF Regulations required an SMS with operating procedures. Case 3 struggled with the transition to formal systems. An assessment extension was required, with only a two-year initial licence being granted. Throughout the Safety Case development and

\(^\text{124}\) Computer control of the production process.
assessment period, a significant number of visits occurred from the regulator. This continued post-licensing. Meanwhile ownership changes, down-sizing and restructures caused distraction, ultimately leading Case 3 to be considered for licence suspension.

The SMS Prior to the MHF Regulations

The initial scoping audit conducted by WSV in mid-1999 began by suggesting there might be a system in place, Case 3 ‘have safety related procedures within their management system’ (P&C9 scoping audit 1999:2). However the following comments suggest significant work would be required to develop an SMS:

- A systematic approach should be undertaken to identify all safety critical activities and establish safety objectives;
- A system should be in place for the recruitment and training of staff;
- A comprehensive risk identification and risk management system should be established;
- The company should develop a confined space register;
- A formal change management system which requires appropriate review, assessment and approval of changes should be developed, and
- An appropriate system to ensure the on-going integrity of the management system should be put in place (P&C9 scoping audit 1999:2-4).

The auditor concluded that ‘There are a number of commercially available safety management protocols that could be of assistance in the development of the company’s Safety Management System’ (P&C9 scoping audit 1999:5), clearly indicating that there was no SMS in existence.

Case 3 submitted their SCO in November 2000. It stated Case 3 ‘is committed to the establishment and implementation of an SMS’ (P&C9 SCO 2000:3).

‘By applying the principles outlined in the MHF Regulations we shall develop, implement, maintain and review an SMS. This system shall be assessed with regard to AS4360 Risk Management and managed by the Operations Management Team and include a documented system of procedures, work instructions and checklists using ISO 9000 framework with which we are already accredited, to ensure a systematic approach to continual improvement’ (P&C9 SCO 2000:7).

A corporate SMS from overseas affiliates was not mentioned, nor was overseas advice sought on MHF compliance experience. The SCO Gantt chart, of planned activities to achieve MHF Regulatory compliance, consisted of the following:

1. Safety Case Outline
2. Consultation  
3. Hazard identification  
4. Operating procedures  
5. Safety assessment  
6. Control measures  
7. Emergency response plan  
8. SMS draft complete (*duration 2 months – beginning 5 months prior to submission*)  
9. SMS review (*duration 2 months – beginning 3 months prior to submission*)  
10. Submit Safety Case.

The order of activities followed VWA’s unhelpful Guidance Note 3 (VWA 2001c), leaving the SMS until last. No detail was provided, possibly suggesting there was little understanding of the work involved for each item. WSV noted:

*Past history of compliance is very poor, however as we are moving into intensive intervention with the possibility of prosecution this site has changed its existing practice of tardiness and lack of response to full response to the Authority. Properly managed, past historical practice should not feed into the production of their Safety Case, however it will need to be oversighted to ensure they do not lapse back into past practices.* (P&C9 SCO assessment 2000:4)

*Given they have not applied standard project planning techniques to fully understand if resource/timing allocation is appropriate/sufficient.....Given the simplicity of their site and the number of persons available.....I believe their proposal is adequate’* (P&C9 SCO assessment 2000:4).

A simple site with a simple plan. Case 3 had turned over a new leaf and would be responsive to the Authority….or would they? The chemical process may be simple, but does that mean developing a Safety Case and establishing an SMS is simple?

**The Journey to MHF Licensing**

Case 3’s journey to achieve an MHF licence was hindered with a partial change in ownership just three months after submitting their SCO. This change in ownership (a different multinational purchased one of the existing joint venture partners) could have yielded benefits through increased corporate support. However this did not occur. A revised SCO was required, due to the change in ownership, and WSV requested the revised SCO contain a description of how document control, management of change and
quality assurance would be incorporated into Safety Case activities (letter SCO revision P&C9 2001). The revised SCO described the structure of the SMS as being:

(a) Business manual,
(b) Operations manual (procedures and work instructions), and

Internal audits occur on an annual schedule and external audits are performed for quality assurance. The revised Gantt chart had more detail as follows:

Completion of operating procedures *(8 months total)*
- Structure of SMS integrated with ISO 9000 *(1 month)*
- Review and revise non-manufacturing quality procedures, work instructions and forms *(5 months)*
- Review and revise manufacturing quality procedures and work instructions *(5 months)*
- Review and revise system control procedures *(5 months)*
- Implement audit schedule for 2001 *(12 months)*

Completion of SMS draft
- Document schedule 2 and 4 of MHF Regulations *(3 months)*
- Undertake compliance audit using ISO9000 with external auditors

Review SMS
- Review of audit reports *(4 months)*

All this suggested increased understanding of the tasks to be performed. However communication problems existed. The Operations Manager had no formal training and was a practical person who made things happen, favouring ‘agricultural solutions’. He often said “I understand” when later actions showed he did not (Field Officer interview 2005). The Field Officer believed Case 3 may have benefited from a Safety Analyst who was a ‘straight talker’ without ‘technical speak’, who would see beyond “I understand” (Field Officer interview 2005). Information sessions on the MHF Regulations run by the regulator and industry groups were not attended by Case 3 management or personnel (Field Officer interview 2005). Overall, the WorkSafe Field Officer describes the site personnel as “friendly, but not open to new ways of doing things” (Field Officer interview 2005).

Two months later, Case 3 again revised their SCO requesting an extension to their Safety Case submission date due to ‘severe resource issues due to restructuring in December 2000 and retrenchment of the Operations Manager and lower staffing levels’
The revised SCO Gantt Chart contained a footnote for the task ‘review of SMS’, stating ‘milestone is most likely to have resource problems due to lack of trained internal auditors and historically slow responsiveness to completion of OFIs’ (P&C9 SCO May 2001). The WorkSafe Safety Analyst wrote ‘Case 3 are struggling with the complexity of an operating SMS’ (P&C9 oversight plan 2001:3). In September 2001 the Safety Analyst wrote ‘procedures written to ISO quality standards. Hardcopy systems not linked. Operator is significantly behind on upgrade of their SMS procedures according to their plan. Operator has been advised that this lack of progress is not considered acceptable by the Authority and they may fail to gain a licence to operate if they continue down this path.’

Within the month, a site visit occurred where the WorkSafe Safety Analyst and Field Officer met with the General Manager and Technical Manager, who flew in from Sydney. From this point onwards, these senior managers were involved in the Safety Case process and provided significant additional resources to the site. But was this enough to achieve a licence? The Safety Analyst noted ‘procedures now all upgraded to e-SMS which all operators have access to. Still work to be progressed to get back to plan.’ (P&C9 oversight plan 2001:3).

### A Race Against Time to Develop the SMS

The Quality Manager understood forms, how to develop checklists, and product quality certification. The SMS checklists he developed were by geographic area of the plant and were very simple in nature, requiring a tick or yes/no answer. ‘Is drum clamp OK and locking mechanism tight?’ is an example of a checklist question. This is a vague question (what does ‘OK’ mean and how tight is ‘tight’) with no indication of what remedial action is required. No sign-off was required, nor was there any connection to control measures. The SMS consisted of a folder with checklist templates. It was a classic ‘bottom-up’ approach to developing an SMS – and highly defective.

Case 3 submitted their first Safety Case in March 2002. By June 2002 the assessment concluded ‘it did not fully comply with some of the requirements’ of the MHF Regulations (P&C9 AFR June 2002:4). The reasons were:

- All hazards had not been identified;
- Safety Assessment did not meet the requirements of Regulation 303;
- All existing and all possible control measures were not listed. Alternative controls and the reasons for adoption/rejection, had not been provided; and Critical Operating Parameters and Performance Indicators also needed to be better defined;
- More time was required for the operator to complete work on the SMS, and
- Schedule 4 information was incomplete (P&C9 AFR June 2002:4).

Due to the SMS development work remaining, it was unable to be ‘fully assessed at this stage’ (P&C9 AFR June 2002:4). The SMS summary in the Safety Case comprised ‘screen dumps’ listing procedures and other documentation related to the Safety Case. Accompanying this was a collection of incomplete, disconnected documents. At the time of submission, Case 3 had already identified deficiencies in their SMS, and were testing a Hazard Database as part of an improvement program (P&C9 AFR June 2002:9). Case 3 management ‘stated their willingness to complete any tasks necessary to achieve compliance with the MHF Regulations’ (P&C9 AFR June 2002:4). They realised further work was required, and engaged a consultant to assist with the adoption of the new hazard database (P&C9 AFR June 2002:4). Based on this willingness to achieve compliance and commitments made, an assessment extension was granted (letter P&C9 extension 2002).

To achieve compliance, Case 3 continued to develop the SMS content, as required by the MHF Regulations (P&C9 AFR June 2002:11). Work also continued on the hazard database which tied together the results of hazard identification, safety assessment and control measure information and contained links to management and operational procedures which were separately maintained and audited under the ISO9000 regime (P&C9 AFR June 2002:11). Work continued on establishing all the control measures, and then ensuring they had been captured in the SMS. Routine equipment inspections and maintenance were company-wide, global procedures, covered in the operational procedures. Linking these electronically to the SMS was in Case 3’s improvement plan (P&C9 AFR June 2002:11). So Case 3 was focused on activities which established and implemented the SMS.

The second (revised) Safety Case was submitted in August 2002. The opening statement in the assessor’s report was:

Case 3 is a small company that has operated on the basis of experienced people. The transition to formal systems has challenged the facility and more bedding down will be required before the changes can be regarded as sustainable (P&C9 AFR Feb 2003:5).

Case 3 had invested a ‘significant amount of effort and resources into creating a new risk management database’ and the following SMS improvements were noted:
A new risk management database forms the heart of the SMS linking the hazard identification and safety assessment processes with existing and adopted control measures;

A Business Management System is in place that includes a significant number of safety-related procedures, and

Other areas of the SMS, such as review and audit, are already established through the use of a Business Management System which encompasses the SMS, and is certified to ISO9000 (P&C9 AFR Feb 2003:5).

The six month extension had not proved sufficient to fully satisfy WSV. Thus the assessor noted, the following improvements must be addressed for long-term functioning of the SMS:

- Ensure that there is on-going commitment to the full use of the SMS, rather than the previous informal means of maintaining safety;
- Improve documentation for control measures, and
- Specific areas of knowledge are largely held by an individual, and have not been fully documented (P&C9 AFR Feb 2003:5).

Clarification visits found that scheduled implementation dates for some additional controls had been missed or moved, indicating that tracking and close-out mechanisms were not functioning. Verification identified gaps in record keeping and documentation of the SMS, provided evidence that some procedures were not fully implemented, found that testing regimes for some control measures did not exist, and noted the lack of documented follow-up on audit findings (P&C9 AFR Feb 2003:33). Evidence was found showing Case 3 relied on verbal communication rather than formal documented systems (P&C9 AFR 2003:36). Examples included the permit to work and lock-out tag-out systems not being used by plant operators or by some contractors well known to the site – these systems were considered only for people not familiar with the site. Checklists were found to rely on operators’ existing knowledge and that further development (such as documenting what it means for an item to be considered “OK”) was required to allow the plant operator to make sound judgement as to when the check is considered to be satisfactory or a non-conformance (P&C9 AFR Feb 2003:50). Documenting this valuable operator knowledge was considered important for long-term viability, and for training of new operators to ensure that details will not be overlooked (P&C9 AFR Feb 2003:34).

The assessment team raised concerns that safety was being managed on an informal basis, rather than through the SMS. In response, Case 3 management updated procedures and established weekly site reviews and monthly corporate reviews of the
Given that Case 3 had only rectified these concerns during the assessment period, time was needed to verify the effectiveness of these measures (P&C9 AFR Feb 2003:33).

Evidence suggested Case 3’s SMS was newly established and insecure.

*One of the difficulties encountered throughout the assessment process, and in the time following the granting of the extension and the resubmission, was that some of the Safety Case components were developed but not implemented to the stage where their effectiveness could be evaluated. A significant amount of the assessor’s time was taken up by providing assistance to the site* (P&C9 AFR Feb 2003:19).

Assessment found that ‘not all procedures were being strictly followed’ leading to the conclusion that the SMS was not always used as the primary means for ensuring safe operation (P&C9 AFR Feb 2003:30). To counter this finding, Case 3 management completed a review of outstanding items, developed a detailed Improvement Plan, reinforced procedural requirements with all site personnel, and demonstrated a strong commitment to the on-going and consistent use of the SMS (P&C9 additional information Jan 2003). This was sufficient to demonstrate to the assessment team that the SMS was used as the primary means for safe operation (P&C9 AFR Feb 2003:31).

The assessment team concluded that Case 3 met ‘the minimum requirements to comply with Regulation 301’ (P&C9 AFR Feb 2003:30) recommending the ‘comprehensiveness of the SMS’ be improved (P&C9 AFR Feb 2003:36). Hence the significant effort displayed by Case 3 was just enough to show base level compliance.

In closing, the lead assessor noted:

*…..improvements have been made, and many more are listed in the Improvement Plan. During the oversight and assessment periods the tardiness in responding to raised issues, limited detail, and lack of a robust issue-tracking and close-out mechanism (issues confirmed during verification) appear to undermine the foundation on which the structure of long-term safety assurance is being built.* (P&C9 AFR Feb 2003:54).

The licence panel responded to this by granting a two-year licence (requiring the Safety Case to be submitted in 18 months). The licence term was ‘selected on the basis that the audit and review process of [Case 3’s] SMS is not well established and that reassessment will be necessary after management have reviewed an annual audit cycle’
Lagger Case Studies

(P&C9 licence decision letter 2003). To leave Case 3 management in no doubt that they only scraped through the first round of licensing, the Director of HMD’s letter continued:

For this reason you will also be made a Focus MHF under the oversight policy which draws increased scrutiny from WorkSafe. You should also expect regulatory action by our inspectors should you not meet the significant milestones in your improvement plan (P&C9 licence decision letter 2003).

Case 3 achieved a short-term licence with significant attention from the regulator. The bare bones of the SMS appeared to be established, however significant elements of the SMS still required full implementation. Effectiveness reviews through audits were also yet to be performed. These items were commitments in the Improvement Plan which WSV would monitor.

Progress After Licensing

Case 3 were visited by WSV approximately monthly between their first licence and subsequent licence application. The WSV team assigned to monitor the site, described Case 3 as being ‘in a transitional phase from an informal safety culture to SMS-driven safety management’ with management and employees ‘committed to safety and improving safety at the facility’ (P&C9 Post Licence Oversight Plan September 2003:3). In the 18-month period, Case 3 underwent one Annual Inspection, in which ‘overall results achieved were positive, indicating that Case 3 is following a path of continuous improvement’ (P&C9 AI 2004:9).

However, Annual Inspection identified auditing of procedures required improvement to ensure procedures are performed as documented. ‘Audits are being carried out and they check the existence of procedures and if they are current, but do not specifically check if the procedures are being followed. This would provide a cross-check between the written procedures and operational reality (actual practice)’ (P&C9 AI 2004:8) and hence check implementation of the procedure.

WorkSafe’s annual MHF Review of Case 3 in mid 2004, noted an organisational restructure had resulted in improved transfer of knowledge between employees and the Finance Manager’s role was expanded to include operations (P&C9 Review 2004:2). While he was not technically capable, after receiving two enforcement notices (one to use management of change (MOC) and the second to provide a copy of the improvement plan) he did ensure responses were provided to WorkSafe in a more timely manner than his predecessor (Field Officer interview 2005). WorkSafe concluded:

Case 3 have made progress in improving the documentation detail, linkages and clarity but there is still room for improvement. There is evidence that they
are using their SMS procedures more formally.... Case 3 are still implementing their SMS and completing documentation for their control measures, effectiveness and viability statements (P&C9 Review 2004:3-4).

The WorkSafe team held concerns for Case 3’s ability to achieve a renewed licence due to a perceived lack of focus on the Safety Case, however following the involvement of the Finance Manager the site became noticeably more responsive to WorkSafe’s requests and actively reviewed the improvement plan with WorkSafe at site visits, including verification of completed activities (P&C9 Review 2004:1). While it appeared that Case 3 had continued gradual improvement of their SMS, how would it fare in the second assessment?

In the second assessment, the Lead Assessor (LA) found:

...the SMS includes all the elements required by Reg 301(4) and Schedule 2. The Introduction to the Safety Case contains a print out of the full list of Procedures and Work Instructions that make up Case 3’s Business Management System. A significant proportion of these are devoted to the elements that make up the SMS.... Review of these documents found that they formed a comprehensive and integrated system that fits well with the way Case 3 operates (P&C9 AFR 2005:21).

...Case 3 has done much to demonstrate that its safety systems and procedures are now well established (P&C9 AFR 2005:42).

Annual inspection and verification have confirmed that Case 3’s control measures and SMS elements are well implemented and functional (P&C9 AFR 2005:42).

From these comments, the SMS appeared to have matured since the first assessment. A review of the Improvement Plan showed ‘reviews, updates and additions to many SMS elements since licensing early in 2003’ had occurred. (P&C9 AFR 2005:22). Procedure, by procedure, the SMS had been gradually improved. Due to the small number of employees, everyone was involved in the review of procedures. ‘The operators interviewed [during verification] were aware of the contents of the procedures, the reasoning behind the procedure, and were able to walk through the procedure’ (P&C9 AFR 2005:47). Case 3 had taken steps to address WorkSafe’s concerns about possible over-reliance on one manager by making a number of organisational changes that redistributed several roles and responsibilities at management level (involving the Site and Finance Manager, and the Management Systems Co-ordinator/Auditor), and within
operations (two senior operators now had additional supervisory roles) (P&C9 AFR 2005:43).

Hence in 2005, a full-term licence was granted to Case 3. The Director of HMD wrote:

...the Licence Advisory Panel noted the work [Case 3] has done since the issue of your first licence in 2003 to consolidate the use of your SMS and audit cycle. For example, the good results of the Annual Inspection in 2004, the Compliance Register and the proactive measures taken to address issues identified in the emergency exercise in November, were taken as positive evidence of increasing maturity of SMS implementation by [Case 3]. Future oversight by WorkSafe will expect to see this improvement maintained (P&C9 licence decision letter 2005).

Despite this achievement, SMS maintenance then became problematic. While the Finance Manager was responsive to WorkSafe requests, a technical void developed following the removal of the previous Operations Manager. A series of low-level compliance issues began to occur such as incompatible storage of laboratory chemicals, a broken ankle, a puncture wound and a forklift cantilever (P&C9 oversight history report 2008:5). The 2006 Annual Inspection showed less than 50% of the control measures inspected were fully implemented and functional. Partial functionality was due to the SMS not fully supporting the controls. SMS elements reviewed included procurement of critical spares (part of the maintenance system), asset integrity of vessels and management review of the emergency plan. It was found that significant issues existed for the maintenance system and asset integrity system and that fundamental building blocks, such as asset registers, were not being maintained. On a positive note, management review of the emergency plan was occurring as defined (P&C9 oversight history report 2008:6). It was also identified during the inspection that a temperature trip in the DCS was not appropriately programmed. It was recommended that Case 3 review the status of all DCS control loops, interlocks and trips to ensure no other alarms were overlooked. This general situation appeared to indicate deterioration in the SMS.

**Licence Suspension?**

The 2007 Annual Inspection showed further deterioration with just 30% of control measures inspected found to be fully implemented and operational. SMS elements reviewed included training, MOC, calibration of critical equipment and hazard reporting. Each element reviewed contained significant deficiencies in implementation and operability and a number of improvement notices were issued (P&C9 oversight history report 2008:6). SMS deficiencies included:
Auditing – had not occurred since Dec 2005 due to lack of resources. Plan for new auditor to commence one day per week.

Training – reduced due to down turn in business. Training of new plant operators has been occurring but external resourced training has ceased.

MOC – some use of MOC (eg. formulation changes), but not for all changes (eg. relocating chemicals and organisation restructure).

Emergency plan – Documentation not maintained (manifest, change in resources)

Permit to work – documents not always completed, primarily due to the small number of personnel.

Asset management – found to be rudimentary. Oversight team provided guidance in 2006 to establish appropriate asset management processes and challenged site personnel to thoroughly understand the NDT [non-destructive testing] and connect this to their asset replacement strategy. These system improvements are occurring slowly due to a lack of understanding of engineering issues. (File Note P&C9 2007:3)

In addition to the above deficiencies, the list of opportunities for improvement (OFIs) was growing with few items being completed (Internal Briefing Note P&C9 2007:2). This impacted the Safety Case and SMS (Internal Briefing Note P&C9 2007:2). Examples of outstanding OFIs included:

- update SMS procedure and train person in JSA techniques (generated four years earlier).
- ensure improvements to maintenance system identified during WorkSafe visit are implemented (generated three years earlier).
- update plant schematics – changes have been made to the plant and operators have to rely on memory to make changes (generated one year earlier).
- failure of control loop – during testing control loop didn’t stop screw feed as required (generated nine months earlier).

The general level of adherence to the documented SMS was clearly decreasing and a number of general dangerous goods issues had arisen (File Note P&C9 2007:1). A new Production Manager was employed with operational experience in complex chemical plants. The new Production Manager spent the first six months of his role focusing on long-standing chemical storage issues and building relationships with all employees. This resulted in dramatic improvements in site housekeeping (P&C9 Internal Brief 2007:5).

The new manager had previous experience of running a more complex facility, but acknowledged to the WSV oversight team that the lack of resources and money to improve systems at Case 3 was frustrating (File Note P&C9 2007:2). Case 3 was
directed by the Authority to review and revise its Safety Case (P&C9 letter Reg 306 2007). Case 3’s MHF licence would be suspended if compliance with the Safety Case could not be shown (Director Brief 2007:5). Case 3’s Safety Case was then reviewed and revised to the satisfaction of the Authority (P&C9 oversight history report 2008:4).

Corporate Support – A Knight in Shining Armour?

In 2008 a further ownership change occurred with one joint venture partner buying out the other. Corporate support suddenly appeared. Funds were made available to recruit a Safety Case coordinator who, along with the new Operations Manager, was sent to the head office overseas for training in the corporate SMS (Field Officer interview 2011). Annual Inspection still showed SMS deficiencies, however improvement in control measure implementation and operability was noted (P&C9 oversight history report 2008:6). For the three SMS elements inspected (training, PTW and asset integrity), implementation and operability deficiencies were identified. The inspection findings for the PTW showed that it was not implemented as defined (JSA authorisation components not being completed). A number of corrective actions continued to be overdue for completion and Case 3 was not transparently auditing against its own SMS performance standards (P&C9 oversight history report 2008:6).

During 2008/2009 WorkSafe provided significant information and support to Case 3 in preparation for its next licence (P&C9 AFR 2009:12). Case 3 made ‘significant use of opportunities to submit draft safety case modules to WorkSafe for assessment and to seek comment and feedback on the content’ which identified some non-compliance issues which were rectified prior to final submission (P&C9 AFR 2009:4). Due to new corporate support, a four-tiered SMS was established consisting of the corporate policies (level 1), then how implementation will occur locally (level 2), then Safety Case, procedures and work instructions (level 3) and finally forms, tags, labels and diagrams (level 4) as evidence of implementation (P&C9 AFR 2009:30).

During assessment four elements of the SMS were reviewed in detail: PTW, MOC, training and auditing. Verification confirmed that these elements were implemented and operating well. ‘This is a positive improvement given the deficiencies that were identified with SMS elements such as Management of Change during oversight and Annual Inspections’ (P&C9 AFR 2009:18).

Auditing of the SMS was occurring. Fifteen internal audits had been completed for the first half of 2009, meeting the schedule. The internal audit function was being performed by a contractor one day per week. The contractor’s services were terminated mid-2009 and the internal audit responsibility was transferred to a staff member based interstate.
For this reason, the site had fallen behind in the scheduled audits (41% compared with the target of 80% completed to schedule). It was observed that Case 3 rescheduled audits to the latter part of 2009 in order to address the audit backlog and allow the new auditor time to become familiar with internal auditing procedures.

Improvements noted since the last Safety Case submission included:

- *Sufficient resources were committed to the Safety Case review* (P&C9 AFR 2009:5),
- *revised Safety Case format with visual representation using bow-ties* (P&C9 AFR 2009:5),
- *A full SMS review was performed, including a gap analysis against the MHF Regulations* (P&C9 AFR 2009:12), and
- *Implementation of additional SMS elements e.g. permit to work system* (P&C9 AFR 2009:5).

The significant focus demonstrated on implementing the SMS was rewarded with a five-year licence, however the licence decision letter sent a clear warning regarding maintaining this focus:

*WorkSafe Victoria would like to acknowledge the significant work undertaken by [Case 3] in reviewing and revising the Safety Case and the improvements observed in safety management systems and risk control measures that have been achieved as a result of this work. A major focus of WorkSafe’s post licence oversight program will be the site’s ability to sustain and build on the improvements observed during the safety case assessment* (P&C9 licence letter 2009).

**Changes Made by the Organisation**

Several corporate ownership changes occurred throughout the Safety Case development and licensing period as noted above. Significant corporate support was only evident at the last ownership change in 2008, which resulted in a corporate SMS being applied and resources being made available to undertake the task of establishing and implementing the SMS.

The facility had been isolated from the MHF community, firstly due to its rural location, but also due to its former Operations Manager not embracing the MHF regime or attending any stakeholder forums (File Note P&C9 2007:2). The former Operations Manager did not challenge the status quo, had no desire to accomplish change, and took no initiative to prevent regulatory intervention. He was willing to make changes when the regulator identified non-compliances, however he wanted (or needed) to be told how to
achieve compliance (possibly due to a lack of knowledge of how to comply). He did not actively look for non-compliances himself, nor encourage their identification by employees.

The technical void in operations became evident when management functions were assumed by the Finance Manager. Without operations know-how, management ability alone was not sufficient to keep the newly-established SMS and control measures implemented. After intervention from the regulator at the highest level, a new Operations Manager was appointed. He brought significant technical experience with him, including SMS experience and held appropriate formal qualifications. He set about changing the way the site operated. However he met with significant resistance. The workforce was stable and most of the day-to-day aspects of running the plant were highly repetitive. Hence when change occurred it caused unease on site (File Note P&C9 2007:2). It took the new manager substantial time to establish working relationships with all employees on site, and to start implementing changes. However he soon found budget restraints inhibited implementing changes to the SMS. He seized the opportunity that new corporate ownership brought, requesting funds to employ a Safety Case co-ordinator with previous experience. The new corporate owners also provided an SMS framework within which existing procedures could be located and existing deficiencies in the SMS identified and filled.

Conclusions

Despite achieving two full-term licences, Case 3 is clearly a ‘lagger’ in SMS development and implementation, as indicated by the initial two-year licence. Both five-year licences were achieved following significant last ditch attempts to focus on the SMS and demonstrate management commitment. Deterioration of the SMS was evident between licences, earning Case 3 the not-so-prestigious title of being the only licensed MHF to date to be considered for licence suspension mid-term. New ownership and new management has improved SMS operation, but its stable maintenance has yet to be demonstrated.

Like the previous cases, WSV clearly wielded the prospect of licence refusal to leverage compliance, suggesting the potency of the process. Like Case 2, management disorganisation and ownership change also caused distraction prolonging the process of implementation as informality gave way to a full SMS. This case highlights SMS deterioration, suggesting the need for frequent external inspection to maintain SMS integrity.
6.5 Case Study 4 - the Lagger Masquerading as a Leader

Facility Overview
Case 4 (P&C7) manufactures at a large site in Melbourne, producing a range of chemicals used by industry. Since establishment in 1941 the site has undergone several ownership changes and developments, with most of the current production facilities being built in the late 1970s. Case 4 employs just over 300 people with operations occurring continuously, 24 hours per day, 365 days per year. The site averages 80 contractors, 90 truck drivers and 30 visitors per day. Case 4 has a stable workforce, most operators and senior managers have spent most of their working life there. Hence there is significant experience in operating the plant amongst the employees. Case 4 is a well-resourced organisation, with significant technical skills in-house, a separate Health, Safety and Environment (HS&E) department and an overseas parent company.

Case 4 appeared initially to be a leader in Safety Case development and MHF Regulation compliance. Case 4 was ‘proactively involved in the MHF process from well before the declaration of the regulations’ (P&C7 Management Review April 2003:3). Case 4 initiated the formation of an MHF interest group through PACIA in May 1999 and appointed a consultant to conduct their Safety Case in September 1999, with work beginning in October 1999 (P&C7 Management Review April 2003:4). These were all significant initiatives taken prior to the MHF Regulations coming into effect in July 2000. Furthermore, Case 4’s HS&E Manager regularly attended MHAC meetings as an industry representative throughout the Safety Case development and assessment process (MHAC 2002 and 2003).

Case 4 required a Safety Case assessment extension, and received a reduced-term MHF licence with conditions. This case study will examine how an apparently compliant SMS and Safety Case can be divorced from operational reality, the disjunction only becoming apparent at verification, when it is too late to implement significant changes and demonstrate their operability to the regulator.

The SMS Prior to the MHF Regulations
Case 4 had an established SMS prior to the MHF Regulations. This fits the findings regarding voluntary SMS implementation discussed in Chapter 5, as might be expected when the site has complex operations, a large number of employees and corporate support. The SMS had its genesis in the Orica (formerly ICI) management system (P&C7 SCO 2000:1). Being part of an overseas parent company, Case 4 has a worldwide HS&E policy and vision statement, with a local complementary HS&E policy
since 1994 and is a signatory in the ‘Responsible Care’ industry program (P&C7 SCO 2000:2). The SMS HS&E policy manual was issued in mid 1997 (P&C7 SCO 2000:1). Safety Management Achievement Program (SafetyMAP) Initial Level accreditation was obtained in June 1999 (P&C7 SCO 2000:1) and was reaccredited in 2001 (P&C7 SC 2002:67). Case 4 noted, ‘While an MHF needs to go beyond SafetyMAP it does provide another independent assurance that the SMS is being operated effectively’ (P&C7 SC 2002:101). Hence Case 4 management were confident that their SMS was effective.

WorkSafe undertook an MHF Scoping Audit in April 1999. Findings for Case 4’s SMS were:

> The Safety Management Systems are clearly appropriate, and extensive time and resources are devoted to these activities. The challenge for the site is ensuring that these systems are implemented on a day to day basis, and that deficiencies are identified and corrected (Scoping audit P&C7 April 1999:5).

The above comment suggests the SMS is appropriately designed, however it flags potential implementation, operation and maintenance issues. These concerns are further highlighted:

> Although a range of audits are conducted, a more systematic approach is suggested to ensure all critical areas are addressed and to assess the effectiveness of the implementation of the safety critical activities (Scoping audit P&C7 April 1999:5).

From this initial information, Case 4’s SMS appeared to provide a good starting point for compliance with the MHF Regulations. As suggested by WorkSafe, the focus for the SMS should be on implementation and auditing. With just over three years until the final date for Safety Case submissions (30 June 2002) and a further six months of assessment, it would initially appear that there was sufficient time to improve the SMS and demonstrate full compliance with the MHF Regulations.

Case 4’s plan to develop their Safety Case and demonstrate compliance with the MHF Regulations involved engaging a consultant in 1999 to assist with Safety Case development (P&C7 Management Review April 2003:4). Also Case 4 was well positioned on industry committees to stay abreast of developments in MHF Regulations and policy.
A gap analysis was conducted by the consultant against Regulation 402 (Content of the Safety Case) resulting in a 271-item Gantt chart to meet the MHF Regulations (P&C7 SCO 2000). Only three items were listed for the SMS. They were:

1. SMS gap analysis (1 day – prior to SCO submission),
2. Critical SMS procedures defined (1 day – prior to SCO submission), and
3. SMS review and update (1 day – 2 months prior to Safety Case submission).

The SMS gap analysis was conducted by the consultant in September 2000, for the October 2000 SCO submission. The timing of the SMS gap analysis suggests this was a last-minute inclusion as the consultant had been engaged since September 1999. The SMS gap analysis showed (among other things) an ‘informal approach to contractor management’ (which had also been noted in the Scoping Audit (1999:4)) with an action to formalise contractor management, ‘weaknesses in the current procedures’ and an action to ‘ensure management system is transparent and personnel are aware of its existence and where to find it’ (SCO 2000:gap analysis). The last two items suggest the SMS was not used or relied upon by the majority of employees. Even though the SMS gap analysis was conducted prior to SCO submission, it is not evident that the findings of this analysis were incorporated in the Gantt chart. For example, when would contractor management be addressed and the weaknesses in current procedures rectified?

Review of the model procedures in the SCO’s Appendix indicated that critical model procedures had been defined (item 2 of the SMS activities on the Gantt chart), but many were not available on the Case 4 computer network, which suggests they did not exist. Their development was also not included in the Gantt chart.

Upon review, there were at least three key steps missing between items 2 and 3 above:

- Develop any missing procedures,
- Implement all SMS procedures, and
- Develop and implement SMS auditing.

Significant time requirements would be envisaged for these items. But according to the Gantt chart, the only activity regarding the SMS post SCO submission was to spend one day reviewing and updating the SMS. This was programmed to occur two months prior to Safety Case submission. This was a gross under-estimate of work to be done on the SMS, and did not address the need for implementation and auditing as identified in the 1999 scoping audit, or Case 4’s own SMS gap analysis findings. Was the planning for other aspects of the Safety Case equally poor, or was it just SMS requirements which were significantly under-estimated and poorly scoped? How did this compare to the level of detail and planning for the other items in the Gantt chart?
In comparison to other items on the Gantt Chart, 5 – 16 days were allowed (depending on the size of the plant) for drafting the hazard identification report and 15 – 45 days to review the hazard identification reports for each area of the plant. Consequence modelling was allocated 20 – 40 days per plant. There was no indication that each plant area activity (hazard identification, safety assessment, control measure review) would add, or link to, the SMS. The SMS listings on the Gantt chart were at the end, followed only by the emergency response plan and the preparation of the final Safety Case report for submission. This listing of activities follows VWA’s Guidance Note 3 (VWA 2001c), replicated in Figure 5.6 of this thesis.

WorkSafe’s assessment of the SCO noted:

*The gap analysis appears extensive although it does detail a recommendation for a further gap analysis of SMS procedures. This requirement (and the implementation of other recommendations made) is not obvious in the associated SCO SMS work schedule.....Good correlation between the requirement of Schedule 2 [MHF Regulations] and details provided on the contents of [Case 4’s] SMS (P&C7 SCO assessment 2000:12).*

The SCO did contain broad statements regarding the SMS such as:

*‘the development of HS&E procedures is an on-going process to enhance the SMS’ (P&C7 SCO 2000:3), and*

*‘Critical procedures are customised from the model procedures to meet local needs, widespread training of personnel is conducted and internal and external auditing’ (P&C7 SCO 2000:6).*

However these statements did not translate to action items on the Gantt chart and hence they were not monitored by either Case 4, the consultant, or the regulator during Safety Case development.

Given the amount of detail and time allocated to other tasks, such as hazard identification, it would appear that there was little understanding of the amount of work that was required for the SMS and no allowance was made for development, implementation, auditing, or training on the SMS.

**Progress to MHF Licensing**

Significant time and effort was devoted to managing the regulator and the regulator’s visits to the site. The regulator spent the majority of on-site time in the HS&E office and not in the operational part of the plant. Personnel were selected by HS&E management
to visit the regulator in the HS&E office to discuss MHF progress. One HSR was
assigned MHF Safety Case duty, representing all site groups. It was later shown that
this was not a suitable arrangement, as he could not contribute to technical discussions
in specific plant areas. An HSR from each area of the plant was later involved (following
Safety Case assessment concerns) which was a more successful arrangement.

The WSV Safety Analyst noted that consultants were ‘heavily involved’ in the Safety
Case methodology development, workshop facilitation and drafting of the Safety Case
documentation (VWA knowledge from oversight May 2003:2). The operator was
reminded of the pitfalls regarding consultant support and gave assurance that Case 4
retained ownership of the Safety Case and its development (VWA knowledge from
oversight May 2003:2).

Case 4 submitted their Safety Case, as planned in June 2002. In preparation for
assessment, the Lead Assessor discussed the development of the Safety Case with
Case 4’s assigned Safety Analyst and Field Officer. WorkSafe did not review the SMS
prior to Safety Case submission (P&C7 Assessment Preparation Report June 2002:3).
No other concerns were flagged in the assessment preparation report.

According to the Lead Assessor, the Safety Case was ‘a well written and presented
document describing the methodologies used, the Safety Management System (SMS)
and how Part 3 and 5 requirements were met, and appeared to satisfy the requirements
of the Occupational Health and Safety (Major Hazard Facilities) Regulations 2000’

Case 4’s Safety Case described the SMS implementation strategy as incorporating:

- Skilful engineering,
- Procedures and systems,
- People behaviours,
- HS&E performance through line management,
- Training, and

The Safety Case described auditing as ‘a fundamental feature of the SMS’ with both
internal and external auditing (P&C7 SC 2002:102). Each procedure described the
performance standard required and included a detailed audit checklist to assess
compliance with that standard (P&C7 SC 2002:101). The system audit process for
HS&E procedures required them to be regularly reviewed and maintained (P&C7 SC
2002:102). It was stated that corporate audits occur every 12 – 18 months with a focus
on the existence of an SMS and compliance with that system (P&C7 SC 2002:68). Overall, the SMS summary and auditing regime presented in Case 4’s June 2002 Safety Case submission described an SMS suitable for an established MHF and appeared to address the weaknesses identified in the scoping audit (P&C7 AFR 2003:81).

So far the Safety Case assessment had progressed well and the Lead Assessor had no reason to anticipate any non-compliance with the MHF Regulations (P&C7 Lead Assessor 2003). As the MHF Regulations only require a summary of the SMS to be included in the Safety Case (r 402(1)(a)) it is customary for the assessor to spend time on site accessing the SMS and looking at the content of key procedures of interest flagged during the Safety Case assessment. When the assessor reviewed the SMS on site, the assessment ‘went pear shaped’ with the assessor finding reality to be very different from that described in the Safety Case. The assessor found ‘key procedures for the SMS were either not available or in draft and not yet issued’ (18/9/02 P&C7 assessor Field Report). The SMS summary in the Safety Case did not reflect actual practice (P&C7 AFR 2003:28).

This finding raised the question, what else in the Safety Case did not reflect reality? Detailed assessment of the safety assessment revealed inconsistencies, resulting in less risk reduction being achieved than reported (P&C7 AFR 2003:28). Initially Case 4 management’s response to the regulator was that only the few items selected for assessment were faulty and they were isolated errors. Management were adamant that there was no methodology flaw as suggested by the regulator. This lack of admission of systemic flaws led the assessors to review more examples and find more faults. Still Case 4 HS&E management stood firm in their belief that the Safety Case was satisfactory and that each identified error was an isolated case and would be reviewed individually. A number of other issues were identified resulting in a request for additional time to provide ‘comprehensive answers’ (P&C7 letter of 29 August 2002) and develop a ‘program to address the clarification issues’ raised by the assessor (email to Lead Assessor on 27 September 2002). An extension to the assessment period was granted in October 2002. In considering this extension application, the Lead Assessor noted ‘Case 4 has been willing to listen to our [WSV] concerns and negotiate, but is reluctant to accept any identified non-compliances in the Safety Case submission....[however] there is an underlying desire to achieve compliance’ (VWA internal memo from Lead Assessor to Director). The reasons for the extension were:

- ‘All hazards’ had not been identified;
• Hazards in relation to cold temperature embrittlement\textsuperscript{125} had not been identified.
• Critical operating parameters, performance indicators and standards for controls had not been documented;
• Safety Assessment methodology detail was insufficient;
• Key procedures in the SMS were in draft, and
• Further work was required to show that control measures had been implemented to reduce risk so far as is practicable (P&C7 extension letter October 2002).

All of these items relate to the SMS.

Based on Case 4 HS&E management’s belief that these were isolated incidents and would be remedied, a licence panel date was set for January 2003 (P&C7 AFR 2003:29). Verification was undertaken in December 2002, revealing control measures had not been systematically reviewed and hence the protection level assumed in the Safety Case could not be guaranteed. That is, many of the control measures and SMS elements verified were either not implemented, or not effective. Four improvement notices and two prohibition notices were issued (P&C7 AFR 2003:31). Examples of deficiencies included:

\textbf{Permit to work}

• The formal list of permit issuers and receivers did not exist.
• No follow-up of non-signed or non-returned permits.
• Audits were not performed to schedule (P&C7 AFR 2003:43).

Remedial action taken by Case 4 included issuing of an information sheet on work permits, highlighting the need for return and closure of permits. Five start-work permits issued in January were reviewed during re-verification and all were shown to have been completed, returned and signed. A new audit schedule was developed and audit checklists established (P&C7 AFR 2003:44).

Between verification and re-verification, Case 4 demonstrated a greater level of implementation of the permit to work procedure. Consistent with other aspects of the SMS, on-going emphasis was required by Case 4 to ensure that all aspects of the procedure were consistently implemented and that supporting tools were completely developed and employees informed of the tools and instructed in their use (P&C7 AFR 2003:44).

\textsuperscript{125} As had occurred at Longford.
Management of Change
The emergency HAZOP concluded that a second emergency assembly point was required for a section of the plant. The action item was to inform personnel of this change. WSV considers it practicable that this information would have been passed onto personnel as soon as Case 4 became aware of this need, and that MOC would be followed. Verification showed that no communication or documentation had occurred and that the MOC process was not followed. Re-verification confirmed that the second emergency assembly point had been communicated and MOC documentation was being finalised (P&C7 AFR 2003:44).

Procedures
Evidence of procedures not being implemented included:

- The operating procedure for the hoist (critical control) did not exist;
- High high temperature trip on the reactor showed no procedure for testing and no records for the completed tests;
- The oxygen analyser (critical control) inspection and calibration procedure was found to be sparse in detail, resulting in reliance on the technician’s experience and knowledge of the unit, and
- The manual monitoring of temperature rise during reaction was an interim control. Operators were unaware of the acceptable variation in temperature rise (not documented in the procedure) and did not identify loss of agitation as a possible cause of high temperature (P&C7 AFR 2003:67).

Instrumentation
Instrumentation deficiencies included:

- High high pressure trip requires a nitrogen purge to keep the trip switch clean. The nitrogen purge flowrate is checked daily. Operators were unaware of the required flow or remedial actions to be taken;
- Functional testing of the incinerator burner shutdown system and flame arrestor (critical control) had not been developed, and
- The flowmeter for addition of reactants into the reactor (critical control) had been off-line for six months (AFR 2003:69).

Pressure Systems
Deficiencies in the pressure system included:

126 A ‘high high’ temperature trip is set at a temperature higher than the ‘high’ temperature trip.
A number of pressure relief valves (PRVs) were outside their scheduled testing frequency, and PRVs (critical controls) on two reactors were scheduled to be checked weekly. Records showed this check was performed twice in a two-month period. The operator was unaware of remedial action to take. Operators were unaware of the need to inspect the PRV following an exothermic reaction, as discussed in the Safety Case (P&C7 AFR 2003:69-70).

**Document Management**

Document management deficiencies included several versions shown as the Master, attachments missing, etc. (26/11/02 assessor Field Report:7).

**Training**

Operator training was scheduled to occur after licensing (P&C7 letter 24/12/02 to WSV). WorkSafe stated that the training was required prior to licensing, to show compliance.

**Contractor Management**

The HS&E contractor management procedure focused on selection and bidding requirements – not performance auditing. No formal auditing requirements were contained in the Case 4 purchasing procedures (26/11/02 assessor Field Report:6). Contractor management deficiencies included:

- Flammable liquid loading hoses showed no means of identification, no records of hydrostatic testing or information on the age of the hose were available (field report 28/11/02);
- No records of hydrostatic testing were available to verify the integrity of the hose for toxic substance transfer (identified critical control measure) (field report 9/12/02);
- The hoist was poorly maintained. Case 4 contracted the inspection to a company, who sub-contracted the job. Inspection reports were not provided in a timely manner, defective items from the inspection were not actioned and Case 4 had not received copies of these reports and were unaware of the number of items identified as requiring repair/maintenance;
- A number of fire monitors were in poor condition. Inspection records provided by the contractor did not highlight these issues. Site personnel were unclear what was expected of the contractor;
- Driver training for unloading a toxic substance was not specific to the Case 4 site and relied on another MHF’s training, and
Operators were unsure who, how and when the ammonia refrigeration system high level trip (critical control) was tested (P&C7 AFR 2003:68).

In response to WSV’s findings, Case 4 reviewed critical control measures under the control of third parties, and made a number of changes. Case 4 stated that the deficiency in hose management was identified in an internal audit in 2002 and corrective action had been initiated, but not completed at the time of verification. Case 4 dismissed the incumbent contractor and engaged another to complete the testing and inspection of hoses at the facility. Contract arrangements for the fire equipment inspections were improved through a Letter of Agreement and the requirement for the contractor to leave an inspection report on the day was introduced. Case 4 developed a check sheet for toxic substance unloading and used this as the basis to provide site-specific training to the drivers (P&C7 AFR 2003:68-69).

In contrast to other issues raised by the regulator, Case 4 responded quickly to contractor management issues. Case 4’s management were concerned that they were paying for a service that, in many cases, was not being delivered.

The assessment team’s confidence in Case 4’s process was eroded when verification showed control measures were being assigned layers of protection when the control measure did not exist or was found to be less effective than stated. Following the poor verification results showing a ‘range of control measures which were not in place at the time of verification and the low-level of implementation of the SMS’ the need to address issues raised by WorkSafe in a ‘systematic manner rather than addressing specifics only’, was stressed to Case 4 management (P&C7 AFR 2003:5). To provide Case 4 with the maximum time to undertake improvements, the licence decision panel was postponed to the statutory limit.

Assessment of the SMS continued, revealing discrepancies between the audit system stated in the Safety Case and the SMS procedures, and further discrepancies between the documented system and the actual practice (26/11/02 P&C7 assessor Report:2). Despite the statements in the Safety Case regarding each procedure describing the performance standard required and having an audit checklist, WorkSafe’s finding was that procedures had no reference to auditing or audit checklists (26/11/02 assessor Field Report:3). A completed audit identified that the testing/inspection schedule was overly ambitious and needed review (26/11/02 assessor Field Report:3).

Based on the verification feedback, Case 4 undertook a substantial body of SMS and control measure review, revision or development in a relatively short period of time under
the direction of the new GM Operations, who started this role during Safety Case verification. He attended the verification close-out meeting, which spurred him into action. While re-verification confirmed identified control measure deficiencies had been addressed and systemic issues acknowledged by Case 4 were being addressed (P&C7 AFR 2003:70), this acknowledgement of fault did not come easily to Case 4.

One factor that changed management thinking was the SMS consultant employed to review the system. Although not informed of the regulator’s concerns, the consultant’s conclusions supported the regulator’s findings. It was only after this independent review that senior management were prepared to improve their SMS.

Case 4 then began to address systemic issues concerning procedures not being implemented. It reviewed all procedural controls in the safety assessment (both documentation and implementation) with operator involvement. Implementation of procedures was also incorporated into auditing and reporting activities. The link between the control measure and the bowtie was strengthened by including the procedure number on the bowtie and the procedure now referenced the major incident scenario (P&C7 AFR 2003:68). This procedural review was owned and driven by the plant operations group.

In making the SMS and control measures reflect reality, the ownership of the SMS and Safety Case was removed from the HS&E Department and given to operations. ‘Management accountability for MHF leadership will be moved ....to Senior Operations Managers with support from the HS&E functional group, not the other way around’ (P&C7 AFR 2003:82).

It became apparent that the Safety Case and SMS had been developed by the HS&E Department with the best of intentions, but largely in isolation from operations. Although operations representatives had been involved in hazard identification and safety assessment workshops, they were not given ownership to verify the status of control measures or SMS elements, which in many cases they did not know existed. Some members of the HS&E Department had previously been in operations and based their input on their memory of operations, rather than checking the current status. The SMS was the domain of the HS&E Department and no consideration was given to the involvement of operations personnel.

Concurrent to finalisation of MHF procedures and implementation, another consultant was contracted to develop a more ‘user friendly’ entry to the SMS, integrating aspects from several separate management systems, strengthening SMS components and
establishing an audit framework including auditing protocols, schedules, checklists and KPIs. These activities were all undertaken with operations involvement.

Re-verification confirmed that previously identified deficiencies had been addressed. The Lead Assessor noted the significant amount of work undertaken in 2002 and 2003 to ensure the SMS was developed ‘to an appropriate level for an MHF, with the inclusion of several new MHF related procedures’ and to ‘resolve gaps raised by the assessment team during assessment’ (P&C7 AFR 2003:40). The key gaps were:

- the lack of integration between the HS&E Management System and the other elements of the overall MHF SMS;
- performance monitoring, and
- auditing (P&C7 AFR 2003:40).

Case 4’s SMS comprised elements of the HS&E Management System, the Engineering Management System, the Plant Work Instructions, the Purchasing Management System, the Human Resources (HR) Management System and the Project Management System (P&C7 AFR 2003:41). The integration of these various department management systems was necessary to cover all aspects of control measures (P&C7 AFR 2003:41). The Lead Assessor concluded that Case 4’s SMS was intended to be the primary means of ensuring the safe operation of the facility (P&C7 AFR 2003:41).

Case 4 developed an extensive performance monitoring process to address the controls across the system elements and provide an overall picture of performance of the MHF SMS (P&C7 AFR 2003:41). Case 4 Management acknowledged the need to continue to place a high emphasis on SMS refinement over the coming months in order to ensure the new and changed parts of the system were fully implemented and sustainable (P&C7 AFR 2003:41). Given the early stage of implementation of SMS performance monitoring it was anticipated that the emphasis on review and revisions in response to performance results would be higher in 2003 than in the longer-term (P&C7 AFR 2003:41).

Shortly prior to WSV considering Case 4’s first licence application, Case 4 commissioned a consultant to perform a Management Review examining Case 4’s ‘organisational capability to obtain an MHF licence and maintain a viable long-term strategy for managing an MHF’ (P&C7 Management Review April 2003:1). Case 4 management stated:

*Verification indicated to [Case 4 management] that we had a number of issues to address, however WSV letters formalised and elevated the issues.*

*Face to face meetings between the Major Hazards Division Director of WSV*
and Case 4’s management in January 2003 initiated a major review of our position (letter of submission P&C7 May 2003:2).

While focusing on Case 4 personnel, the reviewers also interviewed WorkSafe personnel. The review concluded by noting opportunities for improvement in six categories (below) (P&C7 Management Review April 2003:1):

**Leadership and strategy**
- MHF strategy needed
- Clear line leadership with functional support (rather than functional HS&E ownership)

**Culture**
- Development of a compliance culture - continuous improvement focus in past needs to shift to actual compliance (introduction of frequent compliance reviews)
- Enhanced personal and team accountability
- Strategic rather than process focus
- Procedural compliance focus for operators

**Relationships**
- Greater actual and perceived openness in WSV relationship
- Less formality and greater sharing of information in daily interactions with WSV
- Plans for continuous improvement in MHF issues should be shared internally and with WSV

**Competency**
- Greater bias towards seeking external ideas and best practice
- Regular and comprehensive communication about the MHF strategy and details of performance to all levels
- Structured training in MHF requirements for team leaders and operators

**Resources**
- Support resources to the line may need enhancement in the areas of inspection and audit programme management, action management, data and reporting and database management. New roles were identified.

**Technical**
- Databases to be developed to create simple, readily maintainable and integrated processes for the management of inspections and audits and other relevant information (seek solutions from other companies and suppliers)
There should be a process to ensure updating and continuous improvement of the SMS (P&C7 Management Review April 2003:4).

The review also concluded ‘there are not enough auditors to cope with the load’ (P&C7 Management Review April 2003:7). ‘There are many significant processes in place that now need to be brought into demonstrable operation’ (P&C7 Management Review April 2003:8). This suggests that auditing was in its infancy.

Case 4’s Management Review also found employees focused inwardly, creating a culture of insularity, not seeking best practice solutions (P&C7 Management Review April 2003:4). The initial interaction with other MHFs was not sustained throughout the Safety Case development process (P&C7 Management Review April 2003:3), and there was ‘little intra company development of an approach to MHF drawing on European and American experience’ (P&C7 Management Review April 2003:3). To overcome this insularity, an inter-company liaison group was formed to ‘ensure [Case 4] has access to MHF best practice’ (P&C7 Management Review April 2003:3).

Further information was provided to WSV shortly prior to licensing, which included the following key admissions:

- The level of rigour and documentation necessary to ensure and demonstrate control measures were in place was not adequate (letter of submission P&C7 May 2003:2).
- The assessment process highlighted that the SMS was not fully integrated – it was based on the Orica/SHE Pacific HS&E model – with no obvious link to relevant Engineering, Purchasing, or HR procedures. Further, whilst there was a level of inspection and auditing, it was not particularly high, nor 100% completed (letter of submission P&C7 May 2003:2).
- A consultant has upgraded and integrated the SMS and a very extensive audit and inspection program was developed to ensure procedures were adequate and followed, and control measures were in place (letter of submission P&C7 May 2003:3).
- Despite the deficiencies uncovered during assessment and verification and the relatively recent work to close these out, in particular the newness of the integrated SMS and its very detailed audit and inspection program, we have confidence that the close senior management focus, coupled with specific action plans and defined accountabilities throughout the organisation...will operate in a safe manner (letter of submission P&C7 May 2003:4).
Case 4's CEO, GM Operations and operations personnel presented this information to the assessment team and HMD Director the afternoon prior to the licence panel meeting. Such admissions from senior management of a significant organisation are not given lightly. It can be concluded that the regulator's findings left Case 4 management in a vulnerable position and at risk of not obtaining an MHF licence. Case 4 senior management chose to admit fault and commit to change, rather than defend the system as the HS&E Department had done. It could be concluded that all of these last-minute submissions and admissions from Case 4 management were to demonstrate commitment from the highest level of the organisation to achieving compliance with the MHF Regulations, and provide assurance to the regulator that the recent activities to achieve compliance would continue into the future. In short, Case 4 management were trying to convince the regulator that a licence should be granted.

Case 4 received a licence to operate as an MHF, although it was a three-year licence with requirements to deliver on promised activities. Reasons for the reduced-term licence were:

- Immaturity of the performance monitoring regime.
- Significant changes to the SMS in recent months including a resource-intensive audit schedule.
- Further activities required to achieve a long-term sustainable 'ability to operate safely' (P&C7 licence panel worksheet 2003).

In the letter advising Case 4 of the licence decision, the HMD Director stated 'the assessment and redevelopment of Case 4's safety case has been resource intensive for both parties, but is clearly leading to substantial changes'.

**Progress After Licensing**

After the admissions and commitments made immediately prior to licensing, Case 4’s management needed to continue to deliver on their promises regarding further implementation of the SMS and auditing to ensure the continued operation of the SMS. At the end of 2003, the Safety Analyst assigned to Case 4 noted:

*Case 4 senior management have acknowledged the issues identified during assessment and verification and are actively working towards addressing them with employee involvement* (Safety base line 2003)

A year later, they commented:

*The original Safety Case assessment revealed issues with a number of key areas. Case 4 management have actively worked with employees to address these shortcomings. As the site prepares for the next submission*
of the Safety Case, the development of a sound methodology that ensures that these shortcomings are corrected will require significant management commitment (Safety base line 2004).

Other WSV observations in 2004 included:
Inspections have shown improvements in the implementation and understanding of some control measures and SMS elements, particularly the items that WorkSafe has previously brought to Case 4’s attention (P&C7 MHF Review 2004:2).

Case 4 was observed to operate in ‘silos’ as issues observed in one plant area were not addressed across the entire site. ‘Recent observations suggest Case 4 is now looking across the site and starting to apply learnings for Safety Case issues, however this is yet to be observed for OH&S issues’ (P&C7 MHF Review 2004:3).

Case 4 is showing signs of being a learning organisation, but their auditing system needs further improvement to ensure this continues to happen systematically. Hence Case 4 is yet to show sustained continuous improvement (P&C7 MHF Review 2004:3).

In 2005, the Safety Analyst’s comment was:
The re-alignment of Safety Case responsibilities to Operations has been viewed as one of the core reasons for the significant improvement in the facility since 2003. Ongoing commitment will be necessary to ensure continuous improvement. (Safety base line 2005)

During 2005, Case 4 demonstrated SMS improvements across the site, as well as increased understanding of control measures through employee involvement and support from senior management (P&C7 MHF Review 2005:2). Case 4 has demonstrated an understanding of the safety benefit of Safety Case activities and has moved away from a regulatory compliance focus (P&C Sector Review 2005:7).

In April 2006, Case 4 were successfully granted a five-year licence to operate –
The assessment of your site’s Safety Case and subsequent licence decision recognises the significant advances [Case 4] has made in the facility’s overall risk profile, performance of its safety systems, and organisational and cultural preparedness for ongoing support of a compliant Safety Case. In particular, I congratulate [Case 4] on its efforts to further expand, develop and implement a Safety Management System to provide a robust system for
the management of major hazards risk, and for the observed strong operations line ownership for the process which has been established.

*(Director HMD – correspondence licence decision letter)*

**Changes Made by the Organisation**

Following the independent review, senior management became involved in the SMS. A steering group was formed with the GM Operations, Engineering Manager, HS&E Manager and a HSR. This group initially met weekly to drive the renewal of the SMS.

Roles and responsibilities were re-assigned for the SMS\(^{127}\), line management were given responsibilities and access to the SMS was widened. As the task ahead was large, prioritisation was required, so critical procedures were identified and worked on first. A high-level review also looked for synergies\(^{128}\). The operational aspects of a procedure were examined by operational employees (such as the requirements for making a batch of product) and then the safety aspects were integrated into the one procedure. It was discovered that many activities undertaken for quality reasons also had a safety role, such as ensuring agitation on an exothermic batch reaction. This integration of operations, quality and safety started integrating safety into the business, removing the ‘add on’ approach to safety. Employee involvement in developing the integrated approach resulted in useable documents in which employees had ownership.

Auditing tools were developed based on the revised procedures. Initial performance monitoring focused solely on whether the audit was being conducted. This information was reported to the steering group, who monitored the uptake of audits. The WorkSafe Analyst discussed with the steering group that while the percentage of audits conducted is useful information, it is not actually reporting audit findings and hence the system effectiveness or otherwise. Once audits were occurring at a satisfactory frequency, the number of raised non-conformances was reported. As action tracking and close-out was developed and monitored, this was also reported to the steering group.

Interactions with WorkSafe changed over the Safety Case assessment and post-licensing periods. Initially most individuals on the site were antagonistic towards WorkSafe inspectors and did not understand the role of inspectors. Inspectors gave presentations to Case 4 personnel explaining the role of the regulator and an overview of the legislation. Operations personnel then became active participants in WorkSafe visits and became the contact point for WorkSafe, rather than the HS&E Department. Over

\(^{127}\) The majority of listed people responsible had been promoted within the organisation.

\(^{128}\) Where procedures could be combined.
time, Case 4 personnel began viewing WorkSafe as a source of information and assistance regarding industry comparisons and began asking questions such as 'how do other facilities deal with this issue?' or 'what other approaches to this issue have you seen elsewhere?'. The relationship with WorkSafe became open and honest, and was used as a source of learning. Positive reinforcement from the regulator was sought by site personnel when positive safety initiatives had been implemented.

Conclusions

Like the three other laggers, WSV showed the potency of the licensing process by threatening withholding and by issuing a reduced-term licence. The issues in this case differed, however. Management were keen to work with the new regulations and regulator. However, like Longford – another large complex MHF – their SMS was divorced from reality. The vigour of the licensing process was shown in breaking through the cocoon HS&E placed around WSV visits, and the exposure of shortcomings. It was also revealed in rigorous follow-up on all aspects of the SMS development including the latter stages of operation and maintenance. This case demonstrates an uncompromising approach to licensing.

6.6 ‘Lagger’ Case Studies: Conclusions

The four ‘lagger’ case studies show a range of journeys taken in an attempt to achieve compliance with the MHF Regulations.

Case Study 1 tells the journey of an Exemplar site lacking management commitment, becoming ‘the lagger that gave up’. Case 1’s SMS was poorly implemented and management held the strong belief that safety at the facility did not need improving. Case 1 was refused a licence and significantly scaled back its operation.

Case Study 2 shows a site struggling to introduce an SMS with limited resources and little management focus on risk management. A legacy of OHS inaction and lack of risk management practice had first to be overcome at Case 2 before real gains in the Safety Case could be made and SMS development begin. Following Case 2’s first reduced-term licence, their licence renewal was refused. Unexpectedly, once a licence was finally secured, Case 2 sought deregistration as an MHF.

Case Study 3 presents a simple site with a simple plan to produce a Safety Case and introduce an SMS. Limited resources and initially no in-house expertise resulted in Case 3 struggling to transition to formal systems. Corporate ownership change, down-sizing
and restructures distracted from SMS activities, earning Case 3 the not-so-prestigious title of being the only licensed MHF to be considered for licence suspension. Finally an inflow of corporate resources and the arrival of an expert manager secured the SMS and MHF licence.

Case Study 4 appeared to be a leader in Safety Case development and MHF Regulation compliance, proactively establishing an MHF industry interest group and representing industry on the Major Hazard Advisory Committee (MHAC). However, Case 4 shows how an apparently compliant SMS and Safety Case can be developed in total isolation from operations, with reality only becoming apparent at verification. WSV’s initial capacity to identify these shortcomings was constrained both by plant complexity and management’s apparent confidence in their system. Little time remained between verification and licence determination, making it too late to implement significant changes and demonstrate the SMS’s operability to the regulatory decision-makers. Significant senior management analysis of their mistakes and commitment to future activities were made to the regulator in an attempt to be licensed. A reduced-term licence with conditions was granted. Case 4 honoured their commitments and received a full-term licence at renewal.

These cases highlighted the importance of the SMS in achieving compliance with the MHF Regulations, as significant SMS issues were unable to be easily or quickly rectified and led to reduced-term or no licence being granted. Full analysis of these cases, as well as the ‘leaders’, will be undertaken in the cross-case analysis in Chapter 8. Key similarities and differences between the cases will be identified to establish variables that have a significant impact upon the development of effective SMSs and compliance with the MHF Regulations.

Preliminary and tentative observations suggest that some recurrent influences on development can be identified in some, if not all, of the ‘lagger’ case studies. Most of these concern management. They are:

- Lack of senior management engagement and/or presence on site,
- Lack of skilled SHE professionals,
- Limited management commitment to achieving compliance with the MHF Regulations,
- Limited, if any, employee involvement,
- Limited, if any, site ownership of consultant’s work,
- Poor planning for SMS development,
- Poor SMS implementation,
• Problems implementing and adapting ‘off the shelf’ SMSs,
• Significant changes attempted to be made to the SMS prior to licensing,
• Auditing was non-existent or provided the incorrect message to management, and
• External influences distracted from the SMS.

These observations will be considered more systematically in Chapter 8.

Three other general observations about the progress of ‘laggers’ can be suggested at this point. First, common to all is an insular or informal workforce culture which is slow to adjust to a highly formal SMS. Second, and related, is that SMS development in ‘lagger’ cases entailed multiple attempts to get it right – as management, workers and WSV came to develop a better understanding of each other and their own role, as well as a greater understanding of SMSs. Third is management’s capacity in complex operations to bluff WSV – for a while – a phenomena that does not evade audit in simple operations. Such bluffing was evident prior to the Longford incident, where WSV ‘inspectors were simply “out-gunned” by company experts’ (Hopkins 2000:93).

Finally, all four cases indicate that licensing was a tough process in which WSV vigorously maintained standards for all four stages of SMS development, and followed-up to ensure compliance. However, the evidence in Chapter 5 indicates that ‘operation’ and ‘maintenance’ were frequently weak, even in licensed sites. What do the leaders reveal about the overall integrity of the licensing process, and its sufficiency to ensure compliance? This will be explored in Chapter 7.
CHAPTER 7

‘LEADER’ CASE STUDIES

7.1 Introduction

In contrast to Chapter 6, this chapter presents three ‘leader’ case studies (Cases 5 to 7) selected from the Sector Analysis in Chapter 5. ‘Leaders’ were defined as receiving a full-term licence to operate their MHF. The case studies presented in this chapter describe how three sites achieved compliance with the MHF Regulations to obtain, and retain, a full-term MHF licence. However, each case also examines how well the MHF implemented the SMS Development Model.

The account of each case begins with an overview of the facility; looks at any SMS prior to new regulations; describes the process towards licensing; looks at WSV assessment of the Safety Case and subsequent organisational changes, and concludes with post-licensing developments and analysis.

7.2 Case 5 – A Lagger that became a Leader

Facility Overview

Case 5 (L2) was a logistics business specialising in the transport (tankers, isotoners, bulk IBCs (Intermediate Bulk Containers) and packages) and storage of dangerous goods. Unlike most other MHFs, the business was privately owned, and prior to the granting of its first MHF licence was managed directly by its major shareholder and Managing Director (L2 AFR 2003:7). At this time, the Managing Director reduced his role, concentrating on marketing and Board activities, with all operational aspects of the business being handled by a General Manager. Due to the large amount of goods stored, and the wide range of activities, the site appeared to be relatively crowded, and often very busy (L2 AFR 2003:8). The site was in the middle of an industrial area of Melbourne, with many of Case 5’s neighbours also in logistics. There were normally around 25 people working on the site, 15 of them in the offices, and 10 in the general yard areas. The workforce was relatively stable, with mostly experienced long-term employees.
Management leadership was critical in this case. A passionate and strong willed Managing Director (MD) initially opposed the introduction of the MHF Regulations, but eventually realised the commercial advantage an MHF licence offered, and saw for himself the business gains achieved with a safer operation. He became a convert to the MHF Regulations, encouraged his staff to speak publically at MHF education forums, and espoused the gains they had achieved through compliance. He also made sure the MHF Regulations were applied to all competitors, alerting the regulator to any activity of a would-be competitor without an MHF licence so as to ensure a ‘level playing field’. This led to the prosecution of an unlicensed MHF. With significant leadership drive and commitment, Case 5 came from a poor starting position to achieve a full-term licence.

The SMS prior to the MHF Regulations
Some time prior to the MHF Regulations coming into effect, Case 5 introduced, and actively policed and audited, an SMS based on the Australian Standard. However, the Quality Manager responsible resigned from the organisation prior to the MHF Regulations coming into effect. The role of the Quality Manager in SMS maintenance was not understood by senior management and the SMS became a series of un-used files (the researcher was shown in 2000 a filing cabinet full of defunct SMS documents). The business required external quality accreditation for commercial reasons, so the quality system continued successfully. As the safety and quality systems were not integrated, the quality system continued while the safety system became inoperable (Field oversight plan 2001:2).

The VWA Scoping Audit found ‘safety management procedures are part of the documentation in the ISO9002 controlled systems’ (L2 scoping audit 1999:2). However, the audit recommended that ‘A systematic approach should be undertaken to identify all safety critical activities and establish safety objectives’ (L2 scoping audit 1999:2). Furthermore ‘A comprehensive risk identification and risk management system should be established and an appropriate system to record and track the on-going management of risk should be incorporated into this approach’ (L2 scoping audit 1999:3) and ‘A formal change management system which requires appropriate review, assessment and approval of changes should be developed’ (L2 scoping audit 1999:4). These recommendations suggest that any SMS in existence prior to the regulations was very rudimentary, not having any risk management aspects in place. The report’s final suggestion that ‘There are a number of commercially available safety management protocols that could be of assistance in the development of the company’s Safety Management System’ (L2 scoping audit 1999:5) indicates that there was significant development work to be undertaken on the SMS. A further recommendation ‘An
appropiate system to ensure the on-going integrity of the management system should be put in place’ also indicates that SMS auditing was not occurring (L2 scoping audit 1999:5). Case 5 had significant work ahead to comply with the MHF Regulations.

This work was seen by the Managing Director as an unnecessary regulatory burden which would cost him money and achieve nothing. He used his membership of various industry bodies (both chemical and logistics) to lobby against the regulations. Once he realised he could not stop the implementation of the government’s response to Longford, he then attempted to stop its application to storage and handling facilities as “we’re not no bloody Longford [sic]” referring to the complexities of a hydrocarbon separation process versus a simple dangerous goods storage yard with trucks loading and unloading. He was not aware of the Sandoz warehouse incident of 1986 in Switzerland.

Once he realised the schedule of materials and their quantities that determined a site to be an MHF was not open for debate (as the Victorian legislation was following Europe’s Seveso and COMAH regulations), he then lobbied the regulator directly (meeting with the Hazard Management Division Director) demanding a ‘level playing field’. In response to his request, the regulator divided the group of MHFs into industry sectors, so there was direct comparison only with industry peers.

Reluctantly Case 5 then set about complying with the MHF Regulations, hoping that minimal effort would achieve a licence. But the MD had no knowledge of these regulations or what a risk assessment was, so he employed consultants. The consultants were a small local company which had no prior knowledge of the MHF Regulations or their overseas equivalents and were interested in ‘learning about the MHF Regulations’ so they saw Case 5 as a learning opportunity for their business (interview with consultant 2000). As a result, this consultant put in a low cost bid, to ensure they won the job (interview with consultant 2000).

The consultant prepared the SCO with a number of revealing statements regarding Case 5’s compliance level, such as ‘the basic structure of a management system is available but the system is very short on detail’ (L2 SCO 2000:14). This concurred with the 1999 scoping audit findings. The consultant submitted the SCO direct to the Regulator without providing time for Case 5 management to review the document. As a result, this consultant’s contract was terminated, as was the newly appointed Safety Manager who allowed the direct submission to occur. Neither the consultant, nor the Safety Manager had any previous experience with Safety Cases or developing SMSs.
The SMS now needed to be established and implemented. How was this to be achieved? The SCO stated that ‘SMS development will follow AS4801-2000 and AS/NZS4804 and HB139(int):1999 the Standards Australia handbook for step-by-step guidance on integrating management systems – Health, Safety, Environment and Quality’ (L2 SCO 2000:12). Case 5 stated that they had an existing occupational health and safety management system which ‘satisfies the requirements of the ISO9000 series of quality standards’ (L2 SCO 2000:14). A gap analysis was performed against the MHF Regulations by the ill-fated consultant, concluding ‘It is the objective of the Safety Case to implement an SMS’ (L2 SCO 2000:14). Case 5’s SCO Gantt chart allowed 43 weeks to develop the SMS, with 6 weeks to ‘include all Schedule 2 information’. The content of the SMS was listed as per the MHF Regulations.

To progress Safety Case development, the Managing Director brought in a business associate, with limited safety experience, to assist with safety matters until a permanent safety manager was appointed. A new Safety and Quality Manager was eventually appointed (the incumbent having no safety qualifications or experience), and together they revised the SCO which was resubmitted in September 2001. It stated that a Business Management System (BMS), integrating safety, environment and quality was going to be developed (L2 SCO 2001:16). It also stated:

[Case 5] is currently redefining the ISO9002 quality system and establishing current audit requirements on a formal basis. A number of audits from external auditors have been organised over the last 5 years but these have not been part of a formalised safety management program. This situation will be rectified (L2 SCO 2001:28).

Case 5 decided that the SMS was to be developed by the people who use it (L2 SCO 2001:29) and would include ‘a comprehensive audit tool against which we will monitor the completeness of the SMS’ (L2 SCO 2001:17). At this stage the audit tool was defective, looking at completeness of the SMS, not effectiveness. The Gantt chart followed VWA’s Guidance Note 3 (VWA 2001c), beginning with HAZID, safety assessment, control measures then the SMS. While Case 5 had a significant amount of work ahead, there was a basic plan. The SMS was going to be developed based on the existing BMS and known standards, with the involvement of end-users. The Managing Director now wanted to achieve compliance (albeit in a minimalist manner) and the new Safety and Quality Manager was on the right path – but could he compensate for lost time?
Progress to MHF Licensing

According to the site’s VWA Safety Analyst (2005), “[Case 5] was by no means a model site at the start.” The site’s VWA Field Officer (2005) added, “In the early days, whenever we visited the yard at [Case 5], dangerous goods issues were staring us in the face. Storage of non-compatible dangerous goods together, and sometimes even on top of one another. Spilt chemicals not cleaned up. Chemicals which should be stored away from combustible items due to high fire risk were sitting on combustible material. Chemicals were unloaded into unbunded areas and left there, awaiting relocation when a forklift was available. Truck drivers smoked around the dangerous goods. Trucks and forklifts were going in all directions. A full isotainer was dropped from height when crane cables broke due to lack of maintenance. There was a lot of work to do just to bring [Case 5] to an acceptable dangerous goods standard, let alone an MHF standard.”

How could control measure reviews be conducted meaningfully for major incident prevention when legislated control measures (such as segregation of non-compatible chemicals) were not implemented? Initially a dangerous goods focus was required from the regulator and Case 5 to achieve basic compliance with existing legislation before the increased demands of the MHF Regulations were applied. There were a number of dangerous goods non-compliance enforcement notices issued in 2001 and 2002 resulting in VCAT appeals and strained relationships between Case 5 and the regulator (L2 AFR 2003:52). “My standard operating procedure when leaving [Case 5] was to phone the HMD Director, to inform him of the issues I expected [Case 5’s] Managing Director would complain to him about, arising from my visit.” (interview L2 Safety Analyst 2005). Some time later, the Lead Assessor attributed this strained relationship to ‘the need for flexibility in this industry sector’ (due to immediate requests for short-term storage from the ports and chemical companies), the ‘reliance of [Case 5] on the “goods in transit” exclusion in the 1989 Dangerous Goods Regulations to deal with some dangerous goods regulatory constraints’, which does not exist in the MHF Regulations, and ‘the absence of an effective HS&E Manager’ until the present Safety & Quality Manager was hired (L2 AFR 2003:52 - 53). The issues were resolved with an amendment to Case 5’s Dangerous Goods Licence, and withdrawal of the VCAT appeals (L2 AFR 2003:53). At the end of this process, the regulator had a better understanding of Case 5’s business requirements and processes and Case 5 had a better understanding of the regulatory requirements (L2 AFR 2003:53).
It became evident that the limited resources of a small company such as Case 5, could not cope with competing demands of addressing compliance issues and developing a Safety Case and SMS. ‘[Case 5] have experienced significant delays to our Safety Case project since August 2001...as a direct result of continually re-deploying resources to satisfy the on-going demands of both WSV and MFESB [the fire brigade].’

(letter1 L2 to VWA January 2002). ‘As you are aware, [Case 5] does not have the resources that are more readily available to larger enterprises with relation to progressing work on Safety Case projects. We have been significantly delayed due to compliance issues properly identified by your staff that require our immediate attention’ (letter2 L2 to VWA January 2002). Significantly this correspondence shows Case 5 chose not to fight the compliance issues, which would have occurred in the past - they were simply telling the regulator that they couldn’t do everything at once.

A pilot assessment conducted by WSV on site, prior to Case 5’s Safety Case submission, showed ‘considerable work yet to be undertaken to demonstrate control measures and SMS adequacy...... Further work appears to be required to properly implement the SMS’ (Letter VWA to L2 Feb 2002). Hence an extension to the Safety Case submission date was required and granted. At this time Case 5 stated that they were ‘reliant on their consultant’ for ‘the words’ (VWA File note January 2002). VWA expressed concern that Case 5 was placing themselves at risk of repeating the problems of the first SCO (the consultant had control of the document) resulting in a late submission that did not align with company sentiment (VWA File note January 2002). Despite the tension between Case 5 and the regulator, the purpose of the MHF Regulations was starting to resonate with the Safety & Quality Manager, who noted ‘Case 5 will be using the Safety Case not just as a submission for licensing but continuing it as a live management tool’ (email January 2002).

During Safety Case development, the old SMS files were reviewed by the new Safety & Quality Manager. There was not enough information within the files for the current incumbent to determine how the system actually functioned, and who did what (Interview L2 Safety Manager 2001). The new manager started integrating aspects of the SMS that he thought to be important into the quality system. But being new to the site, he could not write the system himself as he was not familiar with the operational tasks, so he

129 The Metropolitan Fire and Emergency service Board (MFESB) had concerns regarding inadequate fire protection and access to the site. Significant upgrades to the fire protection systems including new fire water tanks, pumps, and extended ring main and hydrants were made to satisfy the MFESB (L2 AFR 2003:39).
130 The consultant was the MD’s associate who was retained for ‘word smithing’ purposes.
enlisted the advice of yard personnel for the development of system elements to make sure the system captured actual practice and made sense to employees. Due to the small number of employees, the new manager's focus was on developing a system that was workable and did not require additional resources to implement. To prevent all knowledge residing with a single person, as had previously occurred, roles and responsibilities within the SMS were distributed across senior management including accounts and operational staff. This approach to SMS development, involving both employees and management, began to take shape and improvements to safety and business efficiency were noted. But how much was the system implemented by the time of Safety Case assessment?

**Safety Case Assessment**

Shortly after Safety Case submission, the assessors conducted an initial review of Case 5’s SMS and acknowledged Case 5 was in a state of transition as a Business Management System (BMS) was being developed, incorporating the SMS. The assessor notified Case 5 that the components of the BMS/SMS required to meet the MHF regulations must be in place and being implemented (letter VWA to L2 July 2002). The assessors also notified Case 5 that a number of apparent deficiencies in the SMS had been identified and encouraged Case 5 to share their improvement plans with the regulator\(^{131}\) (letter VWA to L2 July 2002).

As the Safety Case assessment progressed, further issues arose including:

- Incomplete list of materials to be included under the MHF licence;
- Inconsistencies in the risk assessment methodology;
- Non-compliance of the site’s Emergency Plan with MHF regulatory requirements, and
- Non-compliance of the SMS with the requirements of Regulation 301 and Schedule 2. (L2 extension letter 2002).

Case 5 requested extra time to demonstrate compliance and an extension to the assessment period was granted.

Case 5 continued to establish and implement a basic SMS suitable for a simple site (L2 AFR 2003:20). A safety policy and objectives were developed and each SMS procedure required by the Safety Case was revised to show the connection, ensuring its maintenance in future revisions (L2 AFR 2003:19 and 27).

\(^{131}\) VWA knew that Case 5 was conducting a gap analysis against the relevant Australian Standards and Codes of Practice with a view to identifying gaps and achieving a unified system.
Verification in January 2003 raised some concerns about how well Case 5’s Management of Change (MoC)/Risk Assessment and Auditing were operating. Four enforcement notices were issued (L2 AFR 2003:17). The cause appeared to be different expectations between Case 5 management and WorkSafe - in this instance, on the degree of formalisation and documentation expected. For example, Case 5 only used the MoC procedure for equipment or facility modifications requiring capital investment (L2 AFR 2003:28). For all other ‘changes’ Case 5 used a formal Risk Assessment procedure, but did not necessarily record the outcome. MHD personnel were accustomed to a broader based MoC procedure where the same system is applied to anything other than ‘like for like’ replacement. Case 5 had not recorded these risk assessments in the past to the standard expected by MHD assessors (L2 AFR 2003:28). With further discussion and consideration, Case 5 revised and, in the opinion of the lead assessor, strengthened, its MoC/risk assessment and auditing procedures to ensure that all ‘changes’ are thoroughly reviewed, assessed and recorded (L2 AFR 2003:28). ‘Internal Quality Audit’ was also revised and the audit frequency increased to improve the visibility and priority of auditing of safety critical procedures. Case 5 provided evidence that the revised procedures were being followed (L2 AFR 2003:53). The Lead Assessor was ‘confident that integration of the SMS is now well supported by management procedures at all levels of the organisation’ (L2 AFR 2003:29).

The role of employees in all procedures in the SMS was clearly defined in a “Key Roles” section at the start of each procedure (L2 AFR 2003:50). The Lead Assessor (LA) observed Case 5 to have an experienced disciplined workforce who follow procedures because they understand them, and refer to supervisors whenever they encounter unusual circumstances (L2 AFR 2003:52). Health and Safety Representatives at Case 5 were also an ‘integral part of all safety related work, including that of the Safety Case Team’ (L2 AFR 2003:50). This involvement was apparent during the two hazid/safety assessment workshops that the LA observed noting that the HSR ‘contributed freely and was given due consideration by other members of the team’ (Field Report V00003400142L). During another site tour (4/3/03) given by two HSRs and a yard employee to the LA and MHD Director, the Case 5 employees spoke freely of their involvement in the Safety Case work, and in subsequent risk assessment sessions (L2 AFR 2003:54). The overall impression gained by the LA was ‘one of involvement, consultation and a sense of ownership by the HSRs’ (L2 AFR 2003:55). HSRs interviewed during verification also confirmed this opinion (L2 AFR 2003:55). Yard and warehouse employees appear to work closely with supervisors, and there was no
suggestion of lack of instruction or supervision (L2 AFR 2003:58). The verifiers confirmed that most of the sampled procedures were followed closely in the yard and the warehouse. Overall, the Lead Assessor concluded that Case 5 had ‘an experienced disciplined workforce that follow procedures quite closely’ (L2 AFR 2003:22). Hence the Lead Assessor was ‘confident that the SMS is integrated into the daily activities of yard/warehouse personnel and supervisors’ (L2 AFR 2003:22).

A number of improvements were made to Case 5’s SMS during Safety Case development work and the assessment period. Due to the benefits of the improved SMS, Case 5 planned a further review of the SMS post licensing as a check on internal consistency, and to ensure that all improvements were captured. It was also expected that management auditing of compliance with randomly chosen procedures would identify further revisions (L2 AFR 2003:30).

The assessment concluded:

[Case 5] appear to have undergone a significant shift in safety culture during the Safety Case development and assessment period. Evidence for this is many employees’ opinions during site visits by the Lead Assessor and during Verification. The most recent of these were comments from unaccompanied HSRs during a tour of the site on 4 March 2003 by the LA and the MHD Director. (L2 AFR 2003:52)

Case 5 was granted a five-year licence without conditions.

Changes Made by the Organisation

With senior management and workforce support, the SMS was developed in small steps, building on the existing quality system. Personnel at all levels were involved in the development of procedures and processes. These procedures and processes were developed specifically to be understood and achievable by the responsible individual, and to be both effective and efficient. Auditing of the SMS was undertaken by the senior management team, involving going out into the workplace to undertake the audit. This is a further example of senior management commitment and support to the SMS.

Initially WorkSafe was not welcome on the site, and employees were fearful of being interviewed by WorkSafe personnel. At this time, a significant number of enforcement notices were issued. Over time, WorkSafe demonstrated an understanding of the business and employees became accustomed to seeing WorkSafe personnel on site and understood the role of a WorkSafe Inspector. Senior Management and employees developed a greater understanding of their own systems, processes and risks of their
business, and then understood why WorkSafe Inspectors responded with enforcement action when non-conformances with the site’s systems were identified. Training in the hazards to personnel when handling hydrofluoric acid\textsuperscript{132} was a turning point for employees and management, realising the inherent dangers associated with some of the chemicals on their site (L2 AFR 2003:53). With this understanding, management then encouraged personnel to identify the non-conformances themselves and rectify the situation, rather than waiting for WorkSafe.

Case 5 was a simple site with a hands-on Safety & Quality Manager who delegated system development to end-users. The SMS was developed with a ‘keep it simple’ approach. Auditing by senior management provided a tangible demonstration of senior management support and encouraged senior management to see what was happening in the field. As a result, the SMS remained ‘real’. This approach guarded against the fault found at Esso by the Longford Royal Commission that:

\begin{quote}
There was a tendency for the administration of OIMS to take on a life of its own, divorced from operations in the field. Indeed, it seemed that in some respects, concentration upon the development and maintenance of the system diverted attention from what was actually happening in the practical functioning of the plants at Longford. (RLRC 1999:13.40)
\end{quote}

**Progress After Licensing – SMS Converts!**

Case 5’s first licence was issued in 2003. In 2004, WorkSafe concluded that Case 5 had ‘shown self improvement in OHS and Safety Case (with minor non-compliances)’ (L2 Review 2004:1). Three dangerous goods non-compliance enforcement notices were issued by WorkSafe, primarily due to a ‘lack of focus on the Dangerous Goods Act and Regulations’ (L2 Review 2004:1). Case 5 management rectified this lack of focus (L2 Review 2004:1). Consolidation of the SMS was occurring to improve its implementation and operability (L2 Review 2004:2). This was achieved by reviewing all procedures with the aim of rationalising the number of procedures and creating synergies. WorkSafe believed that ‘this rationalisation will potentially assist Case 5 to achieve full implementation and functionality through clearer focus, as well as achieving all auditing requirements’ (L2 AI 2004:7).

The Case 5 Yard Manager gave a presentation at WorkSafe Week 2004 regarding how they implemented their SMS. His presentation included the following:

\textsuperscript{132} Hydrofluoric acid is highly corrosive and a contact poison.

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• Case 5 has taken a mentoring approach as opposed to a disciplinary system to achieve internal compliance. Employees evaluate their own performance.
• Staff write the points to go into work instructions and they are then assessed and proved jointly. Sometimes clients can also be involved.

**Staff own the SMS, they are their procedures** (L2 WSW Presentation 2004:3)

This clearly demonstrates employee involvement and ownership of the SMS.

Through making safety improvements, such as controlling stock location and ensuring first-in first-out, removing unnecessary double handling of stock, efficiency gains were achieved which led to financial gains. Case 5 was proud to report publically that ‘in the period 2001 to 2004, we have expended 2.5 Million dollars [on safety related infrastructure such as fire protection systems and bunds] that would not have been spent in 2000, or for that matter in years prior, yet we have grown our turnover from 9.7M in 2001 back up to 11.4M’ (L2 WSW Presentation 2004:9).

When asked, “would [Case 5] develop a Safety Case all over again?”, Case 5’s Yard Manager stated “yes we would…because it has changed the company dramatically and in such a way as it would never return to its past. Constant monitoring ensures not only a safer workplace, but our continued economic growth and reputation as a leader in this industry.” (L2 WSW Presentation 2004:10).

These comments show Case 5 finally embraced the requirements of the MHF Regulations, particularly the systems aspects, and used them to their commercial advantage. The benefits of auditing were realised and became an integral part of their business.

However problems remained. Annual Inspection revealed contractor management deficiencies. For example, no written service agreement was in place for the fire pump testing and maintenance, although inspections were occurring albeit to a lesser standard than Case 5 understood. During the Annual Inspection the pumps were found to have low fuel levels (and had for some time), discharge pressures were not being recorded, the pumps were being started but not run, and deficiencies with pressure gauges and cooling systems had not been identified (L2 AI 2004:6).

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133 Expenditure driven by Safety Case findings.

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While many ‘In Part’ observations were made for the SMS during the 2004 Annual Inspection, it was often documentary issues that were identified. WorkSafe believed that the SMS review conducted by Case 5 would identify the need for supporting documentation and appropriate methods for achieving and maintaining this (L2 AI 2004:8). WorkSafe believed that Case 5’s streamlining of practices would help focus personnel on key items and anticipated that the amalgamation and continued focus would lead to improvement in the extent of implemented and operability results obtained (L2 AI 2004:8).

The auditing system was implemented, however further opportunity for improvement was identified in robustly establishing the audit schedule to clearly reflect the required audit frequencies (L2 AI 2004:7). From 2004 Annual Inspection observations, Case 5’s training system, inspection and testing, and audit processes were further improved. These improvements were made as a result of employee and management feedback. WorkSafe encouraged Case 5 to further refine systems and create synergies to meet legislative and business needs (L2 AI 2004:7-8).

The following year’s Annual Inspection showed contractor and third party management was implemented, operational and audited (L2 AI 2005:7). Annual Inspection also identified a strong adherence to procedures in the day-to-day operations of the site (L2 AI 2005:7). Audit documentation indicated a positive commitment for continuous improvement in the site’s SMS (L2 AI 2005:7).

Two years post-licensing Case 5 had significantly improved and strengthened their SMS. The facility completed consolidation of the SMS, including improvements in the auditing regime and the development of performance standards and indicators. Management and employee knowledge had increased and there was overall improvement in major incident management as observed by the Annual Inspection results (Logistics Sector Review 2005:7).

Conclusions
This site had limited resources to re-establish a previously abandoned SMS. However direct senior management support, employee involvement and a development principle of keeping it simple and integrating into current activities over time were key success factors for the site.

Initially there was no focus on complying with the MHF Regulations. Instead all energy was focused on fighting the process, lobbying to have the MHF Regulations abolished or
at a minimum made not applicable to logistics facilities. The SMS was not implemented and it is questionable whether it could be considered to be established, as it was a series of documents in a filing cabinet that were not used or understood by current employees.

Once the Managing Director accepted that the MHF Regulations were not going to be amended for him, he and senior management began to drive the process of achieving compliance – however by doing the minimum required. To achieve compliance the Safety and Quality Manager returned to the origins of the SMS, reviewed the SMS standards and designed the SMS to be simple and integrated into the established QMS. By involving personnel in the development of the system, implementation easily followed design. Learning from the past situation where only the Safety and Quality Manager knew about the SMS and this knowledge disappeared when she resigned, the new incumbent designed the SMS to distribute roles across all senior managers. Hence senior management were also directly involved in the SMS from the beginning. Involvement from the Managing Director, ensured the SMS was implemented. However his concerns regarding such activity initially being a waste of time, ensured the SMS was developed with no unnecessary aspects. Hence the SMS was designed to be simple, which was appropriate for a simple site with a small number of employees and simple control measures.

By the end of the assessment process, Case 5 had begun to appreciate that their SMS could be further refined by revising procedures and by focusing on increasing auditing and making it more effective – not just checking that a task was being performed but that the task was actually effective in preventing a major incident. Due to the high level of integration between the SMS and business activity, commercial gains became evident as safety improvements such as stock handling led to efficiency gains. This business success provided an internal feedback mechanism encouraging continued focus on the SMS. Case 5 then took great pride in being able to tell others of their success.

The decision to licence Case 5 in 2003 signifies acceptance by WSV of sufficient progress in developing an SMS. Undoubtedly the licensing system had galvanised management into taking effective action. Yet subsequent Annual Inspections continued to find faults. A number of these (fire pump problems and contractor management issues) signify that a good SMS may not equate to thorough safety management practices. The implication is that licensing – as an infrequent process – may lift SMS development, but can allow decay over time and the emergence of gaps – even in the best cases.
7.3 Case 6 – the Distracted Leader

Facility Overview

Case 6 (L6) is a purpose-built dangerous goods storage and distribution facility, constructed in 1989 in an industrial area of Melbourne. Case 6 stores products for approximately 70 companies in a wide range of industries including petro-chemical and chemical processing. Case 6 has undergone several expansions, often as a result of ownership change. It is a busy site with 85 vehicle movements daily for small packaged goods and 70-95 shipping container movements weekly. Up to 70 people may be on site, with approximately 30 people directly involved with product movements within the warehouses.

During the period of Safety Case development and licensing, Case 6 changed ownership. When the MHF Regulations were introduced, Case 6 was on the market for a year, before being purchased in February 2001 (L6 AFR 2003:3). During this time of uncertainty, a number of experienced personnel left the organisation (L6 AFR 2003:3). The new Sydney-based owners, conducted a restructure, implementing a ‘spill and fill’ process from late 2002 until mid 2003, and hired casual or contract employees (L6 AFR 2003:3). This resulted in a loss of site knowledge, and up to 50% of the operational employees were casual (L6 AFR 2003:3).

Case 6 started (particularly as a Logistics Sector MHF) from an apparently strong base with regard to its SMS, having a leading-edge electronic stock management system and established auditing (L6 AFR 2003:52). However, an uncertain future for the company distracted management from developing the Safety Case and an assessment extension had to be granted to allow further time to address methodology inconsistencies and identified non-compliances. A number of company takeovers and successive restructures, combined with the introduction of a new corporate SMS led to poor verification results, particularly regarding the implementation of the SMS. A licence inquiry was held in anticipation of a licence refusal decision. Following a significant number of last-minute submissions to the regulator, a five-year licence with conditions was granted. Several months after licensing, a fire at the facility reminded Case 6 personnel that their control measures and systems were not perfect. However, two years after licensing, Case 6 produced a perfect score in their Annual Inspection, demonstrating that a series of changes and improvements had finally taken effect.
The SMS Prior to the MHF Regulations

WSV’s initial audit of Case 6 in 1999 was generally positive, indicating an SMS existed and was being used (L6 scoping audit 1999:2-5). The audit recommended further formalisation of the existing system, such as identifying all safety critical activities and establishing safety objectives, formalising the hazard identification and risk assessment process, documenting procedures for abnormal operations, and finalising change management procedures (L6 scoping audit 1999:2-4). An audit and review process of the management system was found to be established and operational (L6 scoping audit 1999:5). These findings suggested Case 6’s SMS was well on the way to achieving compliance with the MHF Regulations, given that two and a half years remained to demonstrate compliance.

In November 2000 Case 6 submitted a 35-page Safety Case Outline (SCO). It contained many positive statements such as ‘[Case 6] is committed to achieving the highest standards of safety, health and environmental performance’ (L6 SCO 2000:15) and ‘[Case 6] recognises that risk management is an integral part of an effective business management system’ (L6 SCO 2000:17). Case 6’s business management system (BMS) incorporated health, safety, environment, and financial controls, quality and customer service (L6 SCO 2000:6). The BMS was in accordance with ISO 9000, with the HS&E elements audited against SafetyMAP initial level (L6 SCO 2000:6). The SCO described a program of independent internal audits and corrective actions (L6 SCO 2000:15). A gap analysis was performed against the existing system and the MHF Regulations, concluding that ‘all procedures will require reassessment during/following safety assessment to ensure all controls are adequately managed’ (L6 SCO 2000:11). The high-level Gantt chart showed ‘management processes and procedures’ to be occurring throughout the Safety Case development (L6 SCO 2000:attachment). From the positive statements in Case 6’s SCO, the SMS appeared to be in good shape, not requiring much additional effort to achieve compliance with the MHF Regulations.

WorkSafe, however, did not share this opinion. The assessor noted the SCO lacked task detail and required further information to conclude the BMS constituted an SMS (L6 SCO assessment 2000:12). These issues were discussed with the site (Dec 2000) and Case 6 management responded in writing stating that the ‘Safety Case team will ensure the SMS is robust in practice and has been thoroughly implemented’ (L6 SCO additional information Jan 2001:attachment A). An experienced consultant performed detailed studies to support Safety Case development work (L6 SCO 2000:25). Workshops and SMS reviews were handled internally. Some managers at the site had considerable
knowledge of the dangerous goods regulations and were confident that their systems, processes and control measures were compliant (interview Lead Assessor 2005). It was not clear that the differences between the dangerous goods regulations and the MHF Regulations had been identified by Case 6 management. Any non-compliances identified by WSV were actively debated by Case 6 management until the issues were fully understood (interview Lead Assessor 2005). Case 6's Safety Manager and Quality Manager were not focused on the Safety Case and did not complete tasks as agreed with WSV (interview Field Officer 2005). This lack of progress was raised by WSV with Case 6 senior management.

Shortly after this meeting, Case 6 changed ownership and the Quality Manager and Safety Manager left. WorkSafe hoped these management changes would refocus Case 6 on Safety Case outcomes (L6 direct to change 2002:1). In notifying WSV of the ownership change and hence amending their SCO, Case 6 stated that a new corporate SMS would be applied (letter VWA to L6 March 2002:2). When the corporate SMS was introduced, Case 6 personnel believed they were unable to change it (L6 employee interview 2005).

**First Safety Case Assessment**

Case 6 submitted their first Safety Case for assessment in June 2002. Following extensive clarification meetings with WorkSafe and requests for further information, an assessment extension of six months was granted due to the following:

- Incomplete list of materials to be included under the MHF licence;
- Inconsistencies in the risk assessment methodology; and
- Non-compliance of the Emergency Plan with the regulatory requirements (L6 extension letter Dec 2002).

After significant extra work, the Safety Case was resubmitted in March 2003. The assessment team concluded the SMS was ‘well integrated into [Case 6’s] full range of activities and business philosophy’ (L6 AFR 2003:22). Working within a corporate SMS, Case 6 personnel developed a simplistic approach of identifying important control measures, such as rack integrity and employee training and induction, from the control measure review process. Then the associated BMS procedures, essential to ensure the control measure’s implementation and ongoing management, were identified. Twenty-one national procedures were identified and labelled ‘safety critical’ and assigned annual audits (L6 AFR 2003:23). This was a simple solution to linking an existing corporate SMS to control measure review findings. The assessor noted that Case 6 had ‘made a
substantive effort’ to consult employees and HSRs in the SMS revision (L6 AFR 2003:30).

Verification in April 2003 revealed that certain steps in some procedures were not undertaken at the Melbourne site, but perhaps were done at other sites (L6 AFR 2003:29). Several safety critical procedures were not implemented as written in the BMS (L6 AFR 2003:29) including Management of Change, Work Permit System, Site Safety Rules, Warehouse & Distribution Process Management (in particular issues pertaining to stock storage locations and segregation), and Training and Induction (L6 AFR 2003:29). These deficiencies were undetected by Case 6’s auditing (L6 AFR 2003:29). This significant finding shows that while audits were occurring, they were not being performed effectively. Case 6 management acknowledged the auditing deficiencies and undertook to improve (L6 AFR 2003:29).

Case 6’s written response to WSV’s finding of poor SMS implementation results is summarised below:

- Management and supervisors claimed to have been distracted by the sale of the business and the initial unsuccessful attempt to restructure the organisation.
- Management and supervisors also claimed to be under additional strain due to the loss of experienced personnel and the significant growth in the business.
- Case 6 management believed that the new structure was now stable, and newly defined roles and accountabilities would ensure closer attention to site activities.
- At least seven internal audits have been conducted since 9 May, generating 19 follow up action items, three of which have been closed out.
- The audit program and follow-up have senior management attention, with the overall program followed by the responsible Senior Executive.
- The audit program and methods are being used at other sister facilities, and head office had plans in place to apply the program at Case 6 before the WSV verification findings raised this as a concern. (L6 AFR 2003:29).

Verification also found control measures were not implemented as effectively as described in the Safety Case, which appeared to surprise Case 6 management (L6 AFR 2003:41). Two improvement notices and two Dangerous Goods compliance enforcement notices were issued during verification (L6 AFR 2003:18). Examples of the issues discovered include the electronic warehouse management system (WMS) (a
safety critical control measure) was found to permit incompatible materials to be stored together (L6 AFR 2003:42). Furthermore, the segregation chart normally located on the warehouse door that could have provided advice to personnel, independent of the WMS, was missing (L6 AFR 2003:42). Case 6 investigated the situation and found that the rule sets governing incompatibilities for Class 5.1 had been set up in the WMS, but not activated (L6 AFR 2003:42). The verifiers also made a number of negative observations about the Class 5.2 storage facilities and practices:

- Several of the containers were not placarded\textsuperscript{134} properly;
- Temperatures of the containers were to be monitored by security personnel. However, there were no records available to show that this had occurred, and interviewed security personnel showed limited knowledge of their role;
- Interviewed personnel were unaware that the emergency plan required external cooling water on these containers, and
- Some Class 5.2s labelled ‘store below 30\textdegree C’ were stored in non-refrigerated containers (L6 AFR 2003:43).

Documentation confirming testing of the fire protection systems by a contractor could not be produced (L6 AFR 2003:41).

Due to the poor results, meetings were held with Case 6 senior management on site at the completion of verification and the following week at WSV offices (L6 AFR 2003:18). Case 6 management justified the poor verification results based on the many changes in the previous 12 to 18 months, with the Victorian Warehousing Manger stating “We are confident that these changes are now behind us, the issues of concern addressed and that [Case 6] can now look forward to a prolonged period of stability” (L6 letter to WSV 2003).

On 29 April 2003, HMD Director met with Case 6 senior management to discuss Safety Case assessment issues. In response, Case 6’s State Manager wrote to the HMD Director, outlining the skills and experience of all Case 6 senior managers to demonstrate that the ‘management structure in place is capable of and committed to delivering all that is required to attain a Major Hazards Facility Licence’ (L6 letter 29 April 2003:1).

\textsuperscript{134} Labelled to indicate the chemical stored within and the appropriate emergency response (HAZCHEM signs).
On 9 May 2003 a Notice of Inquiry was sent, advising of WorkSafe’s intention to hold an inquiry into whether the Authority should grant, or refuse to grant, a licence to Case 6 (L6 Notice of Inquiry 2003:1). The reasons for the Inquiry were:

- The SMS was not established and implemented (regulation 301(1)),
- The SMS was not used as the primary means of ensuring the safe operation of the MHF (regulation 301(2)),
- Control measures were not adopted (regulation 304(1)) for the segregation of Class 5.1 materials (oxidising agents) and the safe storage of Class 5.2 materials (organic peroxides),
- The emergency plan was not accessible to warehouse employees (Regulation 503(b)), and
- The Local Council had not been provided with information regarding the Safety Case as required under Regulation 505(1), (2) and (3)(b) (L6 Notice of Inquiry 2003:2).

Case 6 made a total of eight additional submissions to WSV regarding the Safety Case between verification and the licence inquiry. Case 6 acknowledged that a post project implementation review should have found the Class 5.1 problems in the WMS. Case 6 conducted a thorough review of the WMS implementation project and ensured that the WMS was functioning correctly (L6 Submission for Inquiry 2003). Case 6’s most Senior Executive audited the Permit to Work system concluding ‘the system was working but required additional attention to detail’ (L6 AFR 2003:32). The Lead Assessor considered Case 6’s response to the Class 5.2 issue was ‘unsatisfactory’, recommending interim equivalent safety be achieved by June 14 while long-term control measures were developed and implemented (L6 AFR 2003:43). Case 6 easily rectified the deficiencies regarding the emergency plan and provision of information to the Local Council.

Based on the additional work and submissions, Case 6 was granted a five-year licence in 2003 with two conditions regarding the longer-term control measures for organic peroxides.

The Wake-up Call – Fire at Case 6

Following a 40°C day, a fire occurred at Case 6 on the evening of 14 February 2004, involving a refrigerated shipping container holding 8 tonnes of organic peroxides (Class 5.2 materials) (L6 Incident Report Feb 2004:3). The door of the shipping container burst open at around 9.45pm and emitted a cloud of light coloured smoke (L6 Incident Report Feb 2004:4). This was observed by a security guard who then commenced emergency procedures (L6 Incident Report Feb 2004:5). The fire brigade arrived before 10pm and
began cooling the shipping container (L6 Incident Report Feb 2004:5). Flames appeared at 10.55pm, and the fire was under control by 11.45 pm (L6 Incident Report Feb 2004:5). One Case 6 employee sustained a splash of contaminated firewater in an eye, requiring treatment from paramedics in attendance (L6 Incident Report Feb 2004:5).

WorkSafe Inspectors attended the fire and six improvement notices were issued for contraventions of the MHF Regulations, mainly related to breaches of control measures described in Case 6’s Safety Case:

1. acceptance of material with Self Accelerating Decomposition Temperature lower than 49°C (breach of Case 6 control measure),
2. no records for temperature monitoring of the refrigerated shipping containers (breach of Case 6 control measure),
3. failure to take action when high temperatures were detected (breach of Case 6 control measure),
4. failure to provide information, instruction and training on related control measures,
5. requirement to review and revise the Safety Case following this Major Incident, and
6. requirement to develop a maintenance and testing regime for the temperature gauge and alarms (breach of SMS) (L6 Incident Report Feb 2004:5).

“We were a focused company and understood the seriousness of what we stored prior to the fire. The fire didn’t scare us as such, but made us realise that our control measures and systems weren’t as good as we really thought” (L6 employee interview 2005). In November 2004, Case 6 advised WorkSafe that it would cease storage of organic peroxides by the end of 2004.

Post-Licence

A month prior to the fire (January 2004), Case 6 breached their second licence condition. The WSV Safety Analyst noted that Case 6 had demonstrated a willingness to implement corrective actions identified by the regulator, but were not proactive in identifying gaps using their own systems and implementing appropriate corrective action (L6 Oversight Plan 2005:5). An analysis of non-compliance notices and directions received by Case 6, performed by the WSV Safety Analyst, showed a pattern of failure to manage and maintain controls that had been put into place (L6 Oversight Plan 2005:5). This suggests the SMS provided limited support for control measures, possibly due to reduced implementation of the SMS, as was found during Safety Case verification.
In July 2004, the Annual Inspection concluded that ‘there are signs of deterioration in the management of some controls on the site and the implementation of the SMS’ (L6 AI 2004:4). WorkSafe believed that Case 6 should have detected these types of inconsistencies through their auditing program, if the audit system had been robust (L6 AI 2004:4). WorkSafe raised concern that auditing did not appear to have sufficiently progressed since licensing (L6 AI 2004:13).

The company underwent a further restructure in August 2004 after which a chemical engineer was employed to oversee storage of dangerous goods, adherence to the Safety Case and perform audits. ‘He was strict, enforced actions and understood the safety and chemical issues” (L6 employee interview 2005). In 2005, Annual Inspection results were ‘a significant and noteworthy step change’ from the results of the previous year, with all items inspected found to be fully implemented and fully functional and all three SMS elements were subject to internal auditing (L6 AI 2005:4). “The internal audit program at Case 6 has advanced a long way from the system that had just commenced at the time of licensing in 2003 to what now appears to be a mature, well administered and documented program” (L6 Safety Case Officer interview 2005). Case 6 had also improved their competency training system to ensure personnel understood their safety roles (Logistics Sector Review 2005:7). Six of the ten control measures inspected in the 2005 Annual Inspection were procedural. All individuals interviewed were able to clearly articulate their role in these procedures, which was further evidence that they had been well trained in their individual roles (L6 AI 2005:7).

WorkSafe attributed the significant improvement between 2004 and 2005 to the direct involvement of senior management, including being made responsible for the effective functioning of specific SMS elements, coupled with the auditing program (L6 AI 2005:8-9). Case 6 made a number of changes shortly before licensing in 2003 to address verification issues. In particular, there were a number of changes made in the management team, an extensive audit program was established, and the training system was overhauled (L6 AI 2005:4). Yet the 2004 Annual Inspection results were poor. Perhaps this indicates that more time was needed to allow the systems to work. Perhaps employing the chemical engineer, following the poor 2004 Annual Inspection results, assisted in SMS implementation and auditing improvements originally intended by the organisation. WorkSafe concluded from the 2005 Annual Inspection that the various changes made by Case 6 were finally making a difference (L6 AI 2005:4) and that Case 6 had ‘considerably improved the level of safety management at its facility since licensing in 2003’ (L6 AI 2005:9).
Conclusions

Changes to ownership and key management personnel caused Case 6 to initially struggle with a new corporate SMS. After showing willingness to improve, but not having the skills to achieve it, Case 6 management sought a balance of experience, skill and enforcement to eventually improve their SMS. Management realised employee involvement was necessary and it was a key factor in successfully making the SMS site-specific. A fire mid-way through their improvement activities highlighted the weaknesses which still existed in control measures and SMS elements. Two years post-licensing, improvement was finally demonstrated with improved auditing conducted by an individual who understood the safety issues and enforced the necessary actions. Also vital was a robust training system for all personnel to ensure their safety roles were understood, and senior management commitment to the SMS.

Case 6 appears to have been a border-line case in achieving its first licence. Clearly it had not, by mid 2003, advanced far in implementing the full SMS development process. Indeed it seems to have just scraped through the design and implementation stages. The 2004 fire testified to how little of the SMS was fully operational, as did Annual Inspection results. Of significance was management’s decision to cease handling organic peroxides – the substance that caused the fire and attracted the two licence conditions. This suggests that management lacked confidence in their SMS, and contracted their operation rather than remedy control measure and SMS weaknesses at that time. Licensing was clearly considered a tough test, which management confronted in several ways including lobbying WSV, cutting their inventory of one substance and then, finally, hiring someone to get the SMS right. Clearly licensing was important, although not without Annual Inspections to back it up.

7.4 Case 7 – the Proactive Leader

Facility Overview

Case 7 (P&C3) import a Schedule 1 material, which undergoes a complex reaction sequence to form a non-hazardous product. The raw material is highly flammable, a known carcinogen, produces toxic smoke and has the potential to explode in a boiling liquid expanding vapour explosion (BLEVE). Influenced by the 1974 Flixborough incident, the site was designed using inherent safety principles (P&C3 AFR 2007:4). The site is located in a sparsely populated industrial area of Melbourne and operates continuously. Case 7 employs 84 people with 4 operators and a manager on shift,
providing 24 hour coverage (P&C3 AFR 2002:8). The most senior Australian manager is present at site (P&C3 SC 2001:12).

Case 7 management embraced the MHF Regulations and positioned the company to be a leader in MHF Regulation compliance in Victoria, by volunteering to provide an ‘Exemplar Safety Case’ (P&C3 exemplar report 2001:13). Case 7 were proactive, seeking information from similar jurisdictions overseas with experience in Safety Case development, and making appropriate resources available both in-house and externally to develop the Safety Case. At all times, Case 7 maintained a philosophy of the SMS being developed by the people who use it. Case 7 successfully obtained a five-year licence without conditions, and was commended for its commitment and industry leadership (P&C3 exemplar report 2001:10).

Initial Approach

WorkSafe’s initial scoping audit of Case 7 found an operational SMS including audits, which was deemed ‘appropriate’ for the facility and it was noted that ‘extensive time and resources’ were devoted to these activities (P&C3 scoping audit 1999:5). Case 7 had a Business Management System (BMS) which incorporated the SMS (P&C3 exemplar report 2001:39).

Case 7 volunteered to be one of three Victorian MHFs to participate in an exemplar process, where their Safety Case development would be fast tracked and assessed by the regulator as a trial run, with the aim of providing feedback to industry and test the regulator’s assessment processes (P&C3 exemplar report 2001:13). Case 7 was the first exemplar Safety Case submitted, in October 2000, at the time other MHFs were submitting their Safety Case Outlines (SCO) (P&C3 exemplar report 2001:15). Due to the short development time-frame, Case 7’s Exemplar Safety Case scope only examined the main Schedule 1 material held and processed at the site (P&C3 exemplar report 2001:5). Case 7 senior management were highly committed to the process, openly discussing their experience (both positive and negative) in public forums, and there was ‘enthusiastic’ involvement from HSRs (P&C3 exemplar report 2001:6). Case 7 Management approached the MHF Regulations as ‘an opportunity to improve the business, rather than a regulatory burden’ and with the expectation that the Safety Case could be used as a tool to first capture, then disseminate, corporate knowledge regarding process safety (Safety Case Manager Conference Paper 2001:655). Case 7 was later

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135 SCO provides a site’s plan for developing their Safety Case to comply with the MHF Regulations.
commended for its commitment and industry leadership (P&C3 exemplar report 2001:10).

The existing SMS (part of a BMS with ISO9001 certification (P&C3 SC 2001:13)) was a combination of systems from two former parent companies – both well-known for their established SMSs (P&C3 exemplar Safety Case 2000:14). The exemplar Safety Case referenced lessons and changes that had been made at Case 7 as a result of the Longford incident and the lessons highlighted by Hopkins (2000) (P&C3 exemplar Safety Case 2000:14). Case 7 had self-initiated a development program of their existing SMS, planning ‘significant changes to the SMS over the next two years, in pursuit of our goal of continual improvement’ (P&C3 exemplar Safety Case 2000:i). As a result, the SMS was found to be ‘in transition’ at the time of the exemplar assessment, and was assessed based on the intent of the new SMS, rather than the actual implementation (P&C3 exemplar report 2001:8).

In undertaking the exemplar process, Case 7 discovered that a large number of external audits had occurred in the previous three years, but had not been part of a formalised program (P&C3 exemplar Safety Case 2000:A71). Case 7 identified that these audits needed to be coordinated, formalised and their scope broadened to include safety aspects (P&C3 exemplar Safety Case 2000:A71). The ownership of audits being located with the Chief Financial Officer was also questioned (P&C3 exemplar report 2001:44). Case 7 identified these flaws during the exemplar process and began developing an integrated audit program for the facility without being prompted by WorkSafe (P&C3 exemplar report 2001:44). Case 7 also realised that the audit process itself was not subject to auditing (P&C3 exemplar report 2001:44). WorkSafe identified the need for further development of SMS Performance Standards and Control Measure Performance Indicators (P&C3 exemplar report 2001:44). These necessary inclusions were considered achievable in the time remaining before Case 7 was required to submit its ‘official’ Safety Case.

Conclusions regarding the SMS’s comprehensive and integrated nature were not made by WorkSafe during the exemplar process as the SMS was in transition. It was flagged for industry and the regulator that future Safety Case submissions may result in good descriptions of the SMS, but result in an inability to demonstrate the SMS’s implementation or comprehensive and integrated nature (P&C3 exemplar report 2001:53). This was to be an issue with a number of Safety Case assessments, where
the extent of SMS implementation did not match the Safety Case description (see ‘Lagger’ case studies for examples).

Safety Case Development
Case 7 was in an advantageous position following the exemplar process, as they revised their Safety Case Outline to incorporate lessons from the exemplar assessment (P&C3 SCO direct to change 2001:1). Case 7’s SCO described the planned SMS changes as ‘two former SMSs being merged into one’ (P&C3 SCO 2000:14). SMS documents were reviewed and integrated, with additional procedures being developed where necessary (P&C3 SCO 2001:22). Case 7’s aim was to align the SMS with the risk profile of the plant, via a focus on monitoring and improving the performance of critical control measures (P&C3 SCO 2000:14). “We are already seeing the benefits of this approach. The risk assessment program undertaken through the exemplar process identified human factors as the main risk driver for many of the major incidents at our plant. As a result we are substantially reviewing our permit to work, training system and operating instructions.” (Safety Case Manager presentation 2000 and P&C3 SCO 2000:14). The permit to work (PTW) system was compared with seven local and international standards, procedures and codes of practice to develop the new PTW system (Safety Case Manager Conference Paper 2001:659). Case 7 had a strong commitment to the SMS being ‘developed by the people who use it’ (P&C3 SCO 2000:15) which was confirmed by WSV during verification (P&C3 AFR 2002:32). Examples of this include Shift Managers and Operators writing operating instructions and reviewing these as part of Job Cycle Checks, and maintenance personnel being involved in the development of alarms, trips and preventative maintenance routines (P&C3 AFR 2000:15).

Because it was self initiated, the review of the SMS was the first item on their Gantt chart with 500 days assigned (P&C3 SCO 2000:attachment). The Gantt chart also included the delivery of an international conference paper on Case 7’s Safety Case experience in the UK in December 2001. This indicates Case 7’s desire to communicate their Safety Case experience with others and be an industry leader. Case 7 assigned a dedicated in-house Safety Case Manager, a Chemical Engineer with significant management and operational experience, and sent him to two key international conferences on Safety Cases in Europe in early 2000 (Safety Case Manager Conference Paper 2001:656). Through these conferences and the contacts made, the Safety Case Manager received ‘clarity of vision’ as to what a Safety Case should be and how it should be undertaken (Safety Case Manager Conference Paper 2001:656). The Safety Case Manager was supported by a consultant Chemical Engineer with Safety Case and risk management experience including being a technical resource to the Longford Royal Commission.
From the generous allocation of resources, willingness to be an exemplar, fact finding from overseas Safety Case experience, and forward planning to present their experience at an international conference, it seems clear that Case 7 management were committed to complying with the MHF Regulations.

**Safety Case Assessment**

Case 7’s Safety Case assessment went smoothly. No additional submissions were made by Case 7 indicating that very few, if any, issues were raised during assessment\(^{136}\) (P&C3 AFR 2002:9). Case 7 benefited from the exemplar process, addressing all of the areas for improvement raised in the Exemplar Safety Case Assessment Report in their formal Safety Case submission (P&C3 AFR 2002:3). A key element of Case 7’s Safety Case was a comprehensive database linking hazards, safety assessment, controls and SMS which was then depicted graphically in a bow-tie diagram (P&C3 AFR 2002:3 and Safety Case Manager Conference Paper 2001:657).

The only new issue identified during Safety Case assessment was the need for further implementation of control measure performance monitoring (P&C3 AFR 2002:3). Performance monitoring was relatively new to Case 7 and was still being implemented. The lead assessor reviewed a document in the BMS titled ‘[Case 7] Plant Measures of Performance (MOPs)’, which provided performance standards for measuring SMS effectiveness. It covered ‘maintenance, induction and other SHE matters and was sufficiently detailed, if fully adhered to, to ensure the effectiveness of the SMS’ (P&C3 AFR 2002:12). It was noted that these effectiveness measures were recently drafted so the assessment team anticipated the level of implementation would need monitoring after licensing (P&C3 AFR 2002:12).

**Not Quite Perfect**

Despite an otherwise clear assessment, verification identified a number of issues where control measures and SMS elements were not as effective as Case 7 believed them to be. A Pressure Relief Valve (PRV) was found to have been installed with a higher test pressure record than the required set point\(^{137}\) (P&C3 AFR 2002:23). The PRV was changed by Case 7 and the pressure management system reviewed (P&C3 AFR 2002:23). Verification also identified that the performance requirements of the fire water...
system were not fully established or understood by site personnel. Examples of this were:

- Flow tests were performed but not always checked against the required performance.
- Pumps were started manually to prevent water hammer effects, but this did not test the pumps’ automatic start and control systems, and raised the question why water hammer was occurring and why this had not been fixed.
- Nozzle failure on two monitors resulted in replacement with a different nozzle type. No flowtest or coverage assessment was performed to determine their suitability, and no review of the nozzle failures was conducted (P&C3 AFR 2002:24).

In all cases, Case 7 promptly rectified the problem following identification by WSV. However it does raise the question of why were these deficiencies not detected by Case 7?

Overall, the control measures verified were in place, however the supporting SMS elements for monitoring and maintaining these controls were not always fully effective (P&C3 AFR 2002:24). This was the situation identified in Chapter 2 of this thesis following analysis of more recent major incidents.

Overall, WSV concluded that Case 7 had developed a comprehensive, well understood and implemented SMS (P&C3 AFR 2002:5). Case 7 was granted a five-year licence without any conditions.

**Post-Licence**

Case 7’s 2004 Annual Inspection results for implementation and auditing of control measures and SMS elements were superior to most of the Plastics and Chemicals Sector (P&C3 AFR 2007:13). However several issues detracted from perfect results. These included certain PRVs that were not required to be inspected regularly as they were protected from environmental damage by dust caps. However it was found that the dust caps were not installed. Also the tanker loading deluge system had blocked nozzles following maintenance activities. Inspection of Contractor Management also revealed difficulty in tracking individual pieces of fire protection equipment, and hoses returned from testing by a contractor had no information tag to provide the hose identification number, test date, next test date, etc. (P&C3 AI 2004:7). While Case 7 dealt with the identified issues promptly and effectively (P&C3 AFR 2007:13), the findings highlight the lack of meaningful information provided by third-party contractors providing testing and
maintenance services (P&C3 AI 2004:7). This was a general finding across all MHFs (discussed in Chapter 5). The 2004 Annual Inspection concluded that Case 7 had ‘continued to be proactive in making improvements, and had continued to demonstrate a high level of safety management’ (P&C3 AI 2004:3). Based on the positive Annual Inspection findings and ‘the strong safety culture’ the WorkSafe oversight team recommended the regulatory visit frequency be decreased (P&C3 AI 2004:3).

A year later (2005), the Annual Inspection concluded that ‘although Case 7 continued to provide a high level of safety management, several areas emerged that require the existing systems and processes to be reviewed and potentially improved’ (P&C3 AI 2005:11). A procedure existed for the use of electrical equipment in hazardous areas, however the procedure had a revised document number to that given in the Safety Case and had not been followed or reviewed since 1995 (P&C3 AI 2005:7). Studies of hazardous area equipment and zoning were undertaken in 2003, but the database monitoring electrical equipment in hazardous areas had not been updated (P&C3 AI 2005:7). Procedures for use of the standby generator system, to provide emergency power, were found to be incomplete and in need of review (P&C3 AI 2005:7). Inspection showed the equipment was ready for use and that employees were able to describe the change-over process from mains power to standby, and were familiar with the equipment (P&C3 AI 2005:7). Due to a lack of Lead Auditors, the compliance audit was overdue and some SMS element audits had been postponed from a frequency of 36 months to either 48 or 60 months without consideration of the criticality of the SMS element (P&C3 AI 2005:10).

WSV summarised Case 7’s performance in their first licence period, ‘[Case 7] had continued to improve its SMS and control measures through improved performance monitoring activities. This has resulted in improved data collection and demonstration of the adequate functionality of control measures for the preventing/mitigating of potential major incidents’ (P&C3 AFR 2007:13).

Verification during the 2007 Safety Case Assessment showed hardware control measures were inspected, tested and maintained in accordance with the schedule and control measure failures resulted in ‘Critical Event’ classification with actions managed via the SH&E Actions Database (P&C3 AFR 2007:39). However verification found fault in the following:

- Some items of lifting equipment were not on the equipment register and/or outside their inspection schedule (P&C3 AFR 2007:40). Two items of lifting
equipment had not been inspected and were without compliance plates. As a result of this, two prohibition notices were issued, which were later complied with (P&C3 AFR 2007:40). The observation raised questions regarding third-party management activities. Case 7 undertook a number of corrective actions including a review of the contractor’s activities, changes to the equipment register and a comprehensive audit of all lifting equipment (P&C3 AFR 2007:40).

- The fire water ring main had not undergone hydrostatic testing, as required by Case 7’s procedure (P&C3 AFR 2007:40). A hydrostatic test was performed shortly after verification (P&C3 AFR 2007:40).
- Two critical control measures had not been signed off in the maintenance system as having missed their inspections, without an incident report being raised. While WorkSafe Inspectors found no indications that the control measures were defective, it indicated the presence of gaps in the system that may allow a faulty control measure to remain unchecked (P&C3 AFR 2007:40).

Despite the above faults, when put in context with the considerable positive verification and assessment findings, Case 7 had demonstrated to the regulator that they had the ability to operate safely in accordance with their Safety Case. This was ‘demonstrated via the development and implementation of systems to identify hazards and major incidents applicable to the facility, and to ensure that appropriate control measures are identified, implemented, functional and maintained’ (P&C3 AFR 2007:4). In 2007 Case 7 was successfully granted a further five-year MHF licence.

### Changes Made by the Organisation

In response to auditing issues raised by WSV following the 2005 Annual Inspection, Case 7 trained an additional four on-site personnel as qualified auditors (P&C3 AFR 2007:12).

A reduction in personnel numbers occurred in September 2004, involving the removal of one administration position, one production role and three mechanical technicians (P&C3 AFR 2007:11). The downsizing did not result in any changes to operator numbers, structure or roles (P&C3 AFR 2007:11).

In 2002, Case 7 was purchased by a senior management group in conjunction with an investment company. In 2005, Case 7 was again sold, with the senior management group maintaining a stake and a different investment company purchasing it. It is noted
that both acquisitions did not result in any organisational changes to the facility in terms of personnel, operational activities or systems (P&C3 AFR 2007:11).

**Conclusions**

Case 7 was a highly-motivated organisation that wanted to be at the forefront of MHF Regulation implementation in Victoria. Case 7 management invested in the Safety Case Exemplar project, making funds and resources available to ensure their organisation had the best chance of succeeding by seeking knowledge from others in similar jurisdictions overseas, and applying suitably skilled and experienced in-house personnel, supported by an external consultant. This motivation and availability of resources continued through the Safety Case development process. The SMS was substantially reviewed and revised over a two-year period with employee involvement throughout this process. Despite the many successes demonstrated by Case 7, WorkSafe inspections revealed that their system was not perfect. Contributing factors to this may have included the inherent complexity of the site and the effects of using outside contractors. More important perhaps – the continuing problems indicate the need for constant vigilance in an MHF, and the inherent tendency for the SMS to decay if not monitored and audited. This was particularly evident when there was a shortage of trained Lead Auditors at Case 7. In all instances, Case 7 responded promptly to rectify any deficiencies identified by the regulator. Case 7 continue to be commended as an industry leader and have achieved two five-year MHF licences without conditions.

Viewed overall, the SMS at Case 7 was perhaps “as good as they got” in Victoria in the aftermath of the new MHF Regulations when all facilities were making changes to get licensed. What is striking about Case 7 is that at the time of licensing and for two or three years after, the maintenance stage in SMS development remained flawed and Annual Inspections by WSV were still essential to ensure that control measures were fully effective. Case 7 could not self-manage compliance fully with its own SMS.
7.5 ‘Leader’ Case Studies: Conclusions

The ‘leader’ case studies have shown in detail three very different journeys taken to achieve compliance with the MHF Regulations.

Case 5 is a ‘lagger’ that became a ‘leader’. This site had limited resources to re-establish a previously abandoned SMS. Initially opposing the introduction of the MHF Regulations, the Managing Director of the privately owned business eventually realised the commercial advantage an MHF licence offered, and saw for himself the business gains achieved with a safer operation. He became a convert to the MHF Regulations, and with significant leadership drive and commitment and employee participation, Case 5 came from a poor starting position to achieve and retain a full-term licence.

Case 6 started from an apparently strong base with regard to its SMS, established auditing and leading-edge control measures for its industry sector. However a number of company ownership changes brought personnel changes and the introduction of a new corporate SMS during Safety Case development, which resulted in SMS implementation deficiencies being detected by the regulator. A licence inquiry was held in anticipation of a licence refusal decision. Following a significant number of last-minute submissions to the regulator, a five-year licence with conditions was granted. Several months after licensing, a fire at the facility reminded Case 6 personnel that their control measures and systems were not perfect. Two years after licensing, Case 6 produced a perfect score in their Annual Inspection, demonstrating that a series of changes and improvements had finally taken effect.

Case 7 is a proactive organisation, making deliberate decisions to position the organisation at the forefront of MHF Regulation implementation in Victoria. Such actions included volunteering to be an Exemplar Safety Case, seeking MHF compliance experience from overseas and hiring a consultant to assist with in-house compliance activities. Case 7 reviewed and revised their SMS substantially during the Safety Case development process, ensuring this development was performed by the people who use the SMS. Case 7 has successfully obtained two five-year licences without conditions.

Re-current themes identified in the ‘leader’ case studies included several related to management’s role:

- Senior management were present on site and involved,
- Senior management were, or became, committed to supporting the MHF Regulations,
Management accepted the regulator’s role and were open to information exchange,
- Management understood the SMS’s initial status,
- Appropriate plans were established for SMS development,
- Consultants were engaged to support in-house staff, not to direct the process,
- SMSs were tailored to the site’s needs (even when corporate SMSs were imposed),
- Auditing was occurring (although Annual Inspections exposed gaps),
- SMS deficiencies detected by the regulator could be addressed relatively easily, and
- External influences were managed to minimise disruption to the SMS.

Also important in all three cases was employee involvement in developing or revising the SMS. Two contrasting approaches are apparent. First is the ‘simple site’ approach of Case 5, where simplicity is turned from a resource weakness to an implementation strength by giving staff and HSRs a key role in SMS development and implementation. Second is the ‘complex site’ approach of Case 7, where HSR and employee involvement is integral to operations in a complex operating environment.

Finally, a cautionary point. All these cases were deemed to be ‘leaders’ because they gained a full licence in the first licensing round. This success should be qualified by their failure to fully accomplish all four stages of SMS development. At the time of licensing, none of the three had reliable SMS maintenance in place, and in all cases, external (WSV) Annual Inspections found the faults their internal audits overlooked.

These, and other points, will be considered further in the cross-case analysis in Chapter 8 to identify the attributes and varied processes or histories of each case which contributed to it being a ‘lagger’ or a ‘leader’, assisting the development of SMSs and ultimately compliance with the MHF Regulations.
CHAPTER 8

COMPARATIVE ANALYSIS OF CASE STUDY FINDINGS

8.1 Introduction

The previous two chapters presented seven case studies of ‘lagger’ and ‘leader’ MHFs as they attempted to gain licences to operate in compliance with Victoria’s new MHF Regulations. This chapter aims to compare the seven case studies using a cross-case analysis designed to both identify factors that affect the process of achieving compliance with the MHF Regulations and to assess SMS development. However the narratives of the seven case study sites reveal a degree of unpredictability suggesting that the variables affecting the dynamic nature of the process are difficult to untangle. For example, some MHFs that started positively, foundered under difficulties and struggled to become licensed, while others overcame unpromising beginnings to gain a full licence. The process of SMS development seems to be a complex one and may be heavily influenced by the parties involved and their interactions, as well as unpredictable external influences.

As an initial starting point, the cross-case analysis compares data for the seven sites under 12 categories. These 12 categories were noted in Chapter 4. They were developed largely on an inductive basis since there is little prior literature to offer evidence on factors that affect SMS development and regulatory compliance. These 12 categories are best understood as ‘input’ factors or variables that go into SMS development. Partial exceptions are 9 (internal auditing) which is a significant part of SMS development (the maintenance stage), and 10 (licensing outcomes) which is normally an ‘output’ variable from SMS development – although it is also used as an input in this chapter. The 12 categories are:

1. **Initial Preparedness:** Some sites were more prepared than others for the new MHF Regulations due to prior experience with an SMS, involvement in the Exemplar program, or access to the resources and experience of an overseas parent company.

2. **Site Management Capability and Employee Representation:** Some site managers had more capability than others to implement Safety Case development initiatives due to the presence of senior management on site, access to SHE
professionals, and the contribution of employee representation and workforce participation.

3. Initial Management Acceptance of the MHF Regulations and the Regulator: Management at some sites were more willing than others to accept the new Regulations, or to cooperate with WSV in learning how to implement an SMS effectively.

4. Initial SMS Development Stage: Some SMSs were more established than others, requiring less developmental work to achieve compliance, as some sites actively used their SMS and understood its development stage.

5. Plans for SMS Development: Some sites had better SMS development plans than others, as they understood their SMS’s initial development stage and planned appropriately for the necessary work to achieve a compliant SMS.

6. Use of External Management Resources: Some sites used external resources to better effect than others, as they selected suitably experienced consultants to assist in-house personnel, maintaining site ownership of the work.

7. Site-specific SMS Development: Some sites were better able to develop site-specific SMSs than others, due to their ability to modify the corporate SMS, involve employees in SMS development and integrate the SMS with other site systems.

8. Regulator Evaluation of SMS Deficiencies: Some sites had fewer SMS deficiencies detected by the regulator than others, resulting in less regulator intervention and less delay in the Safety Case assessment process.

9. Internal Auditing: Some sites had more effective SMS auditing practices than others, as some had more developed auditing practices with skilled auditors working to an achievable auditing schedule, checking if procedures were followed.

10. MHF Licensing Outcomes: Some sites were granted better licences (unconditional full-term licences) than others, due to the site’s ability to demonstrate sustained compliance with the MHF Regulations, particularly the SMS, and the regulator’s firm stance on compliance. Management learning is evident from Round 1 to Round 2, particularly for some sites with negative Round 1 experiences who altered their approach for Round 2.

11. Management Acceptance of the MHF Regulations and the Regulator – During and Post Safety Case: Management at some sites were more willing to demonstrate to the regulator that they had achieved compliance than others, due to their consistent responsiveness to WSV concerns throughout the assessment and licence period, ability to rectify issues unassisted, and the ability to self-initiate improvements, or the realisation that major incident prevention is serious through near-miss events.
12. **External Influences on MHFs:** Some sites were less affected by external influences than others, as management and employees were not distracted by company ownership changes, restructures, down-sizing or supply chain issues during the period examined.

Comparative data for these 12 categories are presented in Tables 8.1 – 8.12 following and analysed in Sections 8.2 to 8.13 of this chapter. In each table the seven cases are ranked on a scale of 1 to 7 (1 highest and 7 lowest) to indicate how well positioned they were towards positive licensing outcomes. Cases 1 to 4 were of course ‘laggers’, and cases 5 to 7 were classed as ‘leaders’. To aid reading of the tables, positive outcomes are shaded.

Following the analysis under these 12 categories, there is a summary section (section 8.14) which reprises the SMS Developmental Model, positions all seven cases at the start and end of the process, identifies key factors that affected (positively or negatively) the process of SMS development, and then briefly summarises those key variables.

### 8.2 Initial Preparedness

Prior to the MHF Regulations coming into effect, the seven cases studied were at different levels of preparedness to undertake compliance with the MHF Regulations. Table 8.1 examines initial preparedness factors and demographics including site process complexity, number of employees, company affiliates with MHFs overseas and the existence or otherwise of an SMS.

In Chapter 5 it was shown that voluntary SMS implementation was influenced by whether a site had a large number of employees and a complex process. Hence it was anticipated that Cases 4 and 7, both with high levels of process complexity and large numbers of employees would have existing SMSs – which they did. It was not expected that Cases 1 and 5 would already have SMSs due to their low process complexity and small workforce. Case 1 belonged to an organisation with many small sites operated throughout Australia, so an SMS was introduced to achieve standard operating procedures. Table 8.1 shows that only Case 3 began the MHF compliance process without an existing SMS.
Table 8.1: Initial Preparedness

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry sector</td>
<td>Utilities</td>
<td>Plastics &amp; Chemicals</td>
<td>Plastics &amp; Chemicals</td>
<td>Plastics &amp; Chemicals</td>
<td>Logistics</td>
<td>Logistics</td>
<td>Plastics &amp; Chemicals</td>
</tr>
<tr>
<td>Site Process Complexity</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>Very high</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Number of employees</td>
<td>1 (+ 15 contractors)</td>
<td>70</td>
<td>13</td>
<td>300</td>
<td>25</td>
<td>40</td>
<td>84</td>
</tr>
<tr>
<td>Other MHFs in Victoria</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Company/affiliates comply with MHF legislation overseas</td>
<td>Yes (Europe)</td>
<td>Yes (Europe)</td>
<td>Yes (USA)</td>
<td>Yes (Europe &amp; USA)</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Exemplar Safety Case - volunteer</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Existing SMS</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Initial Preparedness Ranking</td>
<td>Well prepared &amp; Exemplar (1st)</td>
<td>Prepared &amp; international connections (Equal 2nd)</td>
<td>Unprepared (7th)</td>
<td>Prepared &amp; international connections (Equal 2nd)</td>
<td>Prepared but isolated (Equal 5th)</td>
<td>Prepared but isolated (Equal 5th)</td>
<td>Prepared &amp; Exemplar (Equal 2nd)</td>
</tr>
</tbody>
</table>
From this initial preparedness analysis, Case 1 appeared best positioned with respect to access to information regarding how to comply, an existing SMS and participation in the Exemplar process. Cases 4 and 2 were in the next best position of having access to overseas information and having an established SMS. Case 7 did not have direct access to overseas information, however participation in the Exemplar process may have compensated for this lack of information. Cases 5 and 6 appeared to be in a similar state of preparedness, both with a low complexity process, a small number of employees and an existing SMS. Case 3 appeared to be the least prepared, with no existing SMS and any potential overseas advice coming from a comparatively different legislative regime. There was a significant difference in initial preparedness between the well-prepared sites and the unprepared Case 3. It should be noted how well three ‘laggers’ (Case 1, 2 and 4) performed at this stage, and how poorly two leaders (Cases 5 and 6) performed.

8.3 Site Management Capability and Employee Representation

Table 8.2 provides an indication of site management capability and employee representation arrangements. Site management capability is important for timely decisions being made regarding Safety Case development.

All cases, except Case 1, had senior management present on site. In Cases 2, 4, 5 and 7, the most senior Australian manager was present on site. This individual must sign a declaration under the MHF Regulations (Reg 402(3)) stating that the SMS was accurately described, major incident risks were understood from the safety assessment, control measures had been adopted to eliminate risk or reduce risk so far as is practicable, and that persons participating in SMS implementation had the necessary knowledge and skills. Hence it was anticipated that this individual would be informed of the Safety Case and its progress. Having senior management present on site provided individuals working on the Safety Case with relatively direct access to decision-makers if needed and facilitated a ‘show and tell’ approach if it was necessary to demonstrate the issue to the decision-maker in the field.

Cases 2, 4, 6 and 7 had SHE Departments with qualified SHE professionals on site. However, Case 2 did not have any personnel with risk management experience. Neither did Case 3 or 5.
### Table 8.2: Site Management Capability and Employee Representation

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Most senior Australian manager on site</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Senior management present on site</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Stand-alone SHE Department on site</td>
<td>No&lt;sup&gt;138&lt;/sup&gt;</td>
<td>Yes</td>
<td>No – but Quality Manager</td>
<td>Yes</td>
<td>No – Safety&lt;sup&gt;139&lt;/sup&gt; &amp; Quality Manager (but no department)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Qualified SHE professionals on site</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SHE professionals with risk management skills&lt;sup&gt;140&lt;/sup&gt; on site</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HSR (&amp; formal DWGs)</td>
<td>No (yes for contractors)</td>
<td>Yes</td>
<td>No&lt;sup&gt;141&lt;/sup&gt;</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>H&amp;S Committee</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Relative Management Capability &amp; Employee Representation position</td>
<td>No site management capability or employee representation (7&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Strong site management capability &amp; employee representation, but risk management void (4&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Weak site management capability and no employee representation (6&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Strongest site management capability with employee representation (Equal 1&lt;sup&gt;st&lt;/sup&gt;)</td>
<td>Strong site management capability &amp; employee representation, but SHE void (5&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Strong site management with interstate control and employee representation (3&lt;sup&gt;rd&lt;/sup&gt;)</td>
<td>Strongest site management capability with employee representation (Equal 1&lt;sup&gt;st&lt;/sup&gt;)</td>
</tr>
</tbody>
</table>

<sup>138</sup> Located interstate.<br><sup>139</sup> Safety & Quality Manager had no safety qualifications or experience.<br><sup>140</sup> Risk management skills include aspects such as ability to run a HAZOP, conduct a basic qualitative safety assessment, perform a control measure review, etc.<br><sup>141</sup> Formal DWGs do not exist and HSRs have not been formally elected, however all production personnel have received training as HSRs (P&C9 AFR 2004:44).
Cases 2, 4, 5, 6 and 7 all had employee representation through HSRs and Health and Safety Committees. Case 3, with a very small workforce, had the unusual situation of no formal HSRs or Health and Safety Committee, yet all employees had received HSR training. Thus Cases 4, 6 and 7 had the skilled specialist personnel supported in a SHE Department and employee representation to highlight safety issues and solutions to management. This supports site management’s capability.

Table 8.2 highlights that Cases 4 and 7 were in the strongest position for management capability and Case 1 was in the weakest position with no management or SHE professionals on site or employee representation arrangements. Like Cases 4 and 7, Case 6 had strong management capability except for the need to refer to the most senior Australian Manager inter-state, possibly delaying the actioning of items deemed necessary by site personnel to comply with the Safety Case.

Case 5 had strong management capability, particularly as its private owner was present on-site and was known to make decisions on the spot, however Case 5 had a void of SHE qualified professionals, which may have hampered their ability to understand the MHF Regulations and make appropriate management decisions to comply. Similarly, Case 2 appeared to have strong management capability with the exception of risk management experience on site, limiting in-house decision-making capability regarding risk management items - a significant weakness for Safety Case decision-making. It is questioned how sites with no SHE Department and/or qualified SHE professionals with risk management experience had the skill base to achieve compliance. As discussed later in Section 8.7, these sites sought assistance from consultants, however their initial choice of consultants was flawed, possibly due to their own inability to assess the appropriateness of the consultants and their proposed work.

Case 3 had weak management capability with respect to the Safety Case, with the most senior Australian manager off-site, no SHE department or qualified individuals on site, no risk management experience and no formal representation of employees.

Combining the information in Tables 8.1 and 8.2, Cases 4 and 7 were best positioned to achieve compliance with the MHF Regulations due to their initial preparedness and high degree of management capability. Case 4 had the advantage of access to overseas affiliates with compliance experience with similar legislation. It could be argued that Case 7 would compensate for that by being an Exemplar site. Table 8.1 showed Case 1 was well prepared, but without site management capability, it is questioned how a...
compliant Safety Case, focused on site-specific risks, would be successfully developed by Case 1.

As in the preceding section, there is little relation here between these inputs and subsequent ‘lagger’/‘leader’ status. Formally, all cases demonstrated employee representation except two small and informal operations (Cases 1 and 3). Perhaps employee representation is a necessary, but not sufficient, condition for ‘leader’ status.

8.4 Initial Management Acceptance of the MHF Regulations and the Regulator

Table 8.3 contains information which provides an indication of management acceptance of the MHF Regulations and the regulator.

Management at Cases 4 and 7 were actively involved in providing industry comment on drafting of the MHF Regulations, and were also the only two cases studied who were initially responsive to the regulator. These factors suggested a general understanding of the regulatory function and a desire to comply. Furthermore, Case 4’s management were directly involved in WSV’s policy development for administering the MHF Regulations, being an industry representative on the Major Hazards Advisory Committee (MHAC), giving Case 4 an advantage. Case 6’s management were aware of the MHF Regulations, however were comfortable with the existing dangerous goods regulations and were distracted. Case 3’s management were not interested in the MHF Regulations and did not attend information sessions run by the regulator and industry groups. Cases 1 and 5’s management spent significant time and energy opposing the MHF Regulations and their application to their industries.

This opposition from Case 1 and 5, led to an unwillingness to comply with the MHF Regulations. While neither of these Cases had SHE professionals on site, corporately Case 1 had an experienced SHE Department interstate, whereas Case 5 did not, so theoretically Case 1 had the ability to comply with the MHF Regulations. Cases 2 and 3 accepted that if a law exists, it should be complied with (regardless of whether there was any perceived benefit), however they did not have risk management experienced SHE professionals on site, and hence did not have the ability to comply.
Table 8.3: Initial Management Acceptance of the MHF Regulations and Regulator

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Senior management actively engaged in MHF compliance</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Management support MHF Regulations</td>
<td>No</td>
<td>Yes (but poorly advised)</td>
<td>No</td>
<td>Yes (publically)</td>
<td>No</td>
<td>Yes (but comfortable with existing DG Regs)</td>
<td>Yes</td>
</tr>
<tr>
<td>Sees value/benefit in the MHF regime</td>
<td>No (active opposition)</td>
<td>No</td>
<td>No</td>
<td>No (regulatory compliance focus)</td>
<td>No (active opposition)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Management support SMS</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ability to comply</td>
<td>Not willing but able</td>
<td>Willing but not able</td>
<td>Willing but not able</td>
<td>Willing &amp; able</td>
<td>Not willing &amp; not able</td>
<td>Willing &amp; able</td>
<td>Willing &amp; able</td>
</tr>
<tr>
<td>Overseas experience in MHF compliance sought</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Responsive to regulator</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Response to regulator–identified non-compliances</td>
<td>Fought</td>
<td>How to comply?</td>
<td>How to comply?</td>
<td>Fought</td>
<td>Fought</td>
<td>Question regulator until issue fully understood</td>
<td>Immediate rectification without assistance</td>
</tr>
<tr>
<td>Self-initiate improvements /Proactive</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Challenge the status quo</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Acknowledge “This is serious” event</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Management’s initial acceptance</td>
<td>Opposing (Equal 6th)</td>
<td>Reluctant acceptors (Equal 4th)</td>
<td>Reluctant acceptors (Equal 4th)</td>
<td>Publically welcoming but internally opposing (3rd)</td>
<td>Opposing (Equal 6th)</td>
<td>Accepting but comfortable with past regulations (2nd)</td>
<td>Welcoming (1st)</td>
</tr>
</tbody>
</table>
Despite being willing and able to comply and giving significant public support to the MHF Regulations, Case 4’s management saw no benefit to their site from the regulations and had a regulatory compliance focus, meaning there was no desire to achieve more than the bare minimum. Senior management were not actively engaged in MHF compliance activities or progress monitoring. Management believed that existing systems and control measures were adequate and hence the Regulations provided no benefit to the site, as it was merely a documentation exercise. Hence Case 4 management did not challenge the status quo, nor proactively identify and implement improvements, nor did they seek international MHF compliance experience from within their organisation. Case 4’s resistance to change and insularity were identified during its management review, exacerbated by the stable workforce, meaning that most employees had spent their entire careers at this site and hence were confident in “the way things are done here”. These points differentiate Case 4 from Case 7, which saw value in the MHF Regulations, was always responsive to the regulator, senior management were engaged with MHF compliance activities, overseas experience was actively sought and there was a constant drive for improvement, as demonstrated by the self-initiated review and revision of the SMS. A further factor driving Case 7 was their ‘This is serious event’ of being influenced by the Flixborough major incident, and the fact that they were handling a known carcinogen. It could be argued that Flixborough was several decades ago, however the incident and the lessons from it remain ingrained in the company’s psyche through training and frequent reference.

Other than Case 7, no case identified with a previous ‘this is serious event’, in fact Case 5 vehemently denied the possibility of such an incident, with the Managing Director claiming “we’re not no bloody Longford” [sic], implying a simple logistics site did not have the potential for a major incident. The regular inclusion of major incident lessons at Case 7 possibly provided encouragement to challenge the status quo. No other case examined was proactive in self-initiating improvements or challenging the status quo.

No site sought overseas experience, except Case 7, which did not have its own overseas affiliates. This missed opportunity effectively diminished Cases 1, 2, 3 and 4’s initial preparedness ranking (Table 8.1). Case 1, like Case 4, approached the Safety Case as a documentation only exercise, hence management believed it could be adequately undertaken by personnel remote to the site and did not require information from overseas.

\[142\] Conducted by a consultant at the time of licensing.
If a site’s management supported the MHF Regulations and saw benefit in complying, it was anticipated that such sites would be responsive to the regulator. This was true for Case 7. Both Case 2 and 6, while supportive of the MHF Regulations, were not responsive to the regulator. In both cases, management were distracted by external influences (see Table 8.12). In addition, Case 6 had an air of confidence due to their knowledge of the dangerous goods regulations. Case 2 management had been poorly advised by a consultant on compliance requirements, initially believing minimal change was required and hence saw no benefit in the MHF Regulations. Case 4 was an anomaly amongst the cases studied as management were always responsive to the regulator, despite seeing no value in the regulations. They managed the flow of information to the regulator. However Case 4 put significant effort into fighting the regulator when non-compliances were raised, as management believed that there could not possibly be a problem at their facility, and if it was eventually acknowledged as a problem it was accepted as an isolated fault, never as a system issue. A further level of commitment beyond supporting the MHF Regulations is the active engagement of senior management in MHF compliance. Initially such active engagement was only evident at Case 7.

Generally, management’s support, or otherwise, of the MHF Regulations matched their support, or otherwise, of the SMS.

From Table 8.3, Case 7’s management welcomed the MHF Regulations and the regulator. Case 6 was accepting of the regulations, however actively debated with the regulator until any issues were fully understood. This was exacerbated by Case 6 management’s strong knowledge of the dangerous goods regulations but not the MHF Regulations. Case 4 was supportive of the MHF Regulations and responsive to the regulator, but did not believe there was actually any benefit to their site and proceeded on this basis, fighting any non-compliance identified by the regulator.

Cases 2 and 3 were reluctant acceptors of the MHF Regulations, requiring assistance to comply. Cases 1 and 5’s management unequivocally opposed the MHF Regulations and the regulator with the subtle difference that Case 1 had the ability to comply if they chose to do so, but Case 5 did not have the in-house capability to comply.

Cases 4 and 7 were previously shown to have similar initial preparedness (Table 8.1) and management capability (Table 8.2), however it is now clear that Case 7’s management welcomed the MHF Regulations and the regulator, whereas Case 4 did not. How did this impact their approach towards achieving compliance? But before this
issue is examined it is important to establish the SMS’s development stage at each of the seven cases, as this provides an indication of the initial workload required by each case to achieve compliance with their SMS.

Overall, two ‘leaders’ accepted the new regulations and regulator, and the third ‘leader’ (Case 5) came to do so (Section 8.12), suggesting the importance of collaboration for licensing.

### 8.5 Initial SMS Development Stage

Table 8.4 examines the initial SMS development stage at each of the seven cases to determine the varying starting points, and hence workloads ahead of each MHF, and the SMS stage on which they should focus their efforts.

Table 8.1 showed Case 3 did not have an existing SMS and hence had the most work ahead to achieve compliance with the MHF Regulations. Table 8.4 shows this conclusion to be flawed\(^{143}\) as Cases 2 and 5 did not use their SMS at all, and Case 1 partially used their SMS. So in reality, Cases 2, 3 and 5 were starting without an implemented SMS and Case 1’s SMS was partially implemented. SMS audits were not occurring at Cases 2, 3 and 5. However audits were stated to occur at Case 1, but evidence showed this to be ineffective or not undertaken. Cases 2, 3 and 5 also did not have a corporate SMS. Cases 2, 3 and 5 now align with Chapter 5’s findings of relatively low complexity sites with a small number of employees not voluntarily using an SMS.

Cases 4 and 6 were confident in their SMS’s implementation as they conducted audits and had external SafetyMAP initial level accreditation. Cases 1 and 7 also had confidence in their SMS’s implementation due to their own audits, but did not have external accreditation of their system performance\(^{144}\). All Cases had existing quality systems (except Case 1 which did not mention it), with Cases 6 and 7 being the most integrated with a Business Management System (BMS) incorporating the SMS with all business requirements.

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\(^{143}\) It was wrongly assumed that because a site had an SMS, that it was actually used.

\(^{144}\) It is unknown whether external accreditation had been sought unsuccessfully or otherwise.

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Table 8.4: Initial SMS Development Stage (pre-MHF Regulations)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Existing SMS</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Existing SMS used</td>
<td>Partial</td>
<td>No</td>
<td>-</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Existing SMS audits</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SafetyMAP accreditation (initial level)</td>
<td>Not stated</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Not stated</td>
</tr>
<tr>
<td>Existing other systems</td>
<td>Not stated</td>
<td>Yes – Quality</td>
<td>Yes - Quality</td>
<td>Yes – Quality</td>
<td>Yes - Quality</td>
<td>Yes – Quality</td>
<td>Yes – BMS</td>
</tr>
<tr>
<td>Corporate SMS (applicable to other sites)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SMS stage at beginning of MHF Regulations (according to MHF)</td>
<td>Maintenance</td>
<td>Design</td>
<td>Design</td>
<td>Maintenance</td>
<td>Design</td>
<td>Maintenance</td>
<td>Maintenance (review &amp; revise)</td>
</tr>
<tr>
<td>SMS stage at beginning of MHF Regulations (according to WSV)</td>
<td>Implementation</td>
<td>Design</td>
<td>Design</td>
<td>Implementation</td>
<td>Design</td>
<td>Operation</td>
<td>Maintenance (review &amp; revise)</td>
</tr>
<tr>
<td>Initial SMS Development Stage</td>
<td>Implementation (below site expectation) (Equal 3rd)</td>
<td>Design (Equal 5th)</td>
<td>Design (Equal 5th)</td>
<td>Implementation (below site expectation) (Equal 3rd)</td>
<td>Design (Equal 5th)</td>
<td>Operation (2nd)</td>
<td>Maintenance (1st)</td>
</tr>
</tbody>
</table>

---

145 BMS is a business management system integrating QHSE with business needs.
146 Refer SMS Development Model (Figure 4.1) on page 98.
147 Questioning initial design.
Cases 2, 3 and 5 acknowledged that they were starting at the beginning and hence were designing their SMS. Cases 1, 4, 6 and 7 believed that their SMSs were fully operational and in the maintenance stage, which aligned with the existence of SMS audits at these cases. Case 7 acknowledged the SMS was undergoing a significant review and revision to ensure compliance with the MHF Regulations. Case 6 aimed to ‘reassess’ all procedures following the safety assessment. Cases 1 and 4 were confident that their SMS was adequate, reflective of management’s approach to the MHF Regulations (Table 8.3). It was these two cases which had the greatest disconnect between where the site thought their SMS was operating (maintenance stage) and the WSV assessment team’s findings (implementation stage).

Table 8.4 shows Cases 2, 3 and 5 had significant work ahead to design, implement, operate and maintain an SMS. In contrast Case 7 simply had to review an existing system, already well-integrated in the business. Cases 1 and 4 over-estimated the performance of their SMS and hence it can be expected that they would not apply the necessary effort to achieve compliance due to their false perception of their SMS’s performance.

As with previous ‘input’ variables, the relationship with ‘leader’/‘lagger’ status is not strong, one ‘lagger’ (Case 1) appearing to begin well on initial SMS development, and a slow starter (Case 5) finishing well.

8.6 Plans for SMS Development

The process of achieving their first MHF licence spanned two years for most facilities (see Figure 5.1). The MHF Regulations required a project plan, known as a Safety Case Outline (SCO), to be submitted to the regulator. The SCO included planned activities involving the SMS. Between the seven cases, varying amounts of work were planned for the SMS and at different times across the two-year period.

If the seven cases fully understood the MHF Regulation’s SMS requirements and their SMS’s initial development stage (Table 8.4), their SCO plan would clearly show how and when the gap was going to be closed. Table 8.5 describes the key features of the seven cases’ plans for developing their SMS.
Table 8.5: Plans for SMS Development

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Main activity during Safety Case development</td>
<td>Documenting status quo – HAZID, SA, ERP</td>
<td>HAZID &amp; implementing control measures</td>
<td>Write procedures, implement control measures (&amp; later hazard database)</td>
<td>HAZID, SA</td>
<td>Implement control measures for DG compliance, HAZID, SA</td>
<td>HAZID, SA</td>
<td>Database (linking HAZID, SA, control measures &amp; SMS) &amp; bowties</td>
</tr>
<tr>
<td>SCO plan for SMS</td>
<td>Last item</td>
<td>Last item&lt;sup&gt;148&lt;/sup&gt;</td>
<td>Last item</td>
<td>Last item</td>
<td>Last item</td>
<td>Last item</td>
<td>First item</td>
</tr>
<tr>
<td>Duration of planned work on SMS</td>
<td>short</td>
<td>long</td>
<td>short</td>
<td>Short</td>
<td>long</td>
<td>long</td>
<td>Long (duration of SC)</td>
</tr>
<tr>
<td>Review of SMS scheduled</td>
<td>Yes – start of SMS work</td>
<td>First half of SC development</td>
<td>Last item – 3 months prior to SC due</td>
<td>Last item – 2 months prior to SC due</td>
<td>Post licensing</td>
<td>Throughout SC development</td>
<td>Throughout SC development</td>
</tr>
<tr>
<td>Main SMS activity during Safety Case development</td>
<td>Design (not achieved)</td>
<td>Design (implementation in extension)</td>
<td>Design &amp; implementation</td>
<td>None</td>
<td>Design &amp; implementation</td>
<td>Revise SMS</td>
<td>Significant SMS Revision</td>
</tr>
<tr>
<td>Plans for SMS Development</td>
<td>Not given consideration (ignored) (Equal 6&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Underestimated (Equal 4&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Underestimated (Equal 4&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Not given consideration (ignored) (Equal 6&lt;sup&gt;th&lt;/sup&gt;)</td>
<td>Appropriate (Equal 2&lt;sup&gt;nd&lt;/sup&gt;)</td>
<td>Appropriate (Equal 2&lt;sup&gt;nd&lt;/sup&gt;)</td>
<td>Key focus (1&lt;sup&gt;st&lt;/sup&gt;)</td>
</tr>
</tbody>
</table>

<sup>148</sup> For Case 2, SMS was the last item listed, however work on the SMS was scheduled from the beginning of the Safety Case period.
From Table 8.4, it was anticipated that Cases 2, 3 and 5 would have significant time and resources allocated to SMS development, while Cases 1, 4, 6 and 7 would have a comparatively reduced allocation. However as previously identified, Cases 1 and 4 actually required more work in the implementation stage than the site had identified.

Hazard identification and safety assessment were the main Safety Case development activities for the majority of cases, and not the SMS, possibly following WSV’s Guidance Note 3 (VWA 2001c). Cases 2, 3 and 5 did not previously have a formal hazard identification process, and as a result, needed to implement control measures to provide protection from newly-identified hazards — a fundamental requirement for major incident prevention. Case 7 was the most sophisticated, developing a database to link SMS, hazard identification, safety assessment and control measures including the development of bow-tie diagrams\(^{149}\).

All cases, except Case 7, listed SMS activities last on their SCO Gantt chart, possibly following WSV’s Guidance Note 3\(^{150}\) (VWA 2001c). Cases 1, 3 and 4 assigned only a short amount of time to the SMS. Hence at the outset, the SMS was of little importance to these sites during their Safety Case development. In contrast, Case 7 listed the SMS as the first item in their Gantt chart, spanning the duration of the Safety Case development. Case 6 also planned SMS activities to span the duration of the Safety Case development. Case 5 also planned a long duration of work on the SMS, but not at the start of the Safety Case development period, indicating some understanding of the effort required and allowed other Safety Case activities to commence before focusing on the SMS. Hence the SMS was a significant focus for Cases 5, 6 and 7. This finding reinforced the different level of effort applied to the SMS by Cases 4 and 7.

Cases 2 and 3 had acknowledged that their SMS was starting from the beginning (Table 8.4). However with limited understanding of the work required, Case 3 assigned a short amount of time at the end of the Safety Case development period. Case 2 assigned a long amount of time for the SMS from the beginning of the Safety Case development period, to develop the SMS in parallel with the Safety Case, but detailed understanding of the task, appropriate skills and resources were lacking.

The main SMS activity during Safety Case development for Cases 3 and 5 was design and implementation. Case 2’s Gantt chart suggested the SMS focus was on

\(^{149}\) A bow-tie is a graphical representation of the relationship between various control measures, both preventative and mitigative, and the hazards, major incident and consequences (Philley 2006:29).

\(^{150}\) Showing the SMS as the last item.
Implementation, yet reality was the SMS needed to be created (hence designed). At their first assessment, Case 2’s SMS was found to be 30-40% complete. In response to this finding, Case 2 management purchased an off-the-shelf SMS, hoping to skip the SMS design stage, believing they simply needed to implement it (see Table 8.7). Both Cases 6 and 7 were focused on revising their SMS. Cases 1 and 4 did not undertake any significant activity on their SMS. This aligned with their initial plan of a short amount of time on the SMS at the end of their Safety Case development period.

From Table 8.5 it was clear that the majority of cases programmed the SMS as the last item on their Safety Case Outline, following the guidance provided by WSV (VWA 2001c). However as earlier Safety Case activities experienced delay, it was the SMS at the end of the project plan which was condensed even further. Of those cases scheduling the SMS last, the majority assigned a short duration. Hence these sites had little focus on the SMS and anticipated that any work required would be completed in a short time-frame. It is these sites which experienced significant problems at the time of licensing (Table 8.8) due to the need to make substantial changes to their SMS immediately prior to licensing (Table 8.10). This was because the necessary changes were not identified by the site during the Safety Case development process – Case 7 being the only site which self-initiated the changes from the outset.

In this instance, the relationship with ‘leader’/’lagger’ status is strong, those having an appropriate Safety Case Outline with plans for SMS development over a longer duration progressing through to licensing and achieving a full-term licence.

8.7 Use of External Management Resources

It was previously shown that Cases 2, 3 and 5 (Table 8.2) did not have appropriate skills in-house to develop a Safety Case. As part of their initial planning did these sites seek external resources to address the skill deficit? Did other sites with existing in-house skills also seek external assistance? How successful was this and did the use of external resources impact site ownership of the Safety Case? Table 8.6 contains information regarding the use of external management resources.
### Table 8.6: Use of External Management Resources

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Resources made available initially for SC and SMS</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes (Int and Ext) – SC only not SMS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (Int and Ext)</td>
</tr>
<tr>
<td>External resources used</td>
<td>Yes - 3 month contract engineer (at licence panel)</td>
<td>Yes - HAZID and risk management</td>
<td>Yes – risk management database</td>
<td>Yes - risk management methodology, workshops &amp; SC</td>
<td>Yes – SC methodology</td>
<td>Yes – HAZID, DOA(^{151}) workshops, SA modelling</td>
<td>Yes</td>
</tr>
<tr>
<td>External resource appropriately qualified and experienced for scope of work</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dismissed external resource due to lack of skill</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>External resources supported in-house personnel</td>
<td>No</td>
<td>No – initially Yes - later</td>
<td>No – initially Yes - later</td>
<td>No – initially Yes - later</td>
<td>No – initially Yes - later</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Case developed in-house</td>
<td>Yes – but in Sydney</td>
<td>Yes - significant consultant input</td>
<td>Yes</td>
<td>Yes - significant consultant input</td>
<td>Yes - significant consultant input</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Site ownership of Safety Case</td>
<td>No</td>
<td>No – initially Yes - later</td>
<td>Yes</td>
<td>No - SHE dept initially Yes - later</td>
<td>No - initially Yes - later</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use of External Resources &amp; ownership of Safety Case</td>
<td>No ownership. External resource sought too late (7(^{th}))</td>
<td>Delayed ownership due to inexperienced external resource (Equal 4(^{th}))</td>
<td>Delayed ownership due to external resource (3(^{rd}))</td>
<td>Delayed ownership due to SHE department control and external resource (6(^{th}))</td>
<td>Delayed ownership due to inexperienced external resource (Equal 4(^{th}))</td>
<td>Directed external resources, maintaining internal ownership (Equal 1(^{st}))</td>
<td>Directed external resources, maintaining internal ownership (Equal 1(^{st}))</td>
</tr>
</tbody>
</table>

\(^{151}\) DOA is Demonstration of Adequacy.
Cases 2 and 5 initially used external resources to address in-house skill deficiencies. However their choice of consultants was poor, and in both cases led to the dismissal of their consultant during the Safety Case development process as the consultant was not appropriately skilled for the scope of work. The in-house skill deficit meant site management had little understanding of the methodology proposed by the consultant or the ability to question or challenge the consultant on technical grounds. It was left to the regulator to identify the failings in the methodology and highlight this with site management.

Case 3 did not initially seek external assistance, attempting to develop the Safety Case themselves. As time passed and little progress was made, Case 3 employed external resources with appropriate skills for specific aspects of the Safety Case development.

All seven cases eventually used external resources during their Safety Case development process. It would appear that sites with in-house skills were better able to select appropriate consultants for their identified scope of work. This was possibly due to their ability to understand and challenge the consultant, where necessary.

Cases 1, 2, 4 and 5 did not initially demonstrate site ownership of the Safety Case, which corresponded to the work undertaken by consultants. Quite simply, site personnel were not familiar with, nor understood, the work conducted by consultants. For Case 1, this was due to the Safety Case being developed in Sydney without local employee or management involvement. For Case 4, only SHE Department personnel, and not operations, were involved in developing the Safety Case, with external consultants driving the methodology. This lack of operations personnel involvement is suggested as being a contributing factor to the disconnect between the SMS as described in the Safety Case, and the reality as identified during verification.

It was clear that those cases which developed their Safety Case in-house without significant consultant involvement demonstrated site ownership of the Safety Case. Those cases with significant consultant involvement did not show site ownership of the Safety Case. It was also shown that these cases did not have the external resources assisting an internal manager, rather the consultant was driving the process effectively unchecked by the organisation. As demonstrated by Cases 2, 3, 4 and 5, once the external resource was reassigned to provide assistance to an internal manager, who retained direction and management decision over the processes and Safety Case, site ownership of the Safety Case improved.

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Case 1 attempted to demonstrate site ownership of the Safety Case during the licence panel process by employing a suitably-qualified and experienced engineer for three months. This was not accepted by the licence panel as a sustainable demonstration of site ownership and Case 1’s licence was refused (Table 8.10).

Overall, two leaders (Cases 6 and 7) used external resources effectively and the rest did not initially find a good balance between external expertise and internal ownership – to their cost.

### 8.8 Site-Specific SMS Development

Tables 8.4 and 8.5 showed the seven cases had varying amounts of work to do on their SMS. Some cases had an SMS which was actively used and audited, others had an SMS in disrepair and one did not have an SMS at all. Table 8.7 examines in more detail the development of the SMS, its integration with other site systems and site ownership of the SMS.

It was previously identified that Cases 2, 3 and 5 did not have an SMS in current use (Table 8.4). Rather than implementing a previously ‘failed’ SMS, with personnel unfamiliar with the system, those cases with disused SMSs decided to start from scratch, hence a new SMS was developed to achieve compliance with the MHF Regulations. Cases 3 and 5 used the familiar ISO 9000 framework (due to the existing quality focus of these organisations) and used Australian Standards to assist in developing the safety aspects of the system. Case 2 purchased an off-the-shelf SMS which then required site-specific tailoring. These sites (2, 3 and 5) did not initially try to integrate the SMS into other processes – they were simply focused on establishing the SMS. However Case 5 quickly identified the synergies in combining the systems and did so. Case 3 identified this later in the implementation process, as did Case 4 when the SMS was shifted outside the control of the SHE Department. As a result of these early synergies, Case 5’s SMS was developed and implemented ahead of Case 3.
### Table 8.7: Site-Specific SMS Development

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Undertook development of new SMS for MHF Regulations</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Form of new SMS</td>
<td>-</td>
<td>Purchased off-the-shelf SMS</td>
<td>ISO 9000 + AS4360 risk management</td>
<td>-</td>
<td>ISO 9000 + AS4801</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SMS integrated with other systems</td>
<td>No</td>
<td>No</td>
<td>No – initially Yes - later</td>
<td>No – initially Yes - later</td>
<td>No – initially Yes - later</td>
<td>No – initially Yes - later</td>
<td>Yes</td>
</tr>
<tr>
<td>New corporate SMS introduced during SC development</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Site’s ability to make corporate SMS site-specific</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>Yes (existing)</td>
<td>-</td>
<td>No - initially Yes - later</td>
<td>-</td>
</tr>
<tr>
<td>Site ‘ownership’ of SMS</td>
<td>No</td>
<td>No - initially Yes - later (although challenge of making generic real)</td>
<td>No - initially Yes - later</td>
<td>Partial - only SHE dept - initially Yes - later</td>
<td>No - initially Yes - later</td>
<td>No - initially Yes - later</td>
<td>Yes</td>
</tr>
<tr>
<td>Employee involvement in the SMS</td>
<td>None</td>
<td>limited and not comfortable with accessing intranet system</td>
<td>No - initially Strong - later</td>
<td>No - initially Strong - later</td>
<td>No - initially Strong - later</td>
<td>No - initially Strong - later</td>
<td>Strong</td>
</tr>
<tr>
<td>Employee ‘ownership’ of SMS</td>
<td>No</td>
<td>No</td>
<td>No - initially Yes - later</td>
<td>No - initially Yes - later</td>
<td>No - initially Yes - later</td>
<td>No - initially Yes - later</td>
<td>Yes</td>
</tr>
<tr>
<td>Site-specific SMS Development &amp; Employee Involvement</td>
<td>Not interested in site-specific SMS or involving employees (7th)</td>
<td>Struggled to make SMS site-specific. Limited employee involvement (6th)</td>
<td>Simple synergy driven site-specific SMS with employee ownership (Equal 2nd) (significant transition)</td>
<td>Corporate SMS made site-specific once employees involved (Equal 4th)</td>
<td>Simple synergy driven site-specific SMS with employee ownership (Equal 2nd) (significant transition)</td>
<td>Corporate SMS made site-specific with employee involvement (Equal 4th)</td>
<td>Strong site-specific SMS with employee ownership (1st)</td>
</tr>
</tbody>
</table>

152 However new corporate SMS was introduced in 2008 (during their second MHF licence period).

Sarah Sinclair
Both Case 3 and Case 5 developed simple SMSs which were created by their personnel, so were easy to follow and site-specific (in fact unique to the site). These sites had documented what they do and now they were simply trying to do what they said they do, to achieve compliance with their system. While there was nothing wrong with Case 2’s decision to purchase an off-the-shelf SMS, time and resources needed to be applied to tailor the SMS to the site. Ideally this should have involved both managers and employees. As this step was not undertaken, Case 2 struggled to implement the SMS, which for some elements was not relevant to the site.

Cases 6 and 7 had integrated their SMS with other systems and hence did not need to spend time establishing system links and integration. But Case 6 did have to implement a new corporate SMS, which was not initially planned for in the SCO. The same situation occurred for Case 1. Introducing a new corporate SMS during Safety Case development, without significant warning, resulted in rework for the Safety Case personnel and undermined work already completed. It also put the site at risk of not having an established and implemented SMS at the time of licensing. Both Case 1 and 6 had senior management off-site. Perhaps if senior management were aware of the extent of Safety Case activities, they may have better-timed the introduction of the corporate SMS to occur at the beginning of Safety Case development or delayed until after licensing, so as not to further increase the workload on individuals. Case 6 site management initially felt they had little control over the new corporate SMS and hence had little ownership. Later when site management were more comfortable with the system and approaching senior management external to the site, a method was developed to tailor the system to be site-specific. Case 4 already had a site-specific corporate SMSs, while Case 1 had no ability, nor desire, to tailor their corporate SMS. This was possibly due to the lack of management presence at the actual site, hence there was no management motivation to tailor the SMS for that site.

Case 1 had no employee involvement or ownership of the SMS. In stark contrast was Case 7, with site ownership of the recently revised SMS, through strong employee involvement and ownership of the SMS. Cases 3 to 6 all began with limited, if any, employee involvement in the SMS which corresponded with no employee ownership of the SMS. During the development process, employee involvement increased and as a result their understanding and sense of ownership of the SMS increased. This was mirrored by the overall site ownership of the SMS.

Case 5’s SMS became more ‘automatic’ or self-sustaining once it was integrated with existing systems. The SMS then became part of normal business activity rather than a
Comparative Analysis of Case Study Findings

stand-alone item. Responsibility for different aspects of the SMS was distributed across the senior management team, which increased senior management’s awareness of the SMS and their ownership of the SMS. Employees were heavily involved in developing the SMS and its everyday use, resulting in significant employee ownership of the SMS. The combination of management and employee involvement and hence ownership was critical to the success of the rapid development, introduction and implementation of the SMS. These same elements of a site-specific SMS, integrated with business practices, combined with management and employee involvement in the SMS resulting in strong ownership were evident in Case 7 and developed in Case 6, and developed eventually for Cases 4 and 3. Case 6 had the additional complication of a corporate SMS being introduced in the middle of the Safety Case development work, which initially reduced both site management’s and employee’s ownership of the SMS. A method was finally established to link the corporate SMS to site-specific requirements, however not all aspects of the corporate SMS were found to be implemented during verification. In some instances, the corporate SMS requirement was not relevant to the site, however this was not indicated in the SMS. Case 6 addressed this issue between verification and licensing. While employees had been involved in the site-specific aspects, employee ownership of the corporate SMS requirements was not as strong as the site-specific aspects.

Overall, Case 7 had a strong recently-revised site-specific SMS. Cases 3 and 5 began with nothing and developed simple, but effective synergy-driven site-specific SMSs with strong employee involvement and ownership (this was possibly assisted by the small number of employees on both sites). Cases 4 and 6 had corporate SMSs which were made site-specific (in both cases this occurred near the end of the Safety Case development period, so was not as advanced as site management may have liked at the time of licensing). Case 2 struggled to make the SMS site-specific and Case 1 had no interest in creating a site-specific SMS.

The two ‘laggers’ (Case 1 and 2) are most interesting since the failure to develop a site-specific SMS was coupled with a lack of employee involvement and therefore tendencies to “off-the-shelfism”.

8.9 Regulator Evaluation of SMS Deficiencies

SMS deficiencies were detected by the regulator at different stages of the Safety Case process and often resulted in changes being made to the SMS. In some cases, these
SMS deficiencies affected the site’s ability to gain an MHF licence, as shown in Table 8.8.

All seven cases had SMS deficiencies detected by WSV during the Safety Case process. Some SMS deficiencies were identified during desk-top assessment, while others were first identified during verification. During Safety Case verification, Case 1 was issued with seven notices and undertook a further three voluntary compliances, revealing poor control measure and SMS implementation. Case 4 also had significant verification issues highlighting the disconnect between the Safety Case document and reality. Both Cases 1 and 4 had undertaken little, if any, work on the SMS during Safety Case development.

The identified SMS deficiencies were considered so significant that assessment extensions were required by Cases 1, 2, 3, 4, 5 and 6 to provide them with extra time (up to six months) to rectify the deficiencies. Hence in most cases (Cases 1, 2, 3 and 4) this resulted in significant changes being made to the SMS immediately prior to licensing. In contrast, Case 7 did not make any significant changes to their SMS prior to licensing, rather they continued with the planned review and revision activities. Cases 5 and 6 made some changes immediately prior to licensing. For Case 5 this was a continuation of the gradual improvement witnessed throughout the Safety Case development process, whereas for Case 6 it was a focus on fully-implementing corporate SMS requirements highlighted as deficient during verification.

Despite the assessment extension, Case 1 and Case 6 went to licence inquiry in anticipation of a licence refusal. As shown in Table 8.10 Case 1 was refused an MHF licence due to a deficient SMS, whereas Case 6 rectified the deficiencies and was granted a licence.

Case 7 was the only case studied which did not require an assessment extension and was not making significant changes to the SMS prior to licensing. Case 7, learning from overseas experience, began reviewing the SMS from the beginning of their Safety Case development (Table 8.5) and continued this review throughout the Safety Case process with the involvement of employees and management. Case 7 had the most operationally developed and mature SMS (Table 8.4), hence it was anticipated that such a system should not need significant overhaul immediately prior to licensing.
## Table 8.8: Regulator Evaluation of SMS Deficiencies (first round)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>SMS deficiencies during assessment (A) &amp; verification (V)</td>
<td>Yes (A &amp; V)</td>
<td>Yes (A &amp; V)</td>
<td>Yes (A &amp; V)</td>
<td>Yes (V only)</td>
<td>Yes (A &amp; V)</td>
<td>Yes (V only)</td>
<td>Yes (V only)</td>
</tr>
<tr>
<td>SC verification enforcement</td>
<td>7 notices + 3 voluntary compliance</td>
<td>Clear (after resubmission)</td>
<td>Clear (after resubmission)</td>
<td>Reality vs SC 4 notices + 2 prohibitions</td>
<td>4 notices</td>
<td>4 notices</td>
<td>none</td>
</tr>
<tr>
<td>Significant changes made to SMS immediately prior to MHF licensing</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Some – gradual improvement throughout</td>
<td>Some – corporate SMS implementation focus</td>
<td>No</td>
</tr>
<tr>
<td>Assessment extension</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SMS reason for extension</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Licence inquiry held (anticipation of licence refusal)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SMS reason for licence inquiry</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Regulator Evaluation of SMS Deficiencies</td>
<td>Significant SMS deficiencies NOT addressed (7th)</td>
<td>Significant SMS deficiencies addressed in on-going activities (Equal 5th)</td>
<td>Significant SMS deficiencies addressed in on-going activities (Equal 5th)</td>
<td>Significant SMS deficiencies addressed, some on-going (4th)</td>
<td>SMS deficiencies addressed (2nd)</td>
<td>SMS deficiencies addressed (following inquiry) (3rd)</td>
<td>No significant SMS deficiencies (1st)</td>
</tr>
</tbody>
</table>
By contrast Cases 1 and 4 had assumed their SMS was compliant from the beginning and had not undertaken any significant work on the SMS, as planned (Table 8.5). However verification revealed significant deficiencies in SMS implementation for both Cases 1 and 4. Like Longford, the SMS had taken ‘on a life of its own, divorced from operations in the field’ (RLRC 1999:13.40). The threat of licence refusal forced management to respond by throwing resources at the SMS. Unfortunately Case 1 senior management responded too slowly to the situation – possibly due to their remoteness from the site and the regulator (low level of site management capability Table 8.2). Due to its size and complexity, Case 4 like a large ship at sea, could not be turned around quickly, hence its SMS changes were being implemented at the time of licensing.

Overall, Table 8.8 shows SMS deficiencies had significant impact on a site’s ability to progress through the assessment process and obtain a licence to operate an MHF. Given the commercial significance of not obtaining a licence (requiring removal of Schedule 1 materials from site), what processes did sites have in place to try to identify SMS deficiencies themselves?

8.10 Internal Auditing

Table 8.8 showed all cases had SMS deficiencies detected by the regulator. This occurred even at Case 7 which had shown itself to be proactive and most able to self-identify areas for improvement. WSV’s verification and Annual Inspection activities were a form of auditing and it was through these processes that deficiencies in systems were identified. What were sites doing with respect to auditing and what was WSV doing differently to identify issues not previously detected by the site? Table 8.9 presents information regarding internal auditing at the seven cases and not WSV auditing which is considered external auditing. WSV auditing activity is not examined in this section.
## Table 8.9: Internal Auditing

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity, Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>SMS auditing established initially</td>
<td>Yes</td>
<td>No</td>
<td>No (but yes for quality)</td>
<td>Yes</td>
<td>No (but yes for quality)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Skilled auditors</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>At time of licensing – status of performance monitoring and auditing</td>
<td>Implementation</td>
<td>Design &amp; early implementation</td>
<td>Design &amp; early implementation</td>
<td>Design &amp; early implementation</td>
<td>Implementation</td>
<td>Implementation/operation</td>
<td>Auditing operational Performance monitoring - implementation</td>
</tr>
<tr>
<td>Auditing schedule appropriate for resourcing</td>
<td>Yes</td>
<td>No</td>
<td>Yes – but no auditor for large periods</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Audits check if procedures are followed</td>
<td>In theory but not in practice</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Issues with contractor management</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Auditing</td>
<td>Ineffective established auditing (5th)</td>
<td>Auditing in infancy (Equal 6th)</td>
<td>Auditing in infancy (Equal 6th)</td>
<td>Superficial auditing (4th)</td>
<td>Implemented auditing (3rd)</td>
<td>Implemented auditing with new skilled auditor (2nd)</td>
<td>Operational Auditing (1st)</td>
</tr>
</tbody>
</table>
Table 8.9 shows Cases 1, 4, 6 and 7 initially had established SMS auditing, however of those, only Cases 4, 6 and 7 had skilled auditors. Case 5 had a skilled auditor, but did not initially have an SMS (only a quality audit). Case 2 did not have an established auditing program or skilled auditors. Case 3 had a quality auditing program without skilled auditors. Based on this information, it was expected that Cases 4, 6 and 7 would have operational SMS auditing which would be identifying non-conformances in their SMS, improving the level of SMS implementation and identifying where the SMS was not operating as intended. Hence these sites should have higher levels of SMS implementation and operability and hence less, if any, issues detected by WSV. This was not the reality for Cases 4 and 6, which experienced poor verification results (reported in Table 8.8). As Case 4 and 6’s SMS implementation issues had not been discovered by internal auditors, it suggests the internal auditing process was not fully effective. Further investigation into Case 4 revealed auditing checked whether procedures existed, not if they were actually implemented, nor if the people who needed the procedure had access to it. The WSV inspectors were going beyond the practice of the internal auditors by examining how the procedure was implemented. This was how SMS implementation issues were identified by WSV, which had been undetected by the site.

Contractor management issues were evident across all sites as items outsourced to contractors were rarely audited, which supports the overall findings from Chapter 5. Contractor management appeared to be a forgotten area for all seven cases with activities outsourced to supposed experts in their field, thereby delegating management of that activity to the contractor. It was an eye-opener to management to be informed by a third-party (the regulator) of deficiencies with their contractors. Management were responsive to contractor issues raised by WSV as they were paying for a contractor’s services and wanted ‘value for their money’.

It is clear from Table 8.9 that Cases 5, 6 and 7 had skilled auditors, with auditing of appropriate complexity, which included checks that procedures were actually being followed. In Case 4, despite having skilled auditors, the auditing schedule was too resource-intensive so it was not being achieved, and the audits were too superficial or administratively focused, not examining how procedures were implemented, or otherwise, in the field. These issues were also present in Cases 1 to 3 but with the absence of skilled auditors – Case 3 eventually employing a skilled auditor part-time.

Table 8.9 shows that the sites with implemented or operational performance monitoring and auditing at the time of licensing had appropriate auditing schedules and more in-
Comparative Analysis of Case Study Findings

depth auditing was occurring. Those sites with performance monitoring and auditing in its infancy (design and early implementation) were still working through teething issues such as schedules which were too resource-intensive and were so focused on performing the audits that the quantity of audits took priority to the quality or depth of the audit.

Case 7 was in the best position for auditing, followed by Case 6 and Case 5, although WSV could still find flaws in their SMS (Table 8.8). Case 6 experienced a step-change improvement when an appropriately-skilled individual with both auditing and chemical-handling knowledge was employed.

Table 8.9 illustrates that sites in the early stages of establishing auditing struggled with appropriate auditing schedules and performing audits to depths which provided meaningful feedback to the organisation. It is possible that these sites were still focused on establishing their SMS and hadn’t (or couldn’t) yet move their focus to maintaining the system through auditing. The cases with less-established auditing had more significant issues during verification, than Cases 5, 6 and 7 with more-established auditing practices.

8.11 MHF Licensing Outcomes

In Chapter 4 mention was made of two licensing rounds that in most cases were five years apart (2002/3 and 2007/8), although reduced-term licensed MHFs (such as Cases 2, 3 and 4) came to their second licence much earlier. From Tables 8.1 to 8.9 it is evident that these seven cases undertook quite varied processes in developing their Safety Cases, and specifically their SMS, to comply with the MHF Regulations. Table 8.8 showed Cases 1 to 6 inclusive required assessment extensions and Cases 1 and 6 both had licence inquiries held in anticipation of a licence refusal due to SMS deficiencies. How did the seven cases fare at licensing? Is there evidence of learning from licensing Round 1 to Round 2? Table 8.10 shows MHF licensing outcomes for the seven cases in Round 1 and Round 2.
### Table 8.10: MHF Licensing Outcomes

<table>
<thead>
<tr>
<th>Licensing Outcome</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td><strong>First Round</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Licence granted</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Negative licence</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>decision appealed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-term licence</td>
<td>-</td>
<td>No (18 mth)</td>
<td>No (2 yr)</td>
<td>No (3 yr)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Condition(s) on licence</td>
<td>-</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Second Round</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Licence granted</td>
<td>-</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Full-term licence</td>
<td>-</td>
<td>No (3 yr)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Negative licence</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>decision appealed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition(s) on licence</td>
<td>-</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Licence suspension</td>
<td>-</td>
<td>No</td>
<td>Considered</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SMS stage at second</td>
<td>-</td>
<td>Implementation</td>
<td>Operation</td>
<td>Operation</td>
<td>Maintenance</td>
<td>Maintenance</td>
<td>Maintenance</td>
</tr>
<tr>
<td>round</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MHF Licence Outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-compliant (unlicensable) (7th)</td>
<td>Repeat short-term licences (6th)</td>
<td>Initial reduced-term licence with sporadic improvement (5th)</td>
<td>Initial reduced-term licence with sustained improvement (4th)</td>
<td>Sustained unconditional full-term licences (Equal 1st)</td>
<td>Sustained full-term licences (first conditional) (3rd)</td>
<td>Sustained unconditional full-term licences (Equal 1st)</td>
</tr>
</tbody>
</table>
Cases 5 and 7 received unconditional full-term licences in both their first round and upon reapplication five years later in Round 2. Case 6 received a five-year licence with conditions. Unfortunately the regulator’s concern with the storage of a particular chemical (as indicated by the licence condition) was proved correct by a fire several months after licensing. Following re-evaluation of their chemical holdings and control measures, Case 6 continued to show improvement and received a further five-year unconditional licence.

Case 4 initially received a three-year reduced-term licence with conditions. Significant changes to the SMS immediately prior to licensing (Table 8.8) and commitments made by management which were yet to be fulfilled were the drivers for the short-term licence and conditions. The commitments were fulfilled and improvements continued to be made, resulting in a five-year licence in Round 2. Case 3’s performance was sporadic, with improvements followed by deterioration, as focus and resources were shifted from the SMS. Case 3 was initially granted a two-year licence due to significant changes made to their SMS immediately prior to licensing (Table 8.8) and their commitments to improve the SMS. This was demonstrated in time for the second round of licensing, however it was not sustained throughout the licence period, resulting in a licence suspension being considered by the regulator. Case 3’s management responded to the possibility of losing their MHF licence and provided new resources to manage the Safety Case and SMS. This resulted in continued improvement at the site.

Case 2 received the shortest licence (18 months) ever granted to an existing MHF, with conditions. Due to improvement being demonstrated in only a limited number of SMS items, which WSV had highlighted to Case 2, and many of the same deficiencies were apparent from the previous Safety Case submission, and no self-initiated improvements were evident, WSV refused to licence Case 2 for their second licence application. Case 2 management appealed the decision through VCAT and during the elapsed time between the appeal application and hearing, Case 2 undertook some focused improvements on their SMS, resulting in WSV sending consent orders for a three-year licence.

Case 1 was refused a licence due to ‘extensive non-compliances’ with Part 3 (safety duties of operators) of the MHF Regulations, ‘particularly in relation to the SMS’ (SU3 Notice of Inquiry February 2003) (Table 8.8). Despite the initial opposition presented by Case 1 management towards the MHF Regulations (Table 8.3), Case 1 management did not contest the negative licence decision. Case 1 management’s last-minute attempts to throw resources at the SMS and Safety Case were not seen as sufficient commitment by
the regulator to the SMS and Safety Case, particularly given the number of warnings and discussions which led to the negative licence decision. Several months following the negative licence decision, Case 1’s supplier of Schedule 1 material closed (this external influence will be discussed further in Section 8.12). This external influence may explain Case 1’s acceptance of the negative licence decision. However, it does not explain their last-minute application of resources.

The outcomes over the two licensing rounds suggest a management learning process dynamic. Case 4’s learning from Round 1 to Round 2 was the most pronounced as Case 4 management engaged a consultant to determine how and why their first Safety Case preparation and licence outcome went so poorly and what improvements were necessary to obtain a five-year licence in Round 2. Case 4 management ensured the consultant’s recommendations were addressed and commitments made to WSV were met.

Case 6 also learnt from their negative first round experience and maintained a focus on improvement and meeting commitments made to WSV for Round 2. Cases 5 and 7 learnt from their first round licensing experience and continued the focus throughout the licence period to Round 2 and beyond. Case 3 management were more sporadic in demonstrating they had learnt from Round 1, however Case 3 final refocused to demonstrate commitment to improvement for Round 2. Case 2 were unable to demonstrate they had learnt from Round 1, particularly when deficiencies noted in the first assessment findings report remained apparent at Round 2. Case 1 showed an unwillingness to learn or change.

Overall, the seven cases had very different licensing outcomes from a refusal through to two full-term unconditional licences. From this it can be concluded that WSV did not ‘rubber stamp’ all sites with five-year unconditional licences, but rather upheld ‘uncompromising standards’ due to the ‘explicit and absolute support of the government in their [the regulator’s] unequivocal approach to their task’ (Haines 2009:46). WSV used a range of regulatory tools, many unique to the Victorian MHF regime such as refusal to licence (see Chapter 3), throughout the Safety Case development and licensing process to encourage sites to prevent major incidents and receive the ultimate goal of a five-year unconditional licence. This encouragement took many forms, and in some cases led to change in management’s perception of the MHF Regulations and the regulator. The second round outcomes make clear that only the ‘leaders’ had graduated to SMS ‘maintenance’, suggesting that incomplete SMS development was allowed in the first round. Licensing, while tough, had loopholes.
8.12 Management Acceptance of the MHF Regulations and Regulator – During and Post Safety Case

Management acceptance of the MHF Regulations and the regulator at the introduction of the MHF Regulations was presented in Table 8.3. This showed Cases 1 and 5 opposed both the regulations and the regulator. Case 1 was not licensed and Case 5 received a full-term unconditional licence (Table 8.10). Did Case 1 and Case 5’s management continue to oppose the regulations throughout the Safety Case development period, or can changes in management’s acceptance be detected? Did the regulator’s use of regulatory tools assist in bringing about change? Management acceptance of the MHF Regulations and the regulator during Safety Case assessment and post-licensing is shown in Table 8.11.

Initially (Table 8.3) only Cases 4 and 7 were responsive to the regulator and only Case 7 had senior management actively engaged in MHF compliance. Table 8.8 showed all Cases, except Case 7, required assessment extensions. Cases 2, 3, 5 and 6’s senior management became actively engaged in the compliance process and responsive to the regulator when an extension to the Safety Case Assessment process was discussed and granted – without which a site would be refused a licence to operate. The regulator making a stance on what non-compliances were preventing a licence from being granted was confronting for most senior managers, and was seen as a call to action for the sites. A flurry of activity followed the granting of a Safety Case assessment extension, with the exception of Case 1, which continued to be unresponsive to the regulator. Case 1’s senior management finally became engaged and responsive to the regulator immediately prior to their licence decision, when it was too late to show any true commitment to the process or demonstrate improvement – facts highlighted when their licence was refused. Case 6’s initial focus following the assessment extension was lost due to distraction of personnel as a result of company ownership uncertainty. Shortly prior to licensing, Case 6 senior management assured WSV that the new structure was now stable and would ‘ensure closer attention to site activities’ (L6 AFR 2003:29). The possibility of a refused licence resulted in senior management’s re-engagement with the MHF Regulations and the regulator at the highest level.
Table 8.11: Management’s Acceptance of the MHF Regulations and Regulator – During and Post Safety Case

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Senior management actively engaged &amp; responsive to regulator - post-assessment extension</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>- immediately prior to licence decision</td>
<td>Yes (heightened response)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (heightened response)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>- post-licence decision</td>
<td>-</td>
<td>Yes</td>
<td>No - initially</td>
<td>Yes – after enforcement</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Response to non-compliances (finally)</td>
<td>Fought</td>
<td>How to comply?</td>
<td>Use regulator as sounding board for ideas</td>
<td>Use regulator as sounding board for ideas</td>
<td>Regulator as sounding board, with some immediate rectification unassisted</td>
<td>Regulator as sounding board, with some immediate rectification unassisted</td>
<td>Immediate rectification unassisted</td>
</tr>
<tr>
<td>Sees value/benefit in the MHF regime (finally)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Self-initiate improvements (sign of auditing)/Proactive (finally)</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>“This is serious” event post-MHF Regulations</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes – HF training</td>
<td>Yes - fire</td>
<td>No</td>
</tr>
<tr>
<td>Management’s acceptance post Safety-Case</td>
<td>Defeated and disengaged (7th)</td>
<td>Accepting but struggling (6th)</td>
<td>Accepting &amp; trying to best of abilities (5th)</td>
<td>New commitment to engage positively (3rd)</td>
<td>Highly engaged and responsive (1st)</td>
<td>Re-established engagement (4th)</td>
<td>Consistent sustained engagement (2nd)</td>
</tr>
</tbody>
</table>
Case 4’s senior management also responded to the realisation that a licence refusal, or at best, a reduced-term licence was a possibility, based on other licence outcomes for sites undertaking significant remedial work on the SMS immediately prior to licensing. Case 4 continued to be responsive to the regulator throughout the Safety Case process, however a heightened response was evident immediately prior to the licence decision when Case 4 senior management engaged a consultant to review their site’s approach to the MHF Regulations and how it had been managed. This review highlighted, among other things, Case 4’s stage-managed approach to the regulator. Significant changes were made to the management of the Safety Case and SMS internally, shifting responsibility to operations line management. This review was prompted by senior management’s realisation of Case 4’s excellent starting position (Table 8.1) versus the significant verification issues (Table 8.8), assessment extension, significant remedial work on the SMS immediately prior to licensing and the realisation that a licence refusal or reduced-term licence was a possibility. Case 4’s senior management wanted to understand how and why their site’s Safety Case development went so terribly wrong, despite having started the Safety Case development early with a well-resourced and informed SHE Department, and having paid a reputable and experienced consultancy company significant funds. This management review provided answers and clearly showed where Case 4 management’s approach needed to change, however this moment of enlightenment was just prior to licensing. To demonstrate their awareness of the issues and willingness to change, Case 4 senior management documented the issues and solutions and presented this to the regulator with commitments just prior to licensing.

Case 3 became unresponsive to the regulator following licensing. A technical void had developed at Case 3 with the departure of the Operations Manager, and the Finance Manager overseeing the vacant production role. Auditing ceased 11 months after the second MHF licence was issued, due to a lack of resources. Noticeable deterioration and unresponsiveness resulted in licence suspension being considered by the regulator. At this point, Case 3 management, possibly realising the business threat posed by a licence suspension, returned to being responsive to the regulator.

Responses to non-compliances identified by the regulator over the Safety Case development and licence period were seen to mature by each of the seven cases, except Cases 1 and 2. There was increasing acceptance of the role of the regulator in detecting non-compliances and a genuine desire to address the safety issues identified by the regulator, rather than focus on fighting the identification of the non-compliance. Case 7 was able to rectify the problem without assistance from the regulator and increasingly
Cases 5 and 6 were demonstrating that self-sufficient ability. Others needed to use the regulator as a sounding board as their confidence in their own solutions grew. From once fighting the regulator on every issue, Case 5 welcomed the regulator, keen to share issues and discuss ideas for possible solutions and ultimately became proud of showing the regulator what they had improved themselves by using the site’s internal processes of identifying problems and finding solutions.

During the post-licensing period, Cases 3, 4, 5 and 6 developed the ability to identify issues and self-initiate improvements. This development coincided with Cases 3, 4, 5 and 6’s maturing approach to non-compliances and the development of auditing (Table 8.9) at these sites.

Initially only management at Cases 6 and 7 saw benefit in the MHF regime. Table 8.11 shows that this changed during the Safety Case development and licensing process with management at Cases 3, 4 and 5 also seeing benefit, echoing another MHF’s CEO comments, reported in Chapter 3, that his organisation had ‘gained significant value’ from complying with the MHF Regulations (Engelsman 2002). The analytical framework of hazard identification, safety assessment, control measures and SMS (as required by the regulations) provided a structure, often not seen before (particularly for simpler sites such as those in the Logistics, Utilities and basic Plastics & Chemicals Sectors). An MHF operator with over 15 years experience publically stated “The light had finally come on”, as he now understood for the first time, why certain controls were in place, how they worked and most importantly which were critical (MHF Operator 2002). For sites such as Case 5, this approach streamlined their simple business practices, with further synergies made when the SMS was integrated with other business activities. Case 5 became more efficient with less double-handling of stock, gained financial advantage from complying with the MHF Regulations (Case 5 WSW Presentation 2004:9) and ‘would never return to its past’ practices (Case 5 WSW Presentation 2004:10).

Case 5’s Managing Director realised early-on during the Safety Case development process that as the MHF Regulations were staying and his protests to have them removed were not successful, that his business needed to achieve an MHF licence, otherwise they would not be able to operate and his clients would seek storage at his competitors. He also saw the MHF licence as a means of market differentiation, to attract new customers, to charge a premium and to alert the regulator to would-be competitors operating without an MHF licence. Once he saw the many benefits and

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153 Haines (2009:39) concluded that ‘it was clear that pressure on the government by industry to weaken the [Victorian MHF] regime would not be successful’.

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ultimately the positive effect on business profitability, his approach to the MHF Regulations and the regulator changed which was also evident through line management and employees, particularly following Case 5’s ‘this is serious’ event.

Case 5 experienced a ‘this is serious’ event during their Safety Case development process, when they realised that preventing major incidents was to be taken seriously. When management and employees fully understood the dangers of a particular chemical they handled (through attending a training course to comply with an enforcement notice issued by WSV), they realised they were not suitably equipped for a spill of this chemical, nor did they want the potential for such an incident on their premises. Hence management made the decision to ban this chemical from entering the site. It was a sobering moment for employees and management alike. This spurred on a personal interest of employees and management in the properties of the various chemicals present on site and the recommended response to a leak. While there was some truth in the Managing Director’s comment that a storage facility is not the same as Longford gas plant, it still has the potential for undesirable chemical incidents with significant consequences for employees and neighbouring sites. This was now understood by management and employees at Case 5 and a true focus on ensuring hazards had been identified and suitable control measures were in place and supported by the SMS began in earnest.

Case 6 also experienced a ‘this is serious’ event shortly after receiving their first MHF licence. A shipping container self-ignited on a hot day due to a series of control measure failures. A major incident was averted due to the mitigative control measures\textsuperscript{154}. The fire highlighted to management and employees alike that the preventative control measures in place were not 100% effective. After examination, Case 6 also decided to remove the particular chemical from their site as they were not sufficiently equipped to safely manage its storage.

The discussion of Table 8.10 and 8.11 clearly showed that there were ‘carrots’ and ‘sticks’ in the MHF Regulations and the manner in which WSV enforced them. ‘Carrots’ or positive rewards come from having a safer site, a more engaged workforce with greater understanding of safety and operational requirements, constructive dialogue and interchange of information between the regulator and site, and possibly financial gain. ‘Sticks’ or negative feedback come from enforcement action by the regulator and the use of licensing tools such as assessment extensions (to warn of impending licence rejection

\textsuperscript{154} The security guard noticed the smoke and called the fire brigade. Separation distances between the shipping container and other dangerous goods prevented the fire from spreading.
unless activities were undertaken in the additional time to improve the situation), reduced licence terms, licence conditions, licence rejection and licence suspension. These seven cases highlight that the regulator was prepared to, and did use, a range of regulatory tools to enforce and encourage major incident prevention at MHFs in Victoria. However Case 1 provided an example of when the regulator chose not to take additional enforcement action due to the distraction it would cause from the current Safety Case improvement activities. This ‘distraction’ from main Safety Case activities caused by enforcement action was highlighted by Case 5’s correspondence to the regulator during their Safety Case development.

It is unclear whether Case 2 management saw benefit in the MHF Regulations. Case 2 tried to be responsive to the regulator, but was unable to demonstrate any self-initiated improvements. Case 2’s initial short-term licence (Table 8.10) highlighted the regulator’s concerns with the sustainability of Case 2’s processes, which their second licence application confirmed. As will be shown in Section 8.13, Case 2 management were under significant pressure from external influences which prevented them from being more responsive to the regulator or demonstrating improvements.

Overall, management acceptance of the regulations appears to have been critical to achieving leader status. However, as Table 8.11 shows, changes to management’s acceptance, particularly responsiveness to the regulator, can be identified at different stages of the Safety Case development period. These changes can be traced to issues raised by the regulator, impending licence refusal, or the site’s own realisation that major incident prevention is serious through incidents or near-miss events which occurred on site. However as shown by Case 2, management’s approach and responsiveness can also be influenced by factors outside management’s direct control.

8.13 External Influences on MHFs

The seven cases did not operate in isolation during the Safety Case development and licensing period. Corporate changes and events external to the MHFs can impact their ability to achieve compliance with the MHF Regulations. External influences examined in Table 8.12 include change in company ownership, restructures, down-sizing and Schedule 1 material supply chain issues. Two of these – internal restructure and down-sizing are ‘external’ in the sense that Head Office has usually directed internal site management.
### Table 8.12: External Influences on MHFs

<table>
<thead>
<tr>
<th>External Influences</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Low complexity Utilities, small workforce</td>
<td>Medium complexity P&amp;C, medium workforce</td>
<td>Medium complexity P&amp;C, small workforce</td>
<td>Very high complexity P&amp;C, large workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>Low complexity logistics, medium workforce</td>
<td>High complexity, P&amp;C, large workforce</td>
</tr>
<tr>
<td>Company ownership change</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Internal restructure</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Down-sizing</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Schedule 1 material supply chain issue</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>External Influences Factor</strong></td>
<td>Supply chain impact (5th)</td>
<td>Significant negative impact by external influences (7th)</td>
<td>Considerable impact by external influences (6th)</td>
<td>No impact of external influences (Equal 1st)</td>
<td>No impact of external influences (Equal 1st)</td>
<td>Impacted by external influences (4th)</td>
<td>Mildly impacted by external influences (3rd)</td>
</tr>
</tbody>
</table>
External influences can have positive or negative effects. An example of a positive external influence is the change in ownership of Case 3 bringing with it new resources and an understanding of the MHF regulatory regime. A negative external influence, such as supply chain issues for Schedule 1 materials, can have the potential to put an MHF out of business.

From Table 8.12, it is clear that Cases 4 and 5 had no significant external influences during the Safety Case development period. In contrast, Case 2 was impacted by every external influence considered. It was only internal restructure which positively influenced Case 2, providing increased resources to the Safety Case development process. However, these personnel still had their previous jobs to do, so the actual availability of the resources did not significantly increase. The change in Case 2’s ownership resulted in 100% ownership by the joint venture partner which wanted to ‘work’ the existing asset rather than invest and strengthen the venture. The beginning of Schedule 1 material supply chain issues resulted in down-sizing at Case 2, and a complete halt in the supply of Case 2’s Schedule 1 material led to the cessation of its MHF activities. Case 2 site management were unable to actively respond to the regulator or progress beyond a ‘fire-fighting’ approach of addressing issues raised by the regulator. The company and individuals involved were functioning in a very uncertain environment with resources already pushed to breaking point, with more duties being assigned to the same overloaded personnel (Case 2 Lead Assessor licence panel notes 2004:6). With knowledge of these external influences, it was not surprising that Case 2 was unable to demonstrate any significant improvement during its first 18-month licence; and also why their second licence was refused, and why it took a VCAT appeal to refocus some management effort on achieving a licence to operate.

Shortly after licence refusal, Case 1’s supplier of flammable gas ceased operation. As the flammable gas was readily available from other suppliers, unlike Case 2, it was possible that Case 1 could have found an alternative supplier if they wished to remain operational\(^\text{155}\).

Company ownership change had no noticeable impact on Case 7, whereas for Case 6, it brought an end to a period of uncertainty and resulted in an internal restructure and introduction of a new SMS. Case 3 was negatively impacted by ownership changes, down-sizing and restructures, causing distraction, which ultimately led to Case 3 being

\(^{155}\text{Assuming remedial work to obtain an MHF licence could be achieved.}\)
considered for licence suspension. A final change in ownership led to a corporate SMS, understanding of the MHF Regime and additional resources.

Overall, Cases 4 and 5 experienced no major impact from external sources, compared with Cases 2 and 3, which experienced significant negative impacts by external influences during the licensing process. Some ‘laggers’ were plainly distracted in this way, but equally so were two ‘leaders’.

### 8.14 Summary of Performance Factors – ‘Laggers’ or ‘Leaders’?

Tables 8.1 to 8.12 demonstrate that the seven cases followed different processes from the introduction of the MHF Regulations to their first MHF licence outcome, to sustaining the licence (if granted) and applying for a second licence. Changes in the SMS were evident during this period and the status of the SMS at licensing impacted the licence term. Figure 8.1 illustrates the start and end point of the SMS across the period studied for the seven cases, using the SMS Development Model (previously presented in Figure 4.1).

Due to the impact the SMS stage had on the licensing outcome, the detail from Tables 8.1 to 8.12 will be used to examine how the seven cases progressed from their initial SMS stage to their final stage and hence did, or did not, achieve a licence, and what
contribute factors can be identified which influenced performance towards being ‘Leaders’ and ‘Laggers’.

Starting Position

It is evident that the seven cases began their process from different levels of preparedness, which was a combination of the site’s initial preparedness (Table 8.1) and their own systems’ preparedness (Table 8.4), influenced by management acceptance, or otherwise, of the MHF Regulations (Table 8.3) and management’s capability and employee representation position (Table 8.2). Table 8.13 presents these starting factors. For each performance factor, the most positive result is shaded and the worst result is shown with horizontal stripes.

Case 7 was clearly in the lead starting position with a well-established SMS, employee representation, capable management who were welcoming of the MHF Regulations and the regulator, and good initial preparedness with active closure of any perceived deficiency gaps such as lack of previous corporate experience in developing a Safety Case. Case 4 shared the initial preparedness ranking and management capability and employee representation position with Case 7, however Case 4’s management internally opposed the MHF Regulations and had significantly misjudged the starting point of their SMS. Case 4 heavily involved one HSR in the Safety Case and SMS development who was not from the operations group. Case 6, while not in the lead, was well-positioned to achieve compliance with the MHF Regulations as it had an operational SMS, capable management who accepted the MHF Regulations and were reasonably well-prepared, and employee representation. In contrast, Case 1 appeared to have the strongest initial preparedness, but this was eroded by the SMS not being fully implemented (Table 8.4). Case 1 also had the weakest management capability, no employee representation and management who opposed the MHF Regulations and the regulator, with an SMS actually operating below site expectations. Despite their strong initial preparedness, Case 1 was in a poor overall starting position due to the vehement opposition to the regulations demonstrated by management and their lack of site management capability.

Such strong opposition to the MHF Regulations was also shared by Case 5’s management, which was in an even weaker starting position, with low preparedness coupled with no SMS and a complete lack of SHE knowledge within the organisation. The weakest starting position was held by Case 3 due to their complete unpreparedness for the regulations, no SMS, weak site management capability and management being reluctant acceptors of the MHF Regulations.
## Table 8.13: Starting Factors for the Seven Case Studies

<table>
<thead>
<tr>
<th>Performance factor</th>
<th>Case 1 – SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Preparedness Ranking (Table 8.1)</td>
<td>Well prepared &amp; Exemplar (1st)</td>
<td>Prepared &amp; international connections (Equal 2nd)</td>
<td>Unprepared (7th)</td>
<td>Prepared &amp; international connections (Equal 2nd)</td>
<td>Prepared but isolated (Equal 5th)</td>
<td>Prepared but isolated (Equal 5th)</td>
<td>Prepared &amp; Exemplar (Equal 2nd)</td>
</tr>
<tr>
<td>Relative Management Capability &amp; Employee Representation position (Table 8.2)</td>
<td>No site management capability or employee representation (7th)</td>
<td>Strong site management capability &amp; employee representation, but risk management void (4th)</td>
<td>Weak site management capability and no employee representation (6th)</td>
<td>Strongest site management capability with employee representation (Equal 1st)</td>
<td>Strong site management capability with employee representation, but SHE void (5th)</td>
<td>Strong site management with interstate control and employee representation (3rd)</td>
<td>Strongest site management capability with employee representation (Equal 1st)</td>
</tr>
<tr>
<td>Management's initial acceptance (Table 8.3)</td>
<td>Opposing (Equal 6th)</td>
<td>Reluctant acceptors (Equal 4th)</td>
<td>Reluctant acceptors (Equal 4th)</td>
<td>Publicly welcoming but internally opposing (3rd)</td>
<td>Opposing (Equal 6th)</td>
<td>Accepting (2nd)</td>
<td>Welcoming (1st)</td>
</tr>
<tr>
<td>Initial SMS Development Stage (Table 8.4)</td>
<td>Implementation (below site expectation) (Equal 3rd)</td>
<td>Design (Equal 5th)</td>
<td>Design (Equal 5th)</td>
<td>Implementation (below site expectation) (Equal 3rd)</td>
<td>Design (Equal 5th)</td>
<td>Operation (2nd)</td>
<td>Maintenance (1st)</td>
</tr>
<tr>
<td>Starting position</td>
<td>Poor starting position with misjudged SMS (5th)</td>
<td>Reluctant starting position with risk management void (4th)</td>
<td>Weakest starting position (7th)</td>
<td>Strong starting position but misjudged SMS (2nd)</td>
<td>Weak starting position (6th)</td>
<td>Good starting position (3rd)</td>
<td>Strongest starting position (1st)</td>
</tr>
</tbody>
</table>
While a site's demographics, initial preparedness and initial SMS development stage cannot be changed, management acceptance and on-going response to the MHF Regulations and associated activities can be altered. Management capability (site presence and support from the SHE Department) is harder to alter, but can be changed. How important is management capability and management's initial approach to the licence outcome? As will be explored later, these appear to be important factors in determining the licence outcome. Case 1 was clearly weakest on these factors.

While the starting position (Table 8.13) was informative, and provided some sites with an advantage over others (e.g. Case 7 clearly had a starting advantage over Case 3 and Case 5), it did not pre-determine the licence outcome. If it did, Case 5 would not have finished as a 'leader' with two unconditional full-term licences (Table 8.10). Obviously there were inputs along the development process which influenced the outcome.

**The SMS Development Process**

Management's initial acceptance strongly influenced plans and resource allocation for developing the SMS which is presented in Table 8.14, along with other factors showing the development process. The most positive results are shaded while the worst are shown with horizontal stripes. Site-specific SMS development and employee involvement are shown together since employee involvement tended to peak when employees were engaged in customising or starting a new SMS.

According to Figure 8.1, only three of the seven cases studied needed to focus on design of the SMS – these being Cases 2, 3 and 5. While all three acknowledged that they were starting from scratch, only Case 5 sufficiently planned for work on the SMS. This suggests Cases 2 and 3 did not understand the process which lay ahead of them and what was required. Cases 1 and 4 should have been strengthening their implementation of the SMS (but positive auditing results gave management at Cases 1 and 4 the false impression that they were at the maintenance stage, and as in both cases there was no corporate drive to continuously improve, the SMS was not considered to be in need of improvement). Due to these false perceptions, no plans were made by Cases 1 and 4 to further develop their SMS.
### Table 8.14: Development Processes & Employee Involvement in the Seven Case Studies

<table>
<thead>
<tr>
<th>Performance factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Starting position</strong></td>
<td>Poor starting position with misjudged SMS (5th)</td>
<td>Reluctant starting position with risk management void (4th)</td>
<td>Weakest starting position (7th)</td>
<td>Strong starting position but misjudged SMS (2nd)</td>
<td>Weak starting position (6th)</td>
<td>Good starting position (3rd)</td>
<td>Strongest starting position (1st)</td>
</tr>
<tr>
<td><strong>Plans for SMS Development</strong></td>
<td>Not given consideration (ignored) (Equal 6th)</td>
<td>Underestimated (Equal 4th)</td>
<td>Underestimated (Equal 4th)</td>
<td>Not given consideration (ignored) (Equal 6th)</td>
<td>Appropriate (Equal 2nd)</td>
<td>Appropriate (Equal 2nd)</td>
<td>Key focus (1st)</td>
</tr>
<tr>
<td><strong>Use of External Resources &amp; ownership of Safety Case</strong></td>
<td>No ownership. External resource sought too late (7th)</td>
<td>Delayed ownership due to inexperienced external resource (Equal 4th)</td>
<td>Delayed ownership due to external resource (3rd)</td>
<td>Delayed ownership due to SHE department control and external resource (6th)</td>
<td>Delayed ownership due to inexperienced external resource (Equal 4th)</td>
<td>Directed use of external resources maintaining internal ownership (Equal 1st)</td>
<td>Directed use of external resources maintaining internal ownership (Equal 1st)</td>
</tr>
<tr>
<td><strong>Site-specific SMS Development &amp; Employee Involvement</strong></td>
<td>Not interested in site-specific SMS or involving employees (7th)</td>
<td>Struggled to make SMS site-specific. Limited employee involvement (6th)</td>
<td>Simple synergy driven site-specific SMS with employee ownership (Equal 2nd) (significant transition)</td>
<td>Corporate SMS made site-specific once employees involved (Equal 4th)</td>
<td>Simple synergy driven site-specific SMS with employee ownership (Equal 2nd) (significant transition)</td>
<td>Corporate SMS made site-specific with employee involvement (Equal 4th)</td>
<td>Strong site-specific SMS with employee ownership (1st)</td>
</tr>
<tr>
<td><strong>Development process &amp; employee involvement</strong></td>
<td>Ignored development process (7th)</td>
<td>Poor understanding of the process and limited employee involvement (5th)</td>
<td>Gradually understood the process and learnt to involve employees (4th)</td>
<td>SMS development with employee involvement initially ignored (6th)</td>
<td>Benefits of the process realised with employee ownership (3rd)</td>
<td>Appropriate development process with some distractions and employee involvement (2nd)</td>
<td>Clear understanding of development process with employee ownership (1st)</td>
</tr>
</tbody>
</table>
The deficient SMS development plans of Cases 1, 2, 3 and 4 occurred at sites with a poor initial acceptance by management (Table 8.13), which was likely to have influenced how the Safety Case was begun, and whether it was taken seriously with the provision of resources etc., level of work planned, or otherwise. Management acceptance of the MHF Regulations influenced the progress of the Safety Case development (timeliness of decisions) and the provision of additional resources as necessary. Case 5 was an anomaly with appropriate SMS development plans, yet an opposing management approach to the MHF Regulations. It was shown that Case 5’s Managing Director began to change his approach, becoming more accepting of the MHF Regulations during the planning process.

Table 8.14 shows Case 7 to have the best understanding of where they were starting from, where they had to go and what they needed to do to get there, thus maintaining the ‘leader’s’ position. Case 7 effectively planned to review and revise their SMS to ensure all major incident prevention aspects were included, with effective use of skilled consultants, maintaining internal ownership of the process and outcomes, strong employee involvement and a resultant strong site-specific SMS.

Case 6 strengthened their good starting position (from third to second) by having appropriate plans for developing the SMS and directing the work of external resources to maintain internal ownership of the SMS and Safety Case. Despite the unplanned introduction of a corporate SMS, Case 6 eventually made the corporate SMS site-specific with employee involvement.

Case 5 significantly improved their weak starting position (sixth) to third by having appropriate plans for their SMS development. A simple site-specific SMS was created with strong employee involvement which was driven by the synergy gains it produced when integrated with existing systems to create a Business Management System. This synergy provided incentive to further develop the SMS. The one significant negative in Case 5’s development process was its initial inexperienced consultant. However the consultant was dismissed early in the process, during development of the Safety Case Outline, and Case 5 quickly recovered from that set-back. The new consultant employed to assist the Quality Manager, helped develop appropriate plans, the development process was no longer a chore, the process and outcome were understood and benefits were observed by the Managing Director, who increasingly accepted the MHF Regulations and regulator.
Case 3 significantly improved their position from the weakest starting point to fourth in the development process. While Case 3 management had under-estimated what was required to develop an SMS, the at sometimes slow, but eventual development of a simple site-specific SMS with employee involvement showed synergies which further encouraged the use of the new system, thereby encouraging the further development of the SMS.

Case 2 experienced some minor deterioration from fourth starting position to fifth in the development process. Not only had Case 2 under-estimated the amount of development work needed on the SMS, they had not taken the time to make their off-the-shelf SMS site-specific. Their efforts were further hampered by an inexperienced consultant and limited employee involvement.

Case 4 was also poorly-placed for the development process, significantly losing ground from second starting position to sixth in the development process, predominantly due to Case 4’s lack of planning to improve the SMS. This was possibly due to management’s misjudgement of the SMS’s actual development stage, no drive for continuous improvement and delayed ownership by operations personnel due to the SHE Department’s control of the SMS and Safety Case. Once the need for greater site ownership of the SMS and Safety Case (beyond the SHE Department) was identified by senior management, the development of the SMS was broadened to involve site personnel and operations management. So Case 4 re-evaluated and re-established their plans for development of the SMS near the end of the Safety Case development period and changed the way consultants were used – assisting in-house management, rather than directing the process.

Case 1 was clearly in the worst position as they did not acknowledge there was a development process ahead of them, as management were too pre-occupied with fighting the regulations. There was no acknowledgement that SMS improvement, or tailoring to the site’s needs, was required, employees were not involved in the SMS and external resources were not engaged until their licence was likely to be refused. This approach to the development process aligned with Case 1’s management opposing initial acceptance of the regulations, the false perception of the SMS’s actual development stage and their absent site management capability.

To summarise, the discussion throughout this chapter has considered a large number of factors which may impact on the SMS development process, although caution should be

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observed in taking an excessively deterministic approach to them. Clearly management could compensate for lost time and missing pieces in the puzzle if they decided to.

Factors that assisted the development process which can be inferred from the seven cases studied include:

- Understanding of the initial SMS development stage, both content and operation in the field. Any missing content can be determined from a gap analysis against a system framework such as ISO 9000 or AS4801 (for system requirements), as well as a gap analysis against the MHF Regulations (for major incident specific requirements). The field status of the SMS can be determined from conformance and effectiveness auditing.
- Understanding what the end-point looks like, including making the SMS site-specific (see what others do, both locally and overseas) and integrating with existing site systems (if present).
- Understanding the development and improvement process (both content development and field implementation).
- A plan to progress from the start point to the end point (methodologies, sufficient time and resources).
- Employee involvement in the SMS (including developing and revising procedures).
- Appropriate use of external resources, if required, (to assist in-house management and ensure staff are not overloaded with regular duties as well as Safety Case and SMS development, and to cover any in-house technical skill deficiencies). In-house management to remain in-charge of the process.
- Involvement of in-house personnel (including operations management and employees) to ensure ownership remains with the site and not the consultant or SHE Department.
- Management support and commitment to SMS development.
- Strive for continuous improvement in the SMS.
- Acceptance and understanding of the MHF Regulations and acceptance of the role of the regulator.

**SMS Deficiency Detection**

As the process to achieve compliance with the MHF Regulations progressed, SMS deficiencies were identified by either the site or the regulator, and were often a direct result
of the MHF’s development process and ability (or lack thereof) to detect their own SMS deficiencies through auditing. Table 8.15 shows the impact of SMS deficiencies and the state of internal auditing at the seven case studies. The three ‘leaders’ are deemed to have internal auditing that could detect SMS deficiencies. The ‘laggers’ could not. While the licensing process implies this, in fact the case studies show the ‘leaders’ remained weak at auditing. Not even Case 7 could be relied on for fully reliable internal auditing. The findings of Annual Inspections confirm that no case had self-sufficient internal auditing.

The sites with a newly-designed and implemented SMS (Cases 2, 3 and 5 - Table 8.4) performed poorly in Safety Case verification compared with the sites with more established SMSs (Cases 6 and 7), except for Case 5 which rapidly developed a synergy-driven site-specific SMS which was well-implemented, resulting in few issues during inspections (Table 8.7). The sites with a significant mismatch between the stage where they perceived the SMS to be functioning and where WSV determined it to be (Cases 1 and 4 - Table 8.4), also had SMS deficiencies as the SMS was not functioning as described in their Safety Case. The sites with significant SMS deficiencies (Cases 1, 2, 3 and 4) had weak auditing practices (including auditing in its infancy). This observation suggests auditing is necessary to support the functioning of the SMS, through the identification and rectification of SMS deficiencies. It is suggested that without the ability to self-identify SMS implementation issues through auditing, significant SMS deficiencies will persist, hampering efforts to improve the SMS. Hence auditing plays an important role in progressing the development of the SMS.

At the first licensing round Cases 2 and 3 were introducing auditing processes which were not developed and implemented enough to provide useful information regarding any SMS deficiencies prior to the regulator detecting them. Case 3’s reduced-term licence was ‘selected on the basis that the audit and review process of your [Case 3’s] SMS is not well established and that reassessment will be necessary after management have reviewed an annual audit cycle’ (Case 3’s licence decision letter 2003). Cases 2 and 3 both had significant SMS deficiencies which could not be addressed prior to licensing and were committed to through on-going activities.
Table 8.15: SMS Deficiency Detection for the Seven Case Studies

<table>
<thead>
<tr>
<th>Performance factor</th>
<th>Case 1 - SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development process &amp; employee involvement</td>
<td>Ignored development process (7th)</td>
<td>Poor understanding of the process and limited employee involvement (5th)</td>
<td>Gradually understood the process and learnt to involve employees (4th)</td>
<td>SMS development with employee involvement initially ignored (6th)</td>
<td>Benefits of the process realised with employee ownership (3rd)</td>
<td>Appropriate development process with some distractions and employee involvement (2nd)</td>
<td>Clear understanding of development process with employee ownership (1st)</td>
</tr>
<tr>
<td>Regulator Evaluation of SMS Deficiencies</td>
<td>Significant SMS deficiencies NOT addressed (7th)</td>
<td>Significant SMS deficiencies addressed in on-going activities (Equal 5th)</td>
<td>Significant SMS deficiencies addressed in on-going activities (Equal 5th)</td>
<td>Significant SMS deficiencies addressed, some on-going (4th)</td>
<td>SMS deficiencies addressed (2nd)</td>
<td>SMS deficiencies addressed (following inquiry) (3rd)</td>
<td>No significant SMS deficiencies (1st)</td>
</tr>
<tr>
<td>Auditing</td>
<td>Ineffective established auditing (5th)</td>
<td>Auditing in infancy (Equal 6th)</td>
<td>Auditing in infancy (Equal 6th)</td>
<td>Superficial auditing (4th)</td>
<td>Implemented auditing (3rd)</td>
<td>Implemented auditing with new skilled auditor (2nd)</td>
<td>Operational Auditing (1st)</td>
</tr>
<tr>
<td>SMS Deficiency Detection</td>
<td>Incapable of detecting SMS deficiencies (7th)</td>
<td>Still establishing SMS deficiency detection and on-going SMS commitments (Equal 5th)</td>
<td>Still establishing SMS deficiency detection and on-going SMS commitments (Equal 5th)</td>
<td>Continuing development of SMS deficiency detection and on-going SMS commitments (4th)</td>
<td>Ability to detect SMS deficiencies developed (Equal 2nd)</td>
<td>Ability to detect SMS deficiencies developed (Equal 2nd)</td>
<td>Self-correcting SMS (1st)</td>
</tr>
</tbody>
</table>
Deterioration of the SMS was shown to occur in some case studies through management distraction, often due to external influences such as restructuring, change in corporate ownership or removal of skilled auditors. Prior to the MHF Regulations, Cases 1 and 4 may have been at the maintenance stage, as thought by senior management and documented in their Safety Cases. It is suggested that poor auditing practices (shown in Table 8.9) and management’s lack of commitment to the SMS contributed to the deterioration of the SMS over time resulting in the operational practices not being in accordance with the SMS (Case 4 possibly exacerbated by the SHE Department’s control of the SMS with no dissemination of knowledge to operations personnel) and the SMS becoming out-of-date. Hence it is possible that Cases 1 and 4 slipped back to the implementation stage without being aware of this deterioration.

As shown in Table 8.15, Case 7 retained its leadership position by having the most-developed auditing process, and no significant SMS deficiencies identified during the licensing process. However, Annual Inspections uncovered faults.

Cases 5 and 6 cemented their strong positions of equal second due to their ability to address any detected SMS deficiencies, using skilled auditors and recently implemented auditing processes. Case 6’s need for an inquiry was a result of the relatively recent introduction of the corporate SMS, coupled with a period of weak auditing. Case 6’s interstate senior management team also led to delays in decision-making critical to the progress of the SMS and Safety Case. Case 6 management were able to demonstrate that these deficiencies had been addressed and argued more time was required to demonstrate these changes had been effective in the long-term. This was demonstrated by Case 6’s perfect Annual Inspection results two years later. Case 5’s auditing practices changed^156 with the needs of the rapidly-developing SMS and through this auditing came the ability to detect and address SMS deficiencies.

Case 4 improved its position from sixth in the development process to fourth in SMS deficiencies as Case 4 began to address the significant SMS deficiencies, including superficial auditing, determining the root cause of the issues through a detailed management review. However given the large size of the organisation and extent of improvement required, this could not be achieved in a short period of time. Case 4’s strong

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^156 Kausek (2006:23) describes an ‘audit evolution’ as the auditing style develops from conformance to opportunities for improvement, to effectiveness, then to best practice.
management capability assisted in fast-tracking this process as much as possible and demonstrating commitment at the highest level to the regulator.

Cases 2 and 3 retained their poor positions of equal fifth due to the extent of SMS deficiencies detected, their inability to address them quickly and auditing being in its infancy.

Case 1 retained its ‘lagger’ position of seventh with significant SMS deficiencies not being attempted to be rectified by senior management, coupled with ineffective auditing, possibly giving management the false impression of the SMS’s initial development stage, possibly exacerbated by the extremely weak site management capability and no employee involvement or representation.

Factors which assisted the minimisation of SMS deficiencies which can be inferred from the seven cases studied include:

- Understanding the SMS development process and allowing appropriate time and resources for this to occur (see earlier points on SMS development process);
- Establishing auditing processes to support the SMS (don’t leave development of auditing until the maintenance stage of the SMS is reached);
- Engaging skilled auditors, who understand the major incident potential of the site;
- Developing auditing processes beyond a conformance focus (moving from conformance to effectiveness and beyond) in step with SMS development;
- Actively seeking out opportunities for improvement (aim for continuous improvement);
- Addressing detected SMS deficiencies (skills, in-house or external, to rectify the deficiency, management support and follow-up for the improvement);
- Site management capability to support the improvement; and
- Engaged senior management to ensure adequate resource allocation and priority.

**Licence Outcome**

It was shown in Section 8.11 that the extent of SMS deficiencies and the manner in which they were addressed by sites was a strong determinant of licence outcome. This is shown in Table 8.16, along with the final performance rating describing the site’s performance throughout the Safety Case development process.
### Table 8.16: Licence Outcomes for the Seven Case Studies

<table>
<thead>
<tr>
<th>Performance factor</th>
<th>Case 1 – SU3</th>
<th>Case 2 – P&amp;C2</th>
<th>Case 3 – P&amp;C9</th>
<th>Case 4 – P&amp;C7</th>
<th>Case 5 – L2</th>
<th>Case 6 – L6</th>
<th>Case 7 – P&amp;C3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMS Deficiency Detection <em>(Table 8.15)</em></td>
<td>Incapable of detecting SMS deficiencies <em>(7th)</em></td>
<td>Still establishing SMS deficiency detection and on-going SMS commitments <em>(Equal 5th)</em></td>
<td>Still establishing SMS deficiency detection and on-going SMS commitments <em>(Equal 5th)</em></td>
<td>Continuing development of SMS deficiency detection and on-going SMS commitments <em>(4th)</em></td>
<td>Ability to detect SMS deficiencies developed <em>(Equal 2nd)</em></td>
<td>Ability to detect SMS deficiencies developed <em>(Equal 2nd)</em></td>
<td>Self-correcting SMS <em>(1st)</em></td>
</tr>
<tr>
<td>MHF Licence Outcome <em>(Table 8.10)</em></td>
<td>Non-compliant *(un licensable) <em>(7th)</em></td>
<td>Repeat short-term licences <em>(6th)</em></td>
<td>Initial reduced-term licence with sporadic improvement <em>(5th)</em></td>
<td>Initial reduced-term licence with sustained improvement <em>(4th)</em></td>
<td>Sustained unconditional full-term licences <em>(Equal 1st)</em></td>
<td>Sustained full-term licences *(first conditional) <em>(3rd)</em></td>
<td>Sustained unconditional full-term licences <em>(Equal 1st)</em></td>
</tr>
<tr>
<td>Final performance rating</td>
<td>Lagger without commitment <em>(7th)</em></td>
<td>Lagger with outcome impacted by others <em>(6th)</em></td>
<td>Lagger who learnt to improve <em>(5th)</em></td>
<td>Lagger who thought it was a Leader <em>(4th)</em></td>
<td>Lagger to Leader – The Converted <em>(2nd)</em></td>
<td>Re-engaged Leader <em>(3rd)</em></td>
<td>Industry Leader from the outset <em>(1st)</em></td>
</tr>
</tbody>
</table>
Table 8.16 clearly shows that the ability to identify and address SMS deficiencies influenced the licence outcome. SMS issues that could not be addressed sufficiently prior to the licence panel resulted in reduced-term licences or licence refusal. Analysis of the case studies suggests that the status of auditing also influenced the licence delegate as the sites with more-developed auditing processes received full-term licences (as there was more confidence in a site’s ability to maintain its performance level if auditing was established) and sites with rudimentary or developing auditing processes (Cases 2 and 3) received very short licences. In fact the shortest licence granted (Case 2) was based around one cycle of auditing.

Comparing the licence outcomes of the seven case studies with the extent of SMS deficiencies yields the following observations:

- Case 1’s significant SMS deficiencies were left unaddressed resulting in licence refusal;
- Case 2’s inability to independently address SMS deficiencies and improve their auditing process led to repeated short-term licences;
- Case 3 initially demonstrated an inability to maintain its performance level without intervention by the regulator, showing a poorly-implemented SMS and weak auditing, resulting in a reduced-term licence. Staff changes led to improved skill levels and Case 3 demonstrated its ability to learn and improve earning it a full-term licence;
- Case 4’s significant management commitment and involvement to address SMS deficiencies resulted in a reduced-term licence followed by a full-term licence after sustained SMS and auditing improvements were demonstrated;
- Case 5’s ability to identify and quickly address its SMS deficiencies (due to its small and motivated workforce) resulted in consecutive full-term licences;
- Case 6’s auditing improvements and active response to inquiry issues resulted in a full-term licence with conditions followed by a full-term unconditional licence after a sustained period of further improvement, and
- Case 7’s absence of significant SMS deficiencies and operational auditing resulted in two full-term unconditional licences.

Factors which affected licence outcomes which can be inferred from the seven cases studied relate to:

- SMS development in the design or implementation stage at the time of licensing;
- SMS deficiencies detected during Safety Case assessment;
- Significant changes made to the SMS immediately prior to licensing;
- Immature/developing auditing; and
• Management unresponsive to SMS deficiencies.

The process of compliance to achieve an MHF licence was also in some cases positively or negatively influenced by senior management engagement and acceptance of the MHF Regulations and the regulator, and/or external factors such as corporate take-overs.

Case 7 consistently demonstrated engaged management in the Safety Case process and in maintaining its MHF licence. While impacted by external influences, Case 7 was able to address these external issues and continue to achieve consistently good results. The consistent engagement by management in the Safety Case compliance process was a clear influence on Case 7’s sustained strong performance results.

Case 5 underwent a meteoric rise from a weak starting position, with no SMS to a strong finishing result of two full-term unconditional licences. The significant improvement in Case 5 was evident during the development process and continued throughout the licensing process and beyond. This significant improvement was due to the positive change in management’s acceptance of the MHF Regulations and the regulator. Case 5’s management became highly engaged with the Safety Case development process and became responsive to both the regulator and identified deficiencies. This was initially driven by the Managing Director seeing commercial benefit in the application of the SMS and later all staff became acutely aware of improving safety following their personal realisation of the seriousness of major incident potential, following a training session in the storage and handling of a particular chemical. This strong management drive coupled with personal interest in safety by all employees, resulted in a strong positive internal influence on the licensing outcome. Case 5 was fortunate to not have any external factors on it during the Safety Case development period. Case 5’s improvement was also aided by having a small number of employees, allowing easy involvement of all personnel in SMS development and training, as well as strong site management capability.

Case 6 held a leaders’ position throughout the Safety Case process, however the influence of external factors lead to a deterioration in the SMS, distracting senior management and employees from the SMS. Once external factors were addressed and stability returned to the organisation, management were able to re-engage with the MHF Regulations and the regulator and improve the SMS. This strong re-engagement of management was likely to be responsible for Case 6 obtaining a full-term licence, rather than a reduced-term licence as might be expected following a licence inquiry.
Case 4 also demonstrated significant improvement, although to a lesser degree than Case 5. The development process was a negative step for Case 4, not making appropriate plans for improving the SMS. However senior management’s eventual response to the SMS deficiencies showed a clear acceptance of systemic issues and the need to address them. The identification of a significant number of SMS deficiencies was a turning point for Case 4 and a call to action for senior management, which responded swiftly to the issues and took steps to improve the situation. This demonstrated a new commitment by senior management to engage positively with the MHF Regulations and the regulator. Without this new engagement of senior management, and their strong site management capability to make things happen, it is unlikely that the SMS deficiencies would have been addressed sufficiently to obtain a licence or maintain the initial licence. Case 4 was also fortunate to not have any external factors affecting it during the Safety Case development period.

Case 3 was a ‘lagger’ from the beginning with the worst starting position, who slowly learnt to improve as management’s understanding of the process developed, including the benefits of involving employees. Negative external influences were highly distracting to management, leading to SMS deterioration. Finally new corporate ownership brought a corporate SMS and resources to address the Safety Case and SMS. Case 3 finished in fifth position, as they were still establishing SMS deficiency detection and addressing on-going SMS commitments.

Case 2’s management attempted to comply with the MHF Regulations, however significant external influences resulted in site management losing their ability to determine site outcomes and resulted in the site no longer operating as an MHF.

Case 1’s outcome was heavily influenced by management’s defeated and disengaged approach to the Safety Case, which developed from their initial opposition to the MHF Regulations and the regulator. Management’s consistently negative approach to the Safety Case resulted in no work being undertaken on the SMS and no resources being allocated to the task until Case 1 was facing licence refusal. Management’s constant opposition did not encourage the identification of improvements, hence an environment of maintaining the status-quo or deterioration resulted. External influences also had some impact on Case 1 after their licence refusal, with the cessation of flammable gas from their supplier. However as this was an abundant Schedule 1 material, it was possible that another supplier could have been arranged.
Discussion in this chapter has shown the following 13 factors (listed in Table 8.17) appear to affect SMS development and ultimately MHF compliance in the seven cases.

**Table 8.17: SMS Development & MHF Compliance Factors and Indicators**

<table>
<thead>
<tr>
<th>SMS Development Factor</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior management engagement with MHF compliance</td>
<td>Senior management actively involved in monitoring MHF compliance progress and promptly addressing any issues.</td>
</tr>
<tr>
<td>Site management capability &amp; employee representation</td>
<td>Management presence on site with sufficient capability to make informed and timely decisions regarding the SMS and the contribution of employee representation and participation.</td>
</tr>
<tr>
<td>Acceptance of the MHF Regulations and the regulator</td>
<td>Senior management accepting of the regulations and the role of the regulator and are positively engaged.</td>
</tr>
<tr>
<td>Employee involvement &amp; ownership of the SMS</td>
<td>Involvement of employees in developing and reviewing SMS elements relevant to their work activities.</td>
</tr>
<tr>
<td>Actively seek opportunities for improvement in the SMS</td>
<td>Ability to challenge the current way of thinking and the way things are done. A desire for continuous improvement.</td>
</tr>
<tr>
<td>Understand current SMS development stage</td>
<td>Analysis of SMS (both content and field implementation) to determine current stage of SMS development to allow appropriate planning for further SMS development.</td>
</tr>
<tr>
<td>Appropriate plans for SMS development</td>
<td>Based on current SMS development stage, includes sufficient time for each stage to be established, and sufficient resources.</td>
</tr>
<tr>
<td>Appropriate use of external resources to ensure internal ownership of the SMS</td>
<td>Management to remain in control of the process, with assistance from external consultants, to maintain internal ownership (both management and employees) of the SMS.</td>
</tr>
<tr>
<td>Site-specific SMS</td>
<td>Management desire to create a site-specific SMS and undertake activities to develop a site-specific SMS.</td>
</tr>
<tr>
<td>Integrated SMS</td>
<td>Create synergies by building on accepted existing systems (such as quality systems or business management system), if they exist.</td>
</tr>
<tr>
<td>Effective internal auditing</td>
<td>Auditing methodology that supports the continued development of the SMS, such as moving from compliance to effectiveness confirmation.</td>
</tr>
<tr>
<td>Level of resourcing for the SMS</td>
<td>Ensure resourcing for the SMS is sufficient, both skill level and number of people. Spread roles and responsibilities across senior management. Ensure auditors are skilled to the appropriate level (beyond conformance) and understand the major incident potential.</td>
</tr>
<tr>
<td>Capacity to manage external influences</td>
<td>External influences are managed to minimise disruption to the SMS.</td>
</tr>
</tbody>
</table>

As shown by those Victorian MHFs that began without an SMS in place, there is no ‘quick fix’ to creating an SMS which is appropriately designed, implemented, operated and maintained. Paulk *et al.* (1993:26) report software organisations taking 10 years or more to build the foundation and culture oriented toward continuous process improvement. Case 5 supports the view that SMS development is possible over less
than a 10-year period for a small, low complexity, focused and motivated organisation with existing systems and skilled auditors. Case 3 suggests that more than 10 years may be needed to fully develop an SMS when management focus and motivation are sometimes sporadic.

The case study evidence suggested that auditors continue to conduct conformance auditing, when they need to move to effectiveness auditing (Kausek 2006:23 and Hudson 2008:32), which is how WSV performs verification and Annual Inspection. This creates a lack of effective feedback from the audit/review loop which will ultimately delay the ability of the organisation to develop their SMS. This may account for the MHF Annual Inspection findings (Chapter 5) of stronger implementation results than operability, for both control measures and SMS elements. The need for the auditing process to evolve to support SMS development, also adds weight to the argument for using the control measure/SMS element linkage to improve auditing from conformance verification to effectiveness confirmation.

This cross-case analysis and the sector analysis presented in Chapter 5 have highlighted several factors affecting the development of SMSs and the importance of detecting and rectifying SMS deficiencies to achieve an MHF licence. The cross-case analysis showed that sites can progress through the four SMS development stages (design, implementation, operation and maintenance). As discussed in the next section, management engagement and employee involvement, were shown to be especially important factors in SMS development and ultimately MHF compliance.

### 8.15 Conclusions

In this comparative analysis chapter, the progress of seven Victorian MHFs was examined as they attempted to gain a five-year unconditional MHF licence for the first time, and again when this first licence was due for renewal. Of the seven MHFs studied, two received five-year unconditional licences, one received a five-year conditional licence, three received reduced-term licences and one was refused a licence, ceasing operation as an MHF. One of the recipients of the five-year unconditional licence was an industry leader from the outset and maintained this position throughout the period studied. The other recipient of the five-year unconditional licence began the process as a ‘lagger’ with significant management opposition to the MHF Regulations, yet finished the process highly engaged with the regulations and with a fully developed SMS.
From these very different licence outcomes, it can be concluded that WSV did not ‘rubber stamp’ all sites with five-year unconditional licences; rather WSV used a range of regulatory tools throughout the Safety Case development and licensing process to encourage sites to prevent major incidents and receive the ultimate goal of a five-year unconditional licence. The importance of the SMS’s development stage and the extent of auditing at the time of licensing were shown. However the site’s starting point was not shown to be a determinant of the licensing outcome, but rather an indication of the amount of work ahead for the MHF to fully develop their SMS.

Examination of the seven cases, their different starting points and processes taken to achieve compliance with the MHF Regulations, highlighted the four stages of the SMS Development Model, the importance of identifying and understanding which SMS stage a site is at, and the important factors which assist progression. These were shown to be:

- Senior management engagement with MHF compliance,
- Site management capability and employee representation,
- Acceptance of the MHF Regulations and the regulator,
- Employee involvement in, and ownership of, the SMS,
- Active search by management for opportunities to improve the SMS,
- A clear understanding of the strengths and weaknesses of the present stage of SMS development,
- Appropriate plans for SMS development taking account of time and resources,
- Appropriate use of external resources to ensure internal ownership of the SMS,
- Development of a site-specific SMS, rather than use of a generic SMS or ‘standard’,
- Integration of the SMS into other management systems,
- Effective internal auditing which changes in key respects as the SMS develops,
- Adequate resourcing for the SMS, and
- Management of external influences to minimise disruption and distraction.

Were some factors more important than others? While the data from the case studies do not allow weightings to be assigned to each factor, it is clear that senior management engagement with MHF compliance coupled with management acceptance of the MHF Regulations and the regulator was critical to sustaining development of the SMS and ultimately MHF compliance. Equally a negative approach by management did not facilitate the development of the SMS or MHF compliance. Management’s support, or otherwise, influenced resource allocation and the timeliness of decisions impacting the SMS. Hence without management support, the SMS will not progress, so management’s
engagement with MHF compliance, and acceptance of the MHF Regulations and the regulator are the most important factors.

Employee involvement, leading to ownership, of the SMS is also critical for all stages of SMS development, as without employee acceptance of the SMS, it will not be used on a day-to-day basis, hence rendering the SMS less effective or even useless.

Having a clear understanding of the current SMS development stage, including its strengths and weaknesses is crucial to ensure any further planned development of the SMS is appropriate, including the allocation of necessary resources and time.

Effective internal auditing that changes with the SMS’s development stage is also critical to provide feedback on the establishment of each stage of the SMS. Without this feedback, lack of progression or even deterioration is likely in the SMS. Auditing assists in identifying and understanding the strengths and weaknesses of the current SMS development stage.

Driving the process dynamic in these cases was an evolving relationship between WSV (the custodian of the regulations and the licensing body) and the MHFs. It is clear from the seven cases that this relationship evolved in different ways, starting (and staying) positive in some ‘leaders’, becoming positive in others, and consistently staying negative in some ‘laggers’.

Linked to this process dynamic was the site’s ability to learn from their assessment and licensing experience and modify (if necessary) their activities and processes to retain and renew their licence. Sites demonstrating this learning ability, coupled with sustained improvement, received full-term licences in Round 2. Overall the case studies have highlighted the positive and negative factors which impact SMS development and ultimately MHF compliance.

Finally, the licensing process itself must be placed under scrutiny. While clearly a tough test, it functioned best in two ways – by setting substantive and time-line targets for MHFs, and as a potential threat if licensing might be withheld. However five-yearly licensing reviews do not, by themselves, allow the regulator to scrutinise ‘maintenance’. This occurred through Annual Inspections which consistently unearthed SMS deficiencies in even the best MHFs. Two conclusions follow. First, in this time period the research found no MHFs that were capable of self-managing their SMS, thus leaving risks unattended. Second, the licensing process, while necessary to stimulate SMS development, was not sufficient to make it stick.
CHAPTER 9

CONCLUSIONS

9.1 Introduction

The Esso Longford gas plant fire and explosion on 25 September 1998 killed two people, injured eight others, and cut gas supplies to most of Victoria for twenty days, disrupting businesses and households. The Royal Commission that investigated the incident found that the regulatory regime governing Victoria’s 47 Major Hazard Facilities (MHFs) treated them no differently than any other business, taking no account of the special dangers they could pose. The Victorian government, under significant community pressure, acted firmly in response to this finding. Major Hazard Facility Regulations were promulgated in July 2000. These regulations created tough new tests requiring MHFs to be licensed if they were to continue handling dangerous (Schedule 1) materials. In particular each MHF had to develop a Safety Case and a Safety Management System (SMS) which would eliminate, as far as possible, all major incident risks. A two-year period was allowed for MHFs to demonstrate compliance with these regulations. Afterwards each MHF was also subject to an Annual Inspection. Victoria had changed from having no special regulation of MHFs to having perhaps one of the toughest MHF regimes in the world.

This thesis is concerned with the implementation of these new regulations. It asks, how well did Victoria’s 47 MHFs perform in attempting to achieve compliance within two years with strict regulations requiring a Safety Case and prescribing an SMS; whether SMS development was fully achieved; and what factors affected MHF performance in meeting regulatory requirements? These are important policy questions at three levels.

First, there has been little previous research on how businesses manage compliance with MHF regulations. Similar schemes exist elsewhere in the world. However there has been little primary research to investigate what impact those schemes have upon industry, whether regulatory requirements are adhered to, and whether SMS development is complete.
Second, policy compliance is inherently important if the purpose of the regulations is to be achieved and the risk of incidents minimised in MHFs. Regulations serve no purpose if they are ignored, and it is a matter of public interest for research to throw light on this.

Third, since the Victorian MHF Regulations are arguably some of the most stringent in the world, an investigation of compliance with them holds special interest for policy makers elsewhere. Not least, it can be asked if these regulations are a practical template for other regulatory jurisdictions.

Compliance with the new MHF Regulations was essentially about the capacity of management to meet a challenge imposed by the government. But it was also about a set of relationships – between management, its advisors and consultants, the workforce (and its representatives), and the regulator (especially the Major Hazards Unit formed to administer the regulations). While this thesis is concerned with the licensing outcome, it is also concerned with the actions of management, and with the interactive process between management and these other agents that lie behind the licensing outcome. How well-prepared was management for the new regulatory environment, and how did it work with external advisors, its workforce, and the regulator to craft an acceptable Safety Case and a sound SMS? This thesis aims especially to highlight these underlying social dynamics, for it is here that the strength or weakness of the regulatory scheme is determined.

### 9.2 Shaping the Victorian MHF Regulations

The Victorian MHF Regulations were not drafted in an intellectual vacuum. They were constructed on the basis of ideas drawn from a number of different sources. Chapter 2 set the scene by looking at a number of influential sources. It examined the term 'major incident' which was defined as ‘an uncontrolled incident, including an emission, loss of containment, escape, fire, explosion or release of energy, that (a) involves Schedule 1 materials, and (b) poses a serious and immediate risk to health and safety’. Causal analysis of major incidents over time showed control measures were not in place in earlier major incidents due to a lack of understanding of the potential hazards. This situation has changed, with greater hazard awareness and implementation of control measures. However, in later major incidents, the control measures were not sufficiently effective when required to avert a major incident. Theoretically the SMS should manage control measures and ensure their effectiveness. A pattern can be discerned in the evolution of MHF regulation overseas in which a ‘cause’ (usually a major incident) was
followed by the ‘effect’ (state regulation to prevent recurrences). This pattern was tracked from Flixborough (UK, 1974 leading to the CIMAH Regulations) to Pasadena (USA, 1989 leading to OSHA Process Safety Management). Victoria too followed this pattern of ‘cause’ (the Longford major incident) and ‘effect’ (the Victorian MHF Regulations). But it did so well behind many other regulatory jurisdictions, which meant it could learn from them. Since Flixborough, much had been learnt regarding the complex nature of major incidents and the all too common contribution of ineffective SMSs to the major incident. The distinguishing features of the Victorian MHF Regulations are a mandatory licence to operate and a finite time for the regulator to determine its satisfaction, or otherwise, with the submitted Safety Case. These were supported by Annual Inspections by the regulator to check the SMS.

Chapter 2 also introduced another influential strand of thought that underpinned the Victorian regulations – the concept of a Safety Management System. This was defined as ‘that part of the overall management system which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the OHS policy, and so managing the risks associated with the business of the organisation’ (AS/NZS 4801:2001, 4). This central plank of the Victorian regulations, built upon experiences in many parts of the world that had been captured in the extensive OHS literature. But it was also underpinned by concepts developed in the quality management/quality assurance literature about continuous improvement cycles.

Chapter 3 introduced another set of factors that influenced the Victorian MHF Regulations - the local political context. First it noted the public outrage caused by the Longford explosion, and the pressure this placed upon government to act. Then it examined the Longford Royal Commission. That inquiry introduced a cautionary note about the value of Safety Management Systems. Esso at Longford had what was considered to be a ‘world class’ SMS, but it was not operationalised in practice. The Royal Commission cautioned against such ‘paper’ systems, with the majority of its recommendations directed towards preventing MHF Safety Management Systems degenerating in this way. These concerns were reflected in the regulations that followed. First they imposed duties on MHF operators (to have an SMS, conduct hazard identification, safety assessment and demonstrate the adequacy of control measures). But in addition the regulations compelled operators to ensure their SMS was put into practice. Operators had to submit a satisfactory Safety Case (to gain a licence to operate) and then submit to periodic audits and checks. While MHF operators had
discretion about how they might manage risk, in the end they had to satisfy the regulator that they could do so effectively.

Drawing together the findings from these two chapters illustrated how ideas from a number of sources were blended into regulations which lifted the regulatory bar to a high level. MHF operators were given two years to get over this bar.

9.3 Research Methods

The research questions posed in this thesis ask how well did the 47 MHFs perform in attempting to satisfy the challenging requirements of the MHF Regulations, whether SMS development was fully achieved, and what factors affected their performance. An empirical investigation of these questions raised several methodological issues. These were considered in Chapter 4 which described the research concepts and methods employed in this thesis.

To begin with, a conceptual model was developed against which the MHFs' performance in SMS development could be assessed. The SMS Development Model was mentioned in Chapter 2 and fleshed out in Chapter 4. It stems, with adaption, from Deming. It also aligns with the substantive SMS requirements of the Victorian MHF Regulations. It serves the purpose of providing a model against which the performance of the MHFs can be assessed over time as they implemented change.

This chapter also deals with empirical issues. This thesis is concerned with developments in 47 MHFs. Can empirical research be conducted for all these sites? The population size – 47 – was sufficiently small that some empirical data could be collected for every site, however it was too large to permit intensive case-study research. To gain the best of both worlds (examining the whole population while also doing intensive research in a sub-group of cases) a multi-method approach was taken.

First, all 47 MHFs were examined using data that grouped them into four industry sectors. These sectors were Petroleum, Plastics & Chemicals, Logistics, and Utilities. This sectoral classification was made by the regulator in its dealings with the MHFs to meet the criticism that MHFs differed greatly, and that direct comparison should only be made with industry peers. The number of MHFs examined in the sectoral analysis fell to 39 as six sites withdrew from the licensing exercise (one for commercial reasons and five reduced their quantities of Schedule 1 materials below the MHF threshold), one
greenfield site commenced operations and four sites administratively deregistered and re-registered as one site. The sectoral analysis examined how well each MHF progressed (reported at a sector level) through the four stages of the SMS Development Model (design, implementation, operation, and maintenance). Data supporting this analysis came from several sources including a survey of all MHFs (the Sweeney survey), a survey by the Hazard Management Division of WorkSafe Victoria, the administrative records of WorkSafe Victoria, and Annual Inspection data gathered for each site by WorkSafe Victoria. While these data clearly identify licensing outcomes, and sectoral performance information for SMS development stages, they have little value in exposing the variables and social dynamics that shaped these end results. A second data collection method was used for this purpose.

This second approach involved case studies. The aim of these case studies was to explore in detail the role of management and of its interactions with other agents in shaping SMS development and licensing outcomes. Seven cases were selected (using the data in the sectoral analysis) to offer a range of outcomes that could expose different types of social dynamics. Four ‘laggers’ were chosen from the 39 possible cases, selected because they had licensing difficulties (and were granted reduced-term licences or refused a licence). In addition three ‘leaders’ were chosen because they were granted full-term licences. The seven cases exhibited considerable diversity. They spanned three sectors (excluding Petroleum); varied in process complexity from simple storage to complex manufacturing; ranged in size from 13 to 300 employees; and had different environmental settings on matters such as corporate know-how and prior SMS experience. Some were well-prepared for the new regulations and others were not. Empirical data for the seven cases focussed mainly on the two-year period when initial Safety Cases were prepared to support licensing applications. However, the story did not end there in many cases, and so was tracked for up to a further seven years. Multiple data sources were used including WorkSafe Victoria data and files, information supplied by MHF management, data gathered from interviews with managers, contractors and staff, some survey data, and some public domain information (for example conference presentations). This researcher also worked for WorkSafe Victoria’s Major Hazards Unit (and later for the Hazard Management Division) during this period and was directly involved in some Safety Case assessments, site inspections and discussions, licence panels and Major Hazards Advisory Committee meetings.

The multi-method approach adopted in this thesis allowed both a general overview of SMS development and licensing outcomes under the new regulatory regime. It also
allowed a more thorough analysis of the deeper social dynamics at work as MHFs adapted to the new regulations. Inherent in the ‘multiple’ case study method (three ‘leaders’ and four ‘laggers’) was the opportunity for cross-case data comparisons in which inductive analysis could be applied to draw out any significant underlying data patterns.

9.4 Research Findings – The Sectoral Analysis

One of the main aims of the sectoral analysis was to track progress through the four stages of SMS development (design, implementation, operation and maintenance) using sectors rather than individual MHFs as the unit of analysis. The four sectors differed. In general, Petroleum was best-prepared at the beginning, and progressed best through the four stages; conversely Logistics did least well. Plastics & Chemicals and Utilities were both in the middle. Sectoral differences suggest a range of factors that might influence voluntary SMS development including process complexity and corporate support. However these were not a major focus of the thesis.

In general the 39 remaining MHFs that proceeded with licensing performed best at the first SMS development stage, and then progressively worse throughout the later stages. The ‘design’ stage appeared easy for many firms because they had prior experience with voluntary SMSs (82% of survey respondents). However two cautionary points must be made here. First, some without an existing SMS struggled with design because the MHF Regulations gave them an incomplete system blueprint which some erroneously followed. Second, the case studies showed some existing SMSs to be inoperative in practice, and a poor basis on which to build. The design stage did pose difficulties for many MHFs.

Implementation was examined by looking at WSV verification of the extent of SMS implementation. In the initial two-year period this revealed so many problems (in almost half of all cases submitted the operator was not fully implementing the SMS) that a six-month extension provision was enacted. After this time, most managed to gain full-term licences but seven did not (five received reduced-term licences and two refusals, one of which was later granted for a reduced-term following appeal). These results show SMS development to be a critical variable in achieving MHF compliance. The significance of SMS deficiencies was the additional time needed to implement improvements versus the remaining regulatory time before a licence decision was required. By 2004 and
Conclusions

2005 further WSV Annual Inspections were still exposing a shortfall in SMS element and control measure implementation.

Operation involves the performance of functions following SMS implementation. In general the MHFs performed the ‘operation’ stage worse than implementation. A deficient operating SMS implies that the barriers between the hazards and a potential major incident cannot be relied upon to perform effectively at all times. This could possibly give the MHF a false sense of safety if they are unaware of the operational deficiencies (as was shown in Chapter 2 to be the cause of many major incidents). Incidents and enforcement notices from 2002 to 2005 revealed a far from perfect record in converting SMS principles into actual practice. However, a small downward trend in incidents was discernible.

Maintenance involves auditing SMS performance and checking that recommended corrections have been made. By 2005 this was the weakest area of all – although in many cases MHFs were ill-prepared for auditing because progress through the earlier stages was still incomplete. Internal auditing was especially problematic, showing that the MHFs were – as a group – ill-prepared for self-regulation, thus validating the continued need for close regulatory inspection.

The sectoral analysis revealed two contrasting findings. The first was that all but seven of the 39 MHFs had implemented their SMS sufficiently to gain a full-term licence. Any licence delay or refusal was sufficient to show that the process was not automatic, and that the regulator was prepared to use its teeth. It follows that the success of the great majority of MHFs indicates a significant accomplishment in meeting the aims of the regulations. It is reasonable to conclude that the vast majority of MHFs worked hard to gain licences.

The significance of this accomplishment was tempered by the second finding – of faltering progress through the four-stage SMS Development Model. While most MHFs had an SMS which could be verified, too often it was not in full ‘operation’ in a practical sense. Too often external auditing revealed risks suggesting internal auditing was undeveloped or unreliable. Despite gaining licences in 2002/3, by 2005 many MHFs still had much work to do to establish dependable SMSs.
9.5 Research Findings – The Case Studies

The four ‘lagger’ cases, described in Chapter 6, all failed to gain a full-term licence to operate. Conversely the three ‘leaders’, described in Chapter 7, all succeeded in gaining a full-term licence.

Case Study 1 (‘lagger’) – a small utilities depot - began reasonably well. However, when WSV began to audit, a different story unfolded. The SMS was not functional and management (believing the SMS was sufficient) was resistant to change. Dialogue between management and WSV faltered and then broke down. Last-minute provision of skilled resources and policy changes were insufficient to forestall licence refusal, which management did not appeal, and significantly reduced operations at the site.

Case Study 2 (‘lagger’) – a medium-sized chemical manufacturer – had an old SMS that had not been maintained. As hazard identification had not been performed for some time, many uncontrolled hazards were initially identified. WSV verification revealed a highly under-developed SMS; and a management team with too few resources to tackle the demands of rectifying the SMS. Last-minute management efforts to redeem the situation resulted in a short-term licence (18 months). Throughout this process, tensions existed between the two international co-owners, one who was willing to pay for improvements and the other who was not. In 2002 the improvement-focused owners were bought out, hardening the climate against change. In 2004 licence renewal was problematic leading to a process of refusal, appeal, and the granting of a further short-term licence. Finally a blockage in the supply of Schedule 1 materials prompted the firm to deregister as an MHF.

Case Study 3 (‘lagger’) – a small chemical manufacturer – had no prior experience of a formal SMS and a tendency towards informal management practices that inhibited adaption to the new regulatory requirements. Further complications arose during the licensing period including a change of ownership and of some key management personnel. Once settled, resources were made available and a short-term (two-year) licence was granted. Monthly monitoring followed after which Case 3 gained a full-term licence. However, tendencies to system decay still existed. A 2007 inspection found just 30% of control measures were fully implemented and operational, and Case 3 narrowly avoided having its existing licence suspended.

Case Study 4 (‘lagger’) – a large chemical manufacturer – initially appeared to have a well-advanced SMS. Verification of the SMS by WSV exposed a significant divorce
between the SMS on paper and in practice. Not least, the SMS was controlled by the HS&E Department and separated from operations management. It took some time for WSV to identify safety shortcomings because of plant complexity and management confidence. Once they were identified, insufficient time remained for the SMS to become compliant at a level for full licensing. On the brink of licence refusal, the management team accepted the need for radical action. A reduced-term licence (three years) was granted with conditions which were duly met. A full-term licence was granted at renewal.

Case Study 5 (‘leader’) - a medium-sized logistics facility – began poorly, with a deficient SMS and a Managing Director / Owner in vehement denial that more was needed. Moreover, prior management personnel departure had left this system ‘shelved’. WSV visits discovered deficiencies which angered the Managing Director who perceived nothing more than regulatory burden. Half-hearted efforts and a poorly-selected consultant left the firm badly-positioned to achieve compliance. However a new Safety and Quality Manager rescued the situation by developing the SMS in conjunction with yard personnel, who better understood operational requirements and hazards. Employee ‘ownership’ of the SMS went far to demonstrating that it was fully viable and not a ‘paper’ system. Synergies with the existing quality management system were identified and the two systems were promptly integrated, leading to efficiency gains. As a result, the Managing Director changed from reluctant compliance to championing the new regulations as a source of his firm’s unique competitive advantage (by implication publicly challenging his less-advanced competitors). Case 5 received consecutive full-term licences.

Case Study 6 (‘leader’) - a medium-sized logistics facility – began with a strong apparent starting position, with a well-developed SMS. However it did not stand up to WSV scrutiny which exposed lax attention to detail in the system and its implementation. Progress towards rectification was then obstructed by a change of corporate ownership, new management, and the introduction of an entirely new corporate SMS. A licence inquiry was held in anticipation of licence refusal. However last-minute submissions to the regulator led to the award of a five-year licence. Management’s commitment was validated when an Annual Inspection two years after licensing yielded a perfect score. All aspects of the SMS were fully implemented, operational and maintained.

Case Study 7 (‘leader’) - a medium-sized chemical manufacturer - handled highly flammable and carcinogenic materials. It was the only case examined in this thesis that
started, progressed, and finished well in terms of SMS development. A voluntary SMS was in place long before the regulations, supported by management and personnel with a strong commitment to safety. The new regulations were welcomed and adopted. Overseas advice was sought about Safety Case development. The site became one of three Safety Case Exemplars (another being Case 1). The challenge for Case 7 was to adapt its SMS to meet regulatory requirements. SMS gaps were found (such as audit ownership) but rectified without difficulty or delay. Similarly, safety inspections revealed hazards that were promptly fixed. A full licence was granted. Subsequent WSV inspections found elements of system failure (such as incomplete audits), suggesting that even the best cases may be less than perfect, and that without external inspection, problems may develop and go undetected.

The seven case studies briefly summarised here were selected to capture a range of licensing outcomes. One surface finding was that those who start well do not always finish well, and vice versa. Thus Cases 1 and 4 both claimed an established SMS, but ended up as ‘laggers’ with licensing problems. Conversely, Case 5 began without a credible SMS and publicly opposed to the new regulatory burden, but ended up fully licensed and a strong industry advocate of the positive benefits of the regulations. Complex social dynamics are suggested by these changes in direction.

9.6 Research Findings – The Comparative Analysis

A cross-case or comparative analysis of the seven case study sites was undertaken looking at data under 12 categories. These were introduced in Chapter 4 and applied in Chapter 8 after development largely by inductive analysis. These categories are mainly input variables possibly affecting SMS development and MHF compliance. They are:

- **Initial preparedness** (prior SMS existence, exemplar status, or access to overseas corporate guidance);
- **Site management capability and employee representation** (senior management site-presence, access to SHE professionals, as well as employee representation and participation);
- **Initial management acceptance of the MHF regulations and the regulator** (willingness to work with the regulator may affect the capacity to adapt to the regulations);
- **Initial SMS development stage** (the process of regulatory adaption can be aided or hindered by prior levels of experience and expertise);
• **Plans for SMS development** (well-grounded and constructed plans may have a major impact on subsequent development);

• **Use of external management resources** (use of effective consultants in a manner which maintains site ownership);

• **Site-specific SMS development** (regulatory adaption may be aided where management have the ability to adapt corporate or other ‘off-the-shelf’ systems and involve employees in operationalising the SMS);

• **Regulator evaluation of SMS deficiencies** (sites with fewer deficiencies or which responded positively to their identification experienced less friction and delay in dealing with the regulator and could learn more easily);

• **Internal auditing** (more developed auditing practices with skilled auditors strengthened the SMS);

• **MHF licensing outcomes** (both an ‘outcome’ and a stage in the process dynamic, particularly for sites that did not gain a full-term licence, and for all sites considering licence renewal);

• **Management acceptance of the MHF Regulations and the regulator – during and post-Safety Case** (responsiveness to WSV concerns throughout the assessment and licence period, ability to rectify issues unassisted, and the ability to self-initiate improvements, or the realisation that major incident prevention is serious through near-miss events, may affect the capacity to adapt to the regulations); and

• **External influences on MHFs** (including changes in company ownership, restructuring, down-sizing and disruption to supply chains).

The data reported in Tables 8.1 to 8.12 show that only four of these variables (plans for SMS development, regulator evaluation of SMS deficiencies, internal auditing and licensing outcome) align closely with ‘leader’/‘lagger’ status. This should not be surprising given their particular nature. While there may be some movement between the sites awarded the middle rankings for many of the other factors, the emergence of the two extremes of the best ‘leader’ (Case 7) and the worst ‘lagger’ (Case 1) are apparent in the summary tables 8.14 to 8.16. What is more important is the fact that ‘leaders’ (who received full-term licences) could overcome a poor ranking on the other variables and ‘laggers’ (who were not fully licensed) sometimes scored well. While these variables do seem to be important, they function in a contingent rather than mechanistic manner. In particular, management could determine their own fortunes (sometimes quite quickly) if they managed in a certain way. For example, initial acceptance of the regulations and the regulator does help in some cases, but late
converts can make up for lost time, and initial enthusiasts may be incompetent in other critical areas.

Analysis of management suggests 13 factors which appear to assist (or retard) their ability to adjust to the regulations. These factors are:

1. Site management capability and employee representation;
2. Senior management engagement with MHF compliance;
3. Acceptance of the MHF Regulations and the regulator;
4. Employee involvement in, and ownership of, the SMS;
5. Active search by management for opportunities to improve the SMS;
6. A clear understanding of the strengths and weaknesses of the present stage of SMS development;
7. Appropriate plans for SMS development taking account of time and resources;
8. Appropriate use of external resources to ensure internal ownership of the SMS;
9. Development of a site-specific SMS rather than use of a generic SMS or ‘standard’;
10. Integration of the SMS into other management systems;
11. Effective internal auditing which changes in key respects as the SMS develops;
12. Adequate resourcing for the SMS; and
13. Management of external influences to minimise disruption and distraction.

As initial preparedness was not shown to significantly influence the outcome, no factor was identified from this heading. It is too simplistic to conclude management are either capable, or they are not, and that alone determines the outcome of the licensing process. There are more complex factors at work. The difficult challenge of implementing the new regulations set management many hurdles which could prove impassable if there were shortfalls in the above-mentioned factors. While all these factors can – in different cases and with different weightings – play their part in facilitating or obstructing SMS development and adaption to the regulations, it appears that some factors are of greater importance than others.

First, senior management engagement with MHF compliance was critical to sustain SMS development, and ultimately MHF compliance. Management determine resource allocation and timeliness of decisions impacting the SMS and other MHF compliance activities. Hence without senior management engagement, the SMS will not progress.
Second, management acceptance of the MHF Regulations, and of the regulator, was critical in determining whether the adaption process was positive or, at its worst, toxic. Senior management provided legitimacy to the regulations and the associated activities. Without positive support from this quarter, SMSs will develop poorly. In the most positive cases management learned avidly from the regulator, and sought out the benefits an SMS could bring.

Third, employee involvement in the SMS’s development encourages employee ownership of the SMS. Without employee understanding, involvement and acceptance of the SMS, it will not be used on a day-to-day basis, hence rendering the SMS less effective or even useless.

Fourth, a clear understanding of the strengths and weaknesses of the present stage of SMS development is crucial to ensure any further planned development of the SMS is appropriate. This includes allocating appropriate resources and time.

Fifth, effective auditing provides feedback on the establishment of each stage of the SMS. Without this feedback, lack of progression or even deterioration is likely in the SMS. This thesis has shown the success of modifying the auditing techniques (moving from conformance to effectiveness auditing) as the SMS develops.

Central to the process dynamic in all cases was an evolving relationship between WSV (the custodian of the regulation and also the licensing body) and the MHFs. The path along which this relationship would develop was not pre-determined. Rather it evolved as the parties grew to know each other better, and to adjust to their new (if different) responsibilities under the regulations. In some instances the relationship was (or became) positive, and in others it did not. Linked to this was a process of organisational learning in which the MHFs gained information from site inspections, Safety Case assessments and the licensing experience, and modified their behaviour in goal-oriented ways.

In conclusion, Victoria’s 47 MHFs attempted in different ways to achieve compliance with the MHF Regulations, with a range of outcomes. Some were successful from the beginning (such as Case 7), others took several attempts to succeed (such as Case 3), some learnt quickly (such as Case 5), while others gave up (Case 1). Their individual efforts have provided comparative data which allowed the identification of factors which facilitate, or militate against, SMS development and ultimately MHF compliance. It is
suggested that this research also has direct application to the regulation of MHFs in other jurisdictions.

9.7 The Research Questions Revisited

At the beginning of this thesis a set of questions were posed about the implementation of Victoria’s MHF Regulations. This chapter has summarised the nature of those regulations; the process of their development; the conceptual model and research methods for exploring these questions; and the sectoral and case study data that can throw light on them. From this analysis some central findings have emerged.

First, the key distinguishing plank of the regulations (a licensing regime requiring an SMS) appears to have been generally effective in compelling Victorian MHFs to develop Safety Cases and SMSs in a short time-frame.

Second, however, the licensing process – while tough enough to close some operations, was also relaxed to allow through SMSs which were incomplete in terms of the SMS Development Model, and which had persistent flaws exposed by Annual Inspection. Licensing was, by itself, insufficient to ensure robust SMSs and required the companion device of Annual Inspection.

Third, a complex and lengthy set of factors affected SMS development up to the point of licensing. Most of these factors appear to be of contingent importance in the sense that they are not essential to a licence outcome, but help. For this reason a mechanistic analysis of key variables is not helpful.

However five variables do seem to matter more than others, these being:

- Senior management engagement with MHF compliance,
- Positive relationship with the regulator (and with this, acceptance of the MHF Regulations and role of the regulator),
- Employee involvement in SMS development,
- A clear understanding of the strengths and weaknesses of the present SMS development stage, and
- Effective internal auditing.
9.8 Longford’s Legacy – Changes to MHFs in Victoria

Due to their low-likelihood, major incidents are hard to predict accurately and are statistically difficult to analyse. For example, does a five-year period without a major incident show statistically that industry has improved? Such data are likely to be inconclusive. What is clear, is that Victorian Major Hazard Facilities have been forced, through regulations and their enforcement by the regulator, to focus on understanding how major incidents could occur on their site and to understand the possible consequences of such an event. All Victorian MHFs now have a Safety Management System (which was not the case in 2000), that incorporates the processes that identify hazards, assess their possible likelihood and consequences, and ensures control measures are put in place to eliminate, as far as possible, such risks.

The case studies clearly illustrated that change is possible, both from ‘lagger’ to ‘leader’ (Case 5) and ‘leader’ to ‘lagger’ (Case 4). The Annual Inspection of licensed facilities clearly showed deterioration is also possible between licences, as is improvement. The tight regulatory timelines, coupled with mandatory licensing, drew a line in the sand (both in terms of deadline and level of achievement), beyond which the regulator would not negotiate (as demonstrated by Case 1). The ability to appeal to an independent body (VCAT) provided the operator with one further opportunity to show improvement (as demonstrated by Case 2), beyond which removal of Schedule 1 materials (which to most meant site closure) was the only legal option (Case 1).

Beyond Longford, the implementation of the Victorian MHF Regulations has shown a change in industry’s safety mind-set is possible. Sites, such as Case 5, have shifted from disbelieving anything like the Longford major incident could happen at their premises, to fully understanding how a major incident could occur, what control measures are needed to prevent the incident from occurring, and what safety management processes should exist to ensure all these aspects continue to function effectively into the future. The Longford major incident, the resulting regulations and their enforcement have shown that writing a Safety Management System is not enough; it is only through full implementation, operation and maintenance, that the SMS becomes an integral part of the business and its effectiveness is realised.
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APPENDIX A - DEFINITIONS

Definitions

For the purpose of this study, the following definitions will be applied:

**Design stage** is the theoretical plan, purpose and intention of a model to establish an SMS. This is introduced in the SMS Development Model in Chapter 4 and investigated in Chapter 5.

**Implementation stage** is the ‘putting into effect’ of the design plan and procedures for an SMS. This is introduced in the SMS Development Model in Chapter 4 and investigated in Chapter 5.

**Operation stage** is the actual performance and discharge of functions following implementation of an SMS. This is introduced in the SMS Development Model in Chapter 4 and investigated in Chapter 5.

**Maintenance stage** is the need for procedures and practices to be in place to facilitate the effective and efficient continuation of existing operational functions and systems in an SMS. This is introduced in the SMS Development Model in Chapter 4 and investigated in Chapter 5.

**Implemented (control measure or SMS element)** is the item being in place, available and understood. This is discussed further in Chapters 4 and 5.

**Operable (control measure or SMS element)** is the item achieving its intended purpose, i.e., on-going use on demand, at the stated performance level and failures identified and rectified. This is discussed further in Chapters 4 and 5.

**Major Hazard Facility** (MHF) is a site producing, consuming, storing or handling Schedule 1 materials (see Appendix B). Examples of MHFs include oil refineries, chemical plants and dangerous goods warehouses. To be classified as an MHF, a site must hold or be likely to hold a given quantity of Schedule 1 materials at or above specified threshold levels (see *Schedule 1 materials* for the calculation to classify an MHF). MHFs are discussed further in Chapter 2.
**Major Incidents** are ‘uncontrolled incidents, including an emission, loss of containment, escape, fire, explosion or release of energy, that (a) involve Schedule 1 materials (see Appendix B), and (b) pose a serious and immediate risk to health and safety’ (MHF Regulations 2000:4). Major incidents are described further in Chapter 2.

**MHF Regime** is a jurisdiction where legislation regarding major incidents and their prevention and control has been introduced. MHF regimes are discussed further in Chapter 2.

**Safety Case or Safety Report** is a document prepared by the operator of a Major Hazard Facility to demonstrate that their facility is safe to operate i.e., that there are adequate measures in place to prevent a major incident and to mitigate the consequences of any major incident that may occur (VWA 1999a:10). The contents of the Safety Case or Report may be prescribed by law and varies between jurisdictions (Heiler (2006:6-8), Hopkins (2000:96) and Maguire (2006:3-5)). The terms ‘Safety Case’ and ‘Safety Report’ can be used interchangeably (RLRC 1999:14.30) and will be referred to as a **Safety Case** in this study to be consistent with the terminology of the MHF Regulations. Safety Cases are discussed in more detail in Chapters 2 and 3.

**Safety Management System** (SMS) is ‘that part of the overall management system which includes organisational structure, planning activities, responsibilities, practise, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the Occupational Health and Safety (OHS) policy, and so managing the risks associated with the business of the organisation’ (AS/NZS 4801:2001:4). SMSs are discussed further in Chapter 2.

**SafetyMAP** (Safety Management Achievement Program), developed by VWA in 1994, is an audit and review tool for SMSs. SafetyMAP, now in its fourth edition (2002), is aligned with the Australian Standard for Occupational Health and Safety Management Systems AS/NZS 4801:2001 and provides for voluntary third-party certification through two certification levels, Initial and Advanced.

**Schedule 1 materials** are identified in a list of hazardous chemicals and specified threshold quantities which are used to categorise a workplace as a Major Hazard Facility. A workplace is an MHF when the amount of Schedule 1 material divided by that material’s listed threshold quantity exceeds one. If there is more than one material, the
individual ratios are added together and if the summation exceeds one, the workplace is an MHF. Schedule 1 materials for Victoria are listed in Appendix B.

**Statute** is a legislative enactment passed by Parliament, such as the *Occupational Health and Safety Act 1985* (Vic). A statute may provide for the introduction of **subordinate legislation** (regulations) which supports the intent of the statute and is promulgated by the Executive Government through the Governor-in-Council (a meeting of the Governor with a number of ministers of the Government). The scope of any regulation must be consistent with, and cannot exceed, the power created in its authorising statute. Regulations are laid before the legislature, for approval by the full Parliament. An example of subordinate legislation is the *Occupational Health and Safety (Major Hazard Facilities) Regulations 2000* (Vic), made under the *Occupational Health and Safety Act 1985* (Vic).
APPENDIX B – SCHEDULE 1 MATERIALS


MATERIALS AT MAJOR HAZARD FACILITIES (AND THEIR THRESHOLD QUANTITY)

1. Relevant materials
The materials which characterise a workplace as a facility for the purposes of the Victorian MHF Regulations are the materials specifically mentioned in Table B.1 and materials that belong to the types, classes and categories mentioned in Table B.2.

2. "Threshold quantity" of one material
(1) In relation to each such material, the third column of each Table provides a quantity that is described as the "threshold quantity" of that material.

(2) Where a material is mentioned in Table B.1, the threshold quantity of the material is that described in Table B.1, whether or not the material also belongs to a type, class or category mentioned in Table B.2.

(3) Where a material is not mentioned in Table B.1, and where the material belongs to a type, class or category mentioned in Table B.2, the threshold quantity of that material is that of the type, class or category to which it belongs.

(4) Where a material is not mentioned in Table B.1, and where the material appears to belong to more than one of the types, classes or categories mentioned in Table B.2, the threshold quantity of that material is that of the relevant type, class or category which has the lower or lowest threshold quantity.

3. "Threshold quantity" of more than one material
If there is more than one material, a threshold quantity of materials exists where, if a number of materials are present, the result of the following aggregation formula exceeds 1:
\[ q_x + q_y + \ldots + q_n \]
\[ Q_x + Q_y + Q_n \]

Where--
- x, y, ... and n are the materials present or likely to be present;
Appendix B – Schedule 1 Materials

- qx, qy ..... and qn is the quantity of materials x, y, ... and n present or likely to be present, other than--
  (i) material that is present or likely to be present in an isolated quantity less than 2% of its individual threshold quantity;
  (ii) materials that are solely the subject of intermediate temporary storage, while in transit by road or rail;
- Qx, Qy ..... Qn is the individual threshold quantity for each material x, y ... and n;
- a material is present or likely to be present in an “isolated quantity”, if its location at the facility is such that it cannot, on its own, act as an initiator of a major incident.

**TABLE B.1**
The UN number listed against the named material is given for information only. It does not restrict the meaning of the name, which also applies to materials which fall outside the UN number, for example, because they are too dangerous to transport or are part of mixtures covered by another UN number. However, any materials which are covered by the listed UN numbers must be included in the quantity of the material named.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UN Nos INCLUDED UNDER NAME</th>
<th>THRESHOLD QUANTITY (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACETONE CYANOHYDRIN</td>
<td>1541</td>
<td>20</td>
</tr>
<tr>
<td>ACETYLENE</td>
<td>1001</td>
<td>50</td>
</tr>
<tr>
<td>ACROLEIN</td>
<td>1092</td>
<td>200</td>
</tr>
<tr>
<td>ACRYLONITRILE</td>
<td>1093</td>
<td>200</td>
</tr>
<tr>
<td>ALLYL ALCOHOL</td>
<td>1098</td>
<td>20</td>
</tr>
<tr>
<td>ALKYLAMINE</td>
<td>2334</td>
<td>200</td>
</tr>
<tr>
<td>AMMONIA, ANHYDROUS, LIQUEFIED or AMMONIA SOLUTIONS, relative density less than 0.880 at 15 Deg. C in water, with more than 50 per cent ammonia</td>
<td>1005</td>
<td>200</td>
</tr>
<tr>
<td>AMMONIUM NITRATE FERTILISERS</td>
<td>2067, 2068, 2069, 2070</td>
<td>5000</td>
</tr>
<tr>
<td>AMMONIUM NITRATE, with not more than 0.2 per cent combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance</td>
<td>1942</td>
<td>2500</td>
</tr>
<tr>
<td>ARSENIC PENTOXIDE, Arsenic (V) Acid and other salts</td>
<td>1559</td>
<td>10</td>
</tr>
<tr>
<td>ARSENIC TRIOXIDE, Arsenious (III) Acid and other salts</td>
<td>1561</td>
<td>0.1</td>
</tr>
<tr>
<td>ARSINE</td>
<td>2188</td>
<td>0.01</td>
</tr>
<tr>
<td>BROMINE or BROMINE SOLUTIONS</td>
<td>1744</td>
<td>100</td>
</tr>
<tr>
<td>MATERIAL (continued)</td>
<td>UN Nos INCLUDED UNDER NAME</td>
<td>THRESHOLD QUANTITY (tonnes)</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>----------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>CARBON DISULFIDE</td>
<td>1131</td>
<td>200</td>
</tr>
<tr>
<td>CHLORINE</td>
<td>1017</td>
<td>25</td>
</tr>
<tr>
<td>DIOXINS</td>
<td>--</td>
<td>0.1</td>
</tr>
<tr>
<td>DIPHENYLMETHANE 4,4'-DIISOCYANATE</td>
<td>2489</td>
<td>200</td>
</tr>
<tr>
<td>ETHYL NITRATE</td>
<td>--</td>
<td>50</td>
</tr>
<tr>
<td>ETHYLENE DIBROMIDE</td>
<td>1605</td>
<td>50</td>
</tr>
<tr>
<td>ETHYLENE OXIDE</td>
<td>1040</td>
<td>50</td>
</tr>
<tr>
<td>ETHYLENEIMINE</td>
<td>1185</td>
<td>50</td>
</tr>
<tr>
<td>FLUORINE</td>
<td>1045</td>
<td>25</td>
</tr>
<tr>
<td>FORMALDEHYDE</td>
<td>1198</td>
<td>50</td>
</tr>
<tr>
<td>HYDROFLUORIC ACID SOLUTION (greater than 50 per cent)</td>
<td>1790</td>
<td>50</td>
</tr>
<tr>
<td>HYDROGEN</td>
<td>1049</td>
<td>50</td>
</tr>
<tr>
<td>HYDROGEN CHLORIDE</td>
<td>1050</td>
<td>250</td>
</tr>
<tr>
<td>- Anhydrous</td>
<td>2186</td>
<td>250</td>
</tr>
<tr>
<td>HYDROGEN CYANIDE</td>
<td>1051</td>
<td>20</td>
</tr>
<tr>
<td>- Refrigerated Liquid</td>
<td>1614</td>
<td></td>
</tr>
<tr>
<td>HYDROGEN FLUORIDE</td>
<td>1052</td>
<td>50</td>
</tr>
<tr>
<td>HYDROGEN SULFIDE</td>
<td>1053</td>
<td>50</td>
</tr>
<tr>
<td>LP GASES</td>
<td>1011, 1012, 1075, 1077, 1978</td>
<td>200</td>
</tr>
<tr>
<td>METHYL BROMIDE</td>
<td>1062</td>
<td>200</td>
</tr>
<tr>
<td>METHANE or NATURAL GAS</td>
<td>1971, 1972</td>
<td>200</td>
</tr>
<tr>
<td>METHYL ISOCYANATE</td>
<td>2480</td>
<td>0.15</td>
</tr>
<tr>
<td>OXIDES OF NITROGEN, including nitrous oxide, nitrogen dioxide and nitrogen trioxide</td>
<td>1067, 1070, 1660, 1975, 2201, 2421</td>
<td>50</td>
</tr>
<tr>
<td>OXYGEN</td>
<td>1072, 1073</td>
<td>2000</td>
</tr>
<tr>
<td>PHOSGENE</td>
<td>1076</td>
<td>0.75</td>
</tr>
<tr>
<td>PROPYLENEIMINE</td>
<td>1921</td>
<td>200</td>
</tr>
<tr>
<td>PROPYLENE OXIDE</td>
<td>1280</td>
<td>50</td>
</tr>
<tr>
<td>SODIUM CHLORATE, solid</td>
<td>1495</td>
<td>200</td>
</tr>
<tr>
<td>SULFURIC ANHYDRIDE (Alt. SULFUR TRIOXIDE)</td>
<td>1829</td>
<td>75</td>
</tr>
<tr>
<td>SULFUR DICHLORIDE</td>
<td>1828</td>
<td>1</td>
</tr>
<tr>
<td>SULFUR DIOXIDE, LIQUEFIED</td>
<td>1079</td>
<td>200</td>
</tr>
<tr>
<td>TOLUENE DIISOCYANATE</td>
<td>2078</td>
<td>200</td>
</tr>
</tbody>
</table>
## Notes

1. The quantities specified for explosives relate to the weight of explosive exclusive of packing, casings and non-explosive components.

2. If explosives of different Hazard Divisions are present in the same area or storage, all of the explosives shall be classified in accordance with the following table:

<table>
<thead>
<tr>
<th>Div</th>
<th>1.1</th>
<th>1.2</th>
<th>1.3</th>
<th>1.4</th>
<th>1.5</th>
<th>1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1A</td>
<td>1.1A</td>
<td>1.1A</td>
<td>1.1A</td>
<td>1.1A</td>
<td>1.1A</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>1.2</td>
<td>1.1</td>
<td>1.2</td>
<td>1.1</td>
<td>1.2</td>
<td>1.1</td>
<td>1.2</td>
</tr>
<tr>
<td>1.3</td>
<td>1.1</td>
<td>1.1</td>
<td>1.3</td>
<td>1.3</td>
<td>1.1</td>
<td>1.3</td>
</tr>
<tr>
<td>1.4</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>1.5</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1.6</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.6</td>
<td>1.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

### MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>DESCRIPTION</th>
<th>THRESHOLD QUANTITY (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosive materials</td>
<td>Explosive of Class 1.1A</td>
<td>10</td>
</tr>
<tr>
<td>All other Explosives of Class 1.1</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>Explosive of Class 1.2</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Explosive of Class 1.3</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Compressed and liquefied gases</td>
<td>Compressed or liquefied gases of Class 2.1 or Subsidiary Risk 2.1</td>
<td>200</td>
</tr>
<tr>
<td>Liquefied gases of Subsidiary Risk 5</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Compressed or liquefied gases which meet the criteria for Very Toxic in Table B.3</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Compressed or liquefied gases which meet the criteria for Toxic in Table B.3</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Flammable materials</td>
<td>Liquids which meet the criteria for Class 3 Packing Group I Materials (except for crude oil in remote locations)</td>
<td>200</td>
</tr>
<tr>
<td>Crude oil in remote locations which meet the criteria for Class 3 Packing Group I</td>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>Liquids which meet the criteria for Class 3 Packing Group II or III</td>
<td></td>
<td>50000</td>
</tr>
<tr>
<td>Liquids with flashpoints &lt;61°C kept above their boiling points at ambient conditions</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Materials which meet the criteria for Class 4.1 Packing Group I</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Spontaneously combustible materials which meet the criteria for Class 4.2 Packing Group I or II</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Materials which liberate flammable gases or react violently on contact with water which meet the criteria for Class 4.3 Packing Group I or II</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Materials which belong to Classes 3 or 8 Packing Group I or II which have Hazchem codes of 4WE (materials which react violently with water)</td>
<td></td>
<td>500</td>
</tr>
</tbody>
</table>
# Appendix B – Schedule 1 Materials

**MATERIAL (continued)** | **DESCRIPTION** | **THRESHOLD QUANTITY (tonnes)**
--- | --- | ---
Oxidising Materials | Oxidising material listed in Appendix 5 of the ADG Code | 50
| Oxidising materials that meet the criteria for Class 5.1 Packing Group I or II | 200
Peroxides | Peroxides which are listed in Appendix 5 to the ADG Code | 50
| Organic Peroxides which meet the criteria for Class 5.2 | 200
Toxic Solids and liquids (other than materials which are classified as Infectious Substances (Class 6.2) or as Radioactive (Class 7)) | Materials which meet the criteria for Very Toxic in Table B.3 | 20
| Materials which meet the criteria for Toxic in Table B.3 | 200

## TABLE B.3: CRITERIA FOR TOXICITY

**Note:** These criteria are in accordance with the Australian Dangerous Goods (ADG) Code

<table>
<thead>
<tr>
<th>Description</th>
<th>Oral Toxicity</th>
<th>Dermal Toxicity</th>
<th>Inhalation Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LD&lt;sub&gt;50&lt;/sub&gt; (mg/kg)</td>
<td>LD&lt;sub&gt;50&lt;/sub&gt; (mg/kg)</td>
<td>LC&lt;sub&gt;50&lt;/sub&gt; (mg/L)</td>
</tr>
<tr>
<td>Very Toxic</td>
<td>LD&lt;sub&gt;50&lt;/sub&gt;&lt;5</td>
<td>LD&lt;sub&gt;50&lt;/sub&gt;&lt;50</td>
<td>LC&lt;sub&gt;50&lt;/sub&gt;&lt;0.5</td>
</tr>
<tr>
<td>Toxic</td>
<td>5&lt;LD&lt;sub&gt;50&lt;/sub&gt;&lt;50</td>
<td>50&lt;LD&lt;sub&gt;50&lt;/sub&gt;&lt;200</td>
<td>0.5&lt;LC&lt;sub&gt;50&lt;/sub&gt;&lt;2</td>
</tr>
</tbody>
</table>

1. In rats
2. In rats or rabbits
3. Four hours in rats
APPENDIX C – CRIMINAL TRIAL & CIVIL LITIGATION

Civil Class Action

On 29 September 1998, only four days after the Longford disaster, Slater & Gordon and Maurice Blackburn & Co, two large Melbourne litigation law firms, launched a civil class action under the *Federal Court Act 1974 (Cwth)* seeking damages arising from the loss of gas supply for consequent financial and employment loss. This class action attracted more than 12,000 potential claimants and total damages claimed exceeded $1 billion, with individual claims between $2,000 and more than $1 million. The two law firms had joined forces because of the huge number of claimants and the resources needed to prepare the case.

On 29 June 1999, the day following the publication of the Royal Commission Report, full-page advertisements by Slater & Gordon and Maurice Blackburn & Co were published in *The Age* (page 12) and *Herald Sun* (page 31) by order of the Federal Court, giving claimants seven weeks to 19 August 1999 to opt out of the class action if they wished. Any person who opted out of the class action, and who later wished to sue Esso, would have to bring their own suit and be liable for any costs if they lost. Any person who did not opt out of the class action would thereafter be considered to be a party to the proceedings. Claimants in the class action would not be liable for any costs if the case failed. Esso had earlier filed a legal defence in May 1999 that it had no duty of care to the plaintiffs as the plaintiffs knew, or should have known, that gas supplies were not secure and should not have relied on Esso as their sole supplier of gas. The Insurance Council of Australia was expected to bring claims against Esso after paying claims by large companies for loss of production or forced closure as a result of gas supply being cut. Some of these damages claims would be from $80 million to $100 million (Milburn 29 June 1999:9).

Later Criminal and Civil Trials

The function of a Royal Commission is to establish the facts of a situation by calling whatever evidence it pleases, and its proceedings are not governed by the strict rules of evidence and procedure mandated in a criminal or civil trial. Indeed, the evidence and findings of a Royal Commission are not admissible in a criminal or civil trial. It is inappropriate for a Royal Commission to recommend criminal or civil proceedings which might arise from the facts of the inquiry. However the Royal Commission’s TOR

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157 The lead plaintiffs were Johnson tiles Pty Ltd, Gregory Dean and Douglas Chambers.
Clause 2(h) did require determination of whether a breach of any relevant statute or regulation occurred. The clear conclusion of a breach of s.21 of the *Occupational Health and Safety Act 1985* (Vic) was made by the Commission, but no recommendations for criminal or civil proceedings were made (RLRC 1999:15.7). However both a criminal trial and civil litigation, followed the Royal Commission.

**The Criminal Trial**

It is the function of the Director of Public Prosecutions (DPP) to examine all evidence collected by police and other authorities to determine whether he/she believes, on the basis of this evidence, that a criminal offence or offences have been committed and whether a jury, properly instructed in a trial, would be likely to find a defendant guilty of these offences ‘beyond any reasonable doubt’. Only then would criminal charges be appropriate and the prosecution must prove beyond any reasonable doubt that the defendant/s is/are guilty of the offence/s alleged. A criminal conviction requires the judge to impose such penalty as he/she considers to be appropriate in all the circumstances of the case, including any statutory sentencing provisions which may exist.

Following the incident at the Esso Longford facility on 25 September 1998, Esso was initially charged in 2000 with 45 offences against the *Occupational Health and Safety Act 1985* (Vic). A preliminary committal hearing was held in the Melbourne Magistrates' Court and the initial 45 charges were reduced to 21 counts. Esso reserved its defence at this committal hearing and was committed to stand trial in the County Court in Melbourne. The Director of Public Prosecutions considered all the evidence presented by investigators and decided to prosecute Esso on 11 counts arising from alleged breaches of s.21 of the *Occupational Health & Safety Act 1985* (Vic) where it was alleged that the company had failed to ‘provide and maintain so far as is practicable for employees a working environment that is safe and without risks to health’. Each of the counts relied on the presentation of evidence to the court specific to a set of circumstances, and a verdict was required on each separate count. It was therefore possible that the defendant employer might be found guilty by the jury on some counts and acquitted on others.

The County Court is the intermediate court in the Victorian court hierarchy and hears most criminal charges, with only the most serious charges being heard in the Supreme Court (Braybrooke *et al.* 1976:64-65). The County Court is not a court of record and its judgements do not create binding legal precedents to be followed in subsequent cases. In contrast, the Supreme Court is a superior court of record and its judgements create
legal precedents to be followed by all courts of similar or lower jurisdiction in later cases (Braybrooke et al. 1976:65). No charges against the Occupational Health & Safety Act 1985 (Vic) had ever been heard in the Supreme Court (Hopkins 2002:12). The DPP considered that the gravity of charges arising from the Longford disaster was so serious that it was in the public interest to have the matter tried in the Supreme Court so that clear precedents could be established to guide any future cases (DPP v Esso Australia Pty Ltd 2000:7). Judge Cummins, a Supreme Court justice, accepted this submission, despite defence arguments to the contrary, and directed that the trial should be moved to the Supreme Court (DPP v Esso Australia Pty Ltd 2000:9).

Esso was presented for trial by jury in the Criminal Court (Supreme Court) in March 2001. Each of the 11 counts was couched in precise legal terms under s21 or s22 of the Occupational Health & Safety Act 1985 (Vic) but in simple terms related to the following criminal offences:

1. Inadequate hazard identification.
2. Failure to conduct an adequate risk assessment.
3. Failure to maintain plant in a safe condition.
4. Inadequate procedures to deal with loss of warm oil circulation.
5. Failure to adequately train employees to respond to a loss of warm oil.
6. Failure to provide the means for ensuring that items of plant operated at a safe temperature.
7. Failure to adequately train employees regarding the risks associated with abnormally cold plant.
8. Failure to adequately train supervisors regarding the risks associated with abnormally cold plant.
9. Failure to monitor conditions.
10. Failure to ensure that the heat exchanger was protected from thermal shock.
11. Failure to ensure the safety of persons other than employees (Hopkins 2002:13).

All 11 counts can be traced back to failures in the SMS.

All charges were vigorously defended by Esso in the trial, which lasted from 5 March to 28 June 2001. The jury convicted Esso on all 11 counts. In his detailed sentencing remarks the trial judge was very critical of Esso’s conduct, both regarding the incidents which gave rise to the charges, and also in the manner of its defence. He refused to accept that the events were an unforeseeable accident, but rather the outcome of employer negligence ([2001] VSC 263:7-10). The judge imposed the maximum penalty.
of a fine of $250,000 on each of Counts 1 & 7; $200,000 each on Counts 3, 9 & 11; $150,000 each on Counts 2 & 8, and $100,000 each on Counts 4, 5, 6 & 10 ([2001] VSC 263:52-62). Additional penalties of $50,000 each on Counts 1, 3, 7 & 8 were imposed because of prior convictions ([2001] VSC 263:52, 54, 58, 59).

Total fines of $2,000,000 were thus imposed on Esso following criminal convictions in the first ever industrial safety trial heard in the Victorian Supreme Court. The court thus established a clear legal precedent regarding its attitude to serious offences against the Occupational Health & Safety Act 1985 (Vic).

Hopkins (2002:58) in the concluding paragraph of his examination of the trial and its ramifications for employers and occupational law sums up the issues very clearly:

The Esso trial is a landmark. It has set new standards for the conduct of trials and it has enshrined hazard management as the duty of all employers. It has raised the level of fines in this country to new heights and provided a powerful statement of the culpability of firms which fail to provide a safe workplace. It adds a moral dimension to the official response to the Longford disaster and, in so doing, it transcends the Royal Commission.

Civil Litigation

Esso subsequently settled a number of personal injury claims by workers and dependants for substantial undisclosed amounts. It also faced civil proceedings by a number of third-party plaintiffs claiming substantial damages for economic loss to plant and equipment, stock and loss of income as the result of loss of gas supply due to Esso’s negligence. Some of these claims were successful, while others were not (Atherton & Gil 2008:170).

In November 2004, Esso reached an out of court settlement for $A 32.5 million for property damage sustained by industry and the general public following the loss of gas due to the 1998 Longford gas plant explosion. This was the largest damages claim in Australian history at that time (Johnson Tiles v Esso Australia (No 4) [2004]).
APPENDIX D – THE DEVELOPMENT OF MHF LEGISLATION IN AUSTRALIA

Development of Australian MHF Legislation

From Table 2.9, it is noted that Australian legislation did not respond to Flixborough, Seveso or Bhopal. A series of potential major incidents in Australia provided the impetus for the introduction of a National Standard. However MHF legislation was not introduced in most Australian states until a major incident was experienced. Figure D.1 outlines Australian major incidents and potential major incidents in the decade prior to the Longford incident, and the Australian or State Government response.

Figure D.1: Timeline of MHF regime development in Australia

Major Chemical Incidents in Sydney

Two major fires and explosions involving chemicals and LPG storage occurred in metropolitan Sydney in late 1989 and early 1990. The Seven Hills fire in December 1989 involved chemicals which produced dense toxic smoke, resulting in the evacuation of hundreds of residents, serious pollution of a nearby watercourse and millions of dollars of damage to the site. The NSW Government appointed a ministerial committee
of inquiry following this incident and added the Boral LPG Depot explosion and fire at St Peters which occurred soon after the Inquiry’s first meeting.

The Inquiry was chaired by a representative of the NSW WorkCover Authority (WCA) and included 17 members (plus four deputies) who represented 15 government departments and agencies. Ten separate acts and regulations applied to the transport of chemicals, chemical incidents during transportation and clean ups. At least eight government departments and agencies were involved in this regulation (Chemical Inquiry 1991:12).

The Inquiry was wide-ranging\(^\text{158}\) and resulted in 39\(^\text{159}\) recommendations. The Inquiry recommended that the NSW Government pass legislation to control major hazards (Rec. 6). Industry sought a code of practice rather than mandatory requirements, partly because of the potential cost. The Inquiry expressed the view:

*that some measure of self-regulation or industry-maintained responsibility and discipline, is obviously necessary, but that, given the extent and diversity of the industry, self-regulation must operate within an improved framework of government regulation and enforcement.* (Chemical Inquiry 1991:8)

This is suggestive of meta-regulation. However, the Inquiry recommended that this regulation be by a ‘Code of Practice’ rather than mandatory models.

The Inquiry believed that ‘NSW has an opportunity to lead the way in reforming chemical management through an efficient combination of regulatory processes and industry-initiated programs, based on international and national models’ (Chemical Inquiry 1991:15). Nevertheless, 20 years after this report was published this had not happened.

*In order to successfully implement major hazards legislation the WCA recognises the need to acquire technical expertise comparable to industry.* (Chemical Inquiry 1991:16)

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\(^{158}\) The terms of reference included examination of the adequacy of legislative provisions for the transport, storage, manufacture, use and disposal of chemicals in NSW; planning and environmental considerations; efficiency and effectiveness of administrative procedures; efficiency and effectiveness of management of chemical emergencies including police and emergency services; guidelines for storage and transport of environmentally hazardous waste; chemical information requirements of government departments including the major hazards data base in the WCA; and the causes and consequences of the two fires.

\(^{159}\) Eight of the 39 recommendations concerned the establishment of new public service committees or taskforces, while seven concerned administrative changes. Three recommendations involved further consultation and guidance and there were eight recommendations for new or amended legislation or regulations. Recommendation 37 stated that the Worksafe Australia model regulations for the control of Workplace Hazardous Substances be adopted in NSW.

Sarah Sinclair 393
Appendix D – The Development of MHF Legislation in Australia

The Seven Hills and St Peters incidents illustrated the bureaucratic difficulties and significant problems in the level of government expertise and resources in preventing and dealing with major chemical incidents.

**Major Incidents in Victoria**

Prior to the 1998 Longford gas explosion, Victoria had experienced two potential major incidents, both occurring in 1991. A fire ignited at the Coode Island bulk chemical storage facility, located at the Port of Melbourne, only 5km from the central business district of Melbourne. The coronial inquiry concluded that the most probable cause of the fire was a corona discharge, which ignited one tank, triggering a chain reaction resulting in a series of explosions, with some tanks being propelled some 30 metres into the air (Heffey 1994:52). No fatalities were attributed to the fire, however without the fortuitous strong winds dissipating the toxic smoke, fatalities would have been likely. Two fire-fighters were injured.

The Metropolitan Fire Brigade reported many latent failures in control measures such as the facility fire pumps would not start, the fire control systems failed early and were rendered unserviceable, the storage tanks were poorly separated and poor layout hampered access to the site (Perkins 1993).

Also in 1991 a fire and explosion occurred in the acetylene filling area at the Commonwealth Industrial Gases production facility in Preston, approximately 9 km north of the central business district of Melbourne. The fire was attributed to incorrect handling of the acetylene cylinders. The fire brigade was concerned about the calcium carbide store next to the acetylene area, which reacts violently with water. No fatalities were attributed to the fire, however asbestos from the factory roof destroyed in the fire was blown over neighbouring properties (Catalano 1991).

**National Standard (NOHSC 1014(1996))**

The early 1990s saw a focus in Australia on the development of national OHS standards and codes of practice for ‘first order’ priority issues, which included major hazards (Johnstone 2008:5-6). Several incidents in Australia (Seven Hills, St Peters and Coode

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160 In Victoria a coroner may hold an inquest on a fire, not withstanding that no death had occurred in the incident.
161 Also known as St Elmo’s fire.
Island) provided the driving force for a *National Standard for the Control of Major Hazard Facilities* (NOHSC 1996:vii).

The preface to the Standard acknowledges the different public authorities at the time responsible for administering the different legislation relevant to MHF, such as OHS, planning, emergency services, environmental protection, dangerous goods, public health and local government.

The Standard and supporting Code of Practice were published in September 1996. The development of the *National Standard for the Control of Major Hazard Facilities* was agreed to by the National Occupational Health and Safety Commission (NOHSC), in mid 1991, with development work being shaped by the ILO’s *Convention for the Prevention of Major Industrial Accidents* (June 1993) and the then draft Seveso II (NOHSC website October 2003). In September 1992 an Expert Working Group developed the ‘Draft National Standard for the Control of Major Hazardous Facilities’ (VWA 1999a:41). Public comment was sought at the end of 1992 and incorporated into a second draft at the end of December 1993. NOHSC endorsed the *National Standard for the Control of Major Hazard Facilities* subject to an economic impact analysis and supporting code of practice (VWA 1999a:41). The economic impact analysis was completed in 1994 and the *National Standard and Code of Practice* were published in September 1996.

The *National Standard for the Control of Major Hazard Facilities* is a ‘process-based standard’ (Gunningham & Johnstone 1999:37) and is not a legislative requirement. However the expectation of NOHSC and the Commonwealth Government was that the National Standard would be given legislative power by states and territories of Australia (RLRC 1999:14.27). This national uniformity process slowed further in 1996 due to decreased funding of NOHSC with a change of federal government (Johnstone 2008:5-6). Only Western Australia had given legal affect to the National Standard prior to September 1998 (Hopkins 2003:184). The Northern Territory incorporated the *National Standard for the Control of Major Hazard Facilities [NOHSC:1014(2002)]* into the *Dangerous Goods Regulations* and the *Work Health (Occupational Health and Safety) Regulations* on 9 November 2005. This slow development process and inconsistent implementation across the various states and territories was not unique to major hazards and was symptomatic of the ‘cumbersome, slow and…tripartite process within each jurisdiction in which the national proposals might be accepted, accepted with modifications on the grounds of unique jurisdictional differences, or rejected’ (Johnstone 2008:5-6 and Industry Commission 1995:152-157). In 2002, NOHSC published the
National Occupational Health and Safety Strategy 2002–2012, containing nine national targets and priorities, including a nationally consistent regulatory framework (NOHSC 2002:10-12). While major hazards are not specifically mentioned in the strategy, many of the general priorities can be applied to improve the current major hazards regulatory situation.

National standards and codes of practice, such as that for MHFs, may be undermined by the varying provisions across different jurisdictions imposing additional compliance costs on businesses operating across borders (Regulation Taskforce 2006:36-37, Productivity Commission 2008:352).

Other Australian States and Territories

Similarly to international trends (Table 2.9), some states and territories of Australia have not enacted MHF legislation, which suggests unwillingness to learn from other’s experience in the absence of a local incident, as noted by Hopkins (2003:184).

Haines (2009:40-41) discusses the slow response from NSW, despite the similar industrial risk profile to Victoria, suggesting there was ‘little political will to prioritise reform’. As the Longford incident ‘did not present a threat to the legitimacy of the NSW government. The level of public concern in that state was lower with neither the NSW government nor the media doing much to alert the population to the threat local MHFs posed’ (Haines 2009:40).

On 1 January 2004, at a remote location in South Australia, a significant gas cloud release ignited, causing significant damage to the Moomba gas plant. While there were no injuries, gas supply was cut for many weeks. The operator, Santos, in their 2004 First-Half Report to shareholders stated that net profit for the first half year would have been $62 million higher without the loss of earnings from the Moomba incident and the estimated adverse impact of the incident was $25-30 million after tax, after expected insurance recoveries (Santos 2004:1).

Following the 2004 Moomba incident, the South Australian government drafted MHF legislation, which is awaiting promulgation (SafeWork South Australia 2008:2).

At the time of writing, MHF regulations are now in existence in Western Australia, Queensland, the Northern Territory, Commonwealth jurisdiction and most recently New South Wales (Productivity Commission 2008:350). South Australia and Tasmania
(Australian Capital Territory does not have any MHFs) have drafted or are in the process of enacting MHF regulations (Productivity Commission 2008:350).

While national consistency for regulating MHFs in Australia is desirable, the existence of different lead agencies in each state and territory, with their different legislative powers, results in a hindrance to achieving national consistency (Productivity Commission 2008:352-353).
APPENDIX E – LONGFORD ROYAL COMMISSION
TERMS OF REFERENCE

ELIZABETH THE SECOND BY THE GRACE OF GOD
QUEEN OF AUSTRALIA AND HER OTHER REALMS AND TERRITORIES
QUEEN, HEAD OF THE COMMONWEALTH

To The Honourable Sir Daryl Michael Dawson, AC, KBE, CB.
Brian John Brooks BE, FIEAust, FAIP, FAIE, FIE

GREETINGS:

WHEREAS:

A. Gas extracted by ESSO Australia Resources Ltd (“Esso”) and BHP Petroleum (Bass Strait) Pty Ltd (“BHP”) is processed at gas production and processing facilities at Longford, Victoria (“the Longford facilities”) operated by Esso.

B. On Friday 25 September 1998 an explosion and fire occurred at the Longford facilities.

C. As a result of that explosion and fire two persons were killed, a number of persons were injured and all gas supply from the Longford facilities ceased.

D. It appeared to the Governor in Council that the available supply of gas was or was likely to become less than was sufficient for the reasonable requirements of the community and accordingly the Governor in Council, acting under s.62F of the Gas Industry Act 1994 (“the Act”) by proclamation declared that Part 6A of the Act was to apply.

E. Following that proclamation, directions were given under Part 6A of the Act to effect the cessation of all but essential gas usage in those parts of Victoria which rely upon the supply of gas from the Longford facilities.

F. The Governor of the State of Victoria, in the Commonwealth of Australia by and with the advice of the Executive Council has deemed it to be expedient that a Commission should issue to you in the terms set out below.
NOW THEREFORE the Governor of the State of Victoria, in the Commonwealth of Australia, by and with the advice of the Executive Council and acting pursuant to section 88B of the Constitution Act 1975, appoints and constitutes you

The Honourable Sir Daryl Michael Dawson AC, KBE, CB
Brian John Brooks BE, FIEAust, FIAP, FAIE, FIE

to be Our Commissioners

AND HEREBY APPOINTS The Honourable Sir Daryl Michael Dawson, AC, KBE, CB to be Chairman of the Royal Commission.

FOR THE PURPOSE of inquiring into and reporting upon the following matters:

1. What were the causes of:
   (a) the explosion and fire which occurred at the Longford facilities on Friday 25 September 1998;
   (b) the failure of gas supply from the Longford facilities following that explosion and fire.

2. Whether any of the following factors caused or contributed to the occurrence of that explosion, fire and failure of gas supply, namely:
   (a) the design of the Longford facilities including the interdependence of
      (i) the plants and other components which comprise those facilities; and
      (ii) the Longford facilities and other facilities at, or upstream of, the Esso site at Longford;
   (b) operating standards, practices and policies;
   (c) maintenance standards, practices and policies;
   (d) asset management practices and policies;
   (e) risk management procedures and emergency procedures in force at the time of that occurrence;
   (f) any relevant changes in the standards, practices and policies referred to in sub-paragraphs (b), (c), (d) and (e) which had taken place prior to that occurrence;
   (g) the hydrate incident at the Longford facilities which occurred in June 1988, and any other previous incidents considered by the Board to be relevant;
   (h) whether there was any breach of, or non-compliance with, the requirements of any statute or regulation by Esso or BHP.
Appendix E – Longford Royal Commission Terms of Reference

3. What steps should be taken by Esso or BHP to prevent or lessen the risk of:
   
   (a) a repetition of the incidents which occurred at the Longford facilities on 25 September 1988; or
   (b) a further disruption of gas supply from those facilities;

AND WE direct you to make such recommendations arising out of your inquiry as you consider appropriate, including recommendations regarding any legislative or administrative changes that are necessary or desirable.

AND WE by these presents give and grant you full power and authority to call before you such person or persons as you shall judge likely to afford you any information upon the subject of this Our Commission, and to inquire of and concerning, the premises by all other lawful ways and means whatsoever.

AND WE declare that the powers of the Commission at the discretion of the Chairman may, at any time, be exercised by one or more Commissioners.

AND WE will and command that this our Commission shall continue in full force and virtue and that you shall and may from time to time and at every place or places proceed in the execution thereof, and of every matter and thing therein contained although the same be not continued from time to time by adjournment.

AND WE direct you to conduct your inquiry as expeditiously as possible and, not later than 15 February 1999 or such later time as WE may be pleased to fix, to furnish US a report of the results of your inquiry and of your recommendations.

IN TESTIMONY WHEREOF WE have caused Our Letters to be made Patent and the Seal of our State to be hereunder affixed.

WITNESS His Excellency the Honourable Sir James Augustine Gobbo, Companion of the Order of Australia, Governor of Victoria and its dependencies in the Commonwealth of Australia at Melbourne this 20th day of October One thousand nine hundred and ninety eight in the forty-seventh year of Our reign.

Sarah Sinclair 400
JAMES GOBBO
By His Excellency’s Command
J. G. KENNETT
Premier of Victoria

Entered on record by me in the register of Patents Book No. 41 Page No. 166 on the twentieth day of October 1998.
BILL SCALES
Secretary, Department of Premier and Cabinet.
APPENDIX F – SUMMARY OF LEAD REPORTS

The Age lead report included the following points in order:

- Esso is facing possible criminal charges for breaches of OHS law.
- WorkCover, as the regulatory authority is investigating criminal charges and any charges are expected to be laid by September.
- Esso is already subject to Australia’s largest civil class action for financial losses resulting from the interruption to gas supply and faces claims of $1 billion.
- Esso’s spokesperson refused to answer any questions on the report or to commit itself to implementing recommendations.
- In a brief media statement Robert Olsen, CEO Esso Australia, said the company needed time to study the findings and discuss them with Government.
- Esso announced that the rebuilding of the Longford plant had been completed during the weekend and full gas supplies were now assured.
- The report found the State government had not contributed to the disaster, but stricter regulations could have identified crucial warning signs ignored on the day.
- The report recommended the introduction of an independent Safety Case Regime.
- The Safety Case Regime model had been accepted in Europe since the 1970s and in Australia since 1996, but not implemented in Victoria.
- The report rejected Esso’s claims that workers were to blame for the disaster.
- The major problem was insufficient employee training and supervision.
- Esso failed to perform detailed risk analysis of Gas Plant 1.
- Esso also breached its own international safety management protocols.

The major points in the Herald Sun’s lead story on 29 June 1999, included:

- A litany of failures made Longford an unsafe place to work.
- Despite findings Esso refused to apologise & would not comment on the report.
- Widow attacked Esso for blaming workers.
- Unions called for an apology from Esso.
- Mr Jim Ward, a plant operator blamed by Esso for the disaster, said ‘Then I had to defend myself from my own employer who I’ve worked with for nearly 19 years. An apology would probably be a bit hollow at this stage’.
- Esso had not learned from a similar incident a month before September 25 blast.
- Esso failed to train its workers adequately, put in place operating procedures and conduct crucial safety audits.
APPENDIX G – COMPLIANCE COST ESTIMATES

A detailed Economic Impact Analysis (EIA) survey was undertaken during the drafting of the Australian National Standard for MHF (NOHSC:1014(1996)) and these data were used as a benchmark for the Victorian RIS (VWA 1999a:23). Similar data from the UK HSE were also considered, together with comparative international data supplied by Det Norske Veritas (VWA 1999a:24-25). A focus group involving MHF operators and the Australian Industry Group considered the appropriateness of these data in the Victorian context (VWA 1999a:43).

In the early 1990s the EIA estimated the initial costs per MHF operator in meeting the National Standard to be $355,000 plus an additional cost of $200,000 during the next four years, equalling a total cost of $550,000 over a five-year period (VWA 1999a:24). These estimates included the costs of risk assessments, safety management system, Safety Report, consultation and information dissemination but did not include the costs of introducing risk control measures (VWA 1999a:24). These were estimated to be between $3,000 for a small operator to $16 million for a large operator with a very complex MHF (VWA 1999a:24).

Forty-two MHF operators were identified in Victoria in the initial DNV/Aon survey and their total compliance costs, discounted at a rate of 8%, over 10 years was estimated at $25.4 million or approximately $605,000 per operator over 10 years (VWA 1999a:25). Comparable UK HSE data indicated costs of £330,000 (A$800,000) over 10 years (VWA 1999a:25). DNV estimated the need for 3-5 person years to develop and implement an SMS, undertake risk studies and write and submit a Safety Case, with costs of $300,000 for a small operator and $500,000 for a medium to large operator (VWA 1999a:25). DNV classified 16 Victorian operators as ‘small’ and 26 as ‘medium or large’ and weighted these groups to determine average costs (VWA 1999a:26). The weighted average cost per operator over the first two years was estimated as $224,000 for small operators to $424,000 for medium/large operators (VWA 1999a:26).

The proposed regulations required an MHF licence to be reviewed every five years and DNV estimated that this review would require from 35% to 65% of the time devoted to the initial licence preparation (VWA 1999a:26). On this basis the cost was estimated at between $35,000 to $195,000 for small operators and $105,000 to $325,000 for medium/large operators, with weighted averages of $78,000 to $275,000 in the sixth year (VWA 1999a:26). The total costs were $11.3 million to $25 million discounted over 10 years (VWA 1999a:26).
Additional costs including risk assessments, employee/community consultation and safety audits were identified (VWA 1999a:26). The cost of a quantitative risk assessment (QRA) was estimated by the National EIA at $28,400 for small operators (VWA 1999a:26). The VWA focus group in 1999 agreed that this figure was reasonable for small operators but a figure of $100,000 was more realistic for large operators (VWA 1999a:26). On this basis the weighted average is $73,000 for each MHF, with a discounted cost over 10 years of $7.5 million with costs incurred during the first two years (VWA 1999a:26).

The ongoing costs of compliance and the costs to government of increased regulation must also be added to the initial costs. DNV estimated a sum of 35% of initial costs was necessary to maintain an existing SMS, resulting in costs of $30,000 - $100,000 for small operators, $100,000 - $150,000 for medium/large operators with a weighted average of $75,000 to $131,000 per operator (VWA 1999a:26). Total MHF SMS maintenance costs were thus estimated at between $16.8 million and $29.3 million discounted over 10 years (VWA 1999a:26).

Total initial and recurrent costs were estimated to average between $849,000 and $1.5 million per operator discounted over 10 years, with totals for Victorian MHFs of $35.7 million and $61.8 million over the period (VWA 1999a:26).

The additional costs to VWA to administer the proposed regulations included a cost of $1.2 million per year for the new Major Hazards Unit, with a total discounted cost of $9.2 million over 10 years (VWA 1999a:27). This amount would be recovered from operators on a cost-neutral fee-for-service basis (VWA 1999a:19). Total compliance costs for MHF operators were thus estimated at between $45 million and $71 million discounted over a 10-year period (VWA 1999a:27). Table G.1 provides a summary of these figures.

Table G.1: Projected costs of the proposed Victorian MHF Regulations

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Estimated discounted costs over 10 years ($million)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lower estimate</td>
</tr>
<tr>
<td><strong>Initial costs:</strong></td>
<td></td>
</tr>
<tr>
<td>Safety/property assessment (QRAs)</td>
<td>3.0</td>
</tr>
<tr>
<td>SMS &amp; safety case (including emergency plans)</td>
<td>9.1</td>
</tr>
<tr>
<td>Community &amp; employee consultation, Community information</td>
<td>4.0</td>
</tr>
<tr>
<td>Other costs</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>On-going costs:</strong></td>
<td></td>
</tr>
<tr>
<td>Review of SMS/Safety Case</td>
<td>2.4</td>
</tr>
<tr>
<td>Maintenance costs</td>
<td>16.8</td>
</tr>
<tr>
<td><strong>Government costs:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.2</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td>45.0</td>
</tr>
</tbody>
</table>

Source: VWA 1999a:27
It is impossible to determine a statistically-valid estimate of the costs associated with major incidents due to the small sample population numbers and the very infrequent occurrence of major incidents. DNV estimates that during the previous 30 years there was an average MHF major incident rate of one in 200-250 major hazard operating years (number of MHFs multiplied by the number of years) (VWA 1999a:28). Victorian experience is in line with these figures (VWA 1999a:28). There is also evidence that the frequency rates of MHF major incidents have declined in Europe due to the impact of MHF legislation (Keller & Wilson 1991 and Hopkins 2000:95-96).

The published cost of MHF incidents throughout the world is also a very unreliable guide for comparative purposes as there are no standard criteria determining what items are included or excluded from the estimates (VWA 1999a:28 and Fewtrell & Hirst 1998:3). Some of the possible costs such as long-term mortality rates and environmental damage resulting from a major incident may be impossible to quantify. Typical figures might include the cost of loss and damage to plant and property, cost of emergency services and clean up costs, but usually do not include the much more significant estimates of cost of human injury or death, lost production beyond the facility and environmental damage (VWA 1999a:28). Nevertheless available figures, no matter how imperfect, provide telling evidence of the potential costs of MHF major incidents, and therefore the potential benefits of their prevention or minimisation. For example, the estimated cost of $90 million attributed to the Coode Island terminal fire in 1991 clearly exceeds the estimated compliance costs of the proposed MHF regulations in Victoria over a 10-year period. The real costs of the 1998 Longford major incident, estimated at $1.3 billion (The Australian Financial Review 27 April 1999) dwarf this figure.
# APPENDIX H – OCCUPATIONAL HEALTH AND SAFETY (MAJOR HAZARD FACILITIES) REGULATIONS 2000

## TABLE OF PROVISIONS

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<td>Objective</td>
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<td>Application of Regulations</td>
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<td>Processes for certain decisions of Authority</td>
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<td>Safety Assessment</td>
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<td>304.</td>
<td>Control measures</td>
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<td>305.</td>
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<th>Description</th>
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</tr>
<tr>
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<td>Content of Safety Case</td>
</tr>
<tr>
<td>403.</td>
<td>Co-ordination of Safety Cases</td>
</tr>
<tr>
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<td>Revision</td>
</tr>
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<thead>
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<th>Section</th>
<th>Description</th>
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<td>Informing, instructing and training employees</td>
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<td>503.</td>
<td>Further information and access to documents</td>
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<tr>
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<td>Non-employees at the facility</td>
</tr>
<tr>
<td>505.</td>
<td>Local community</td>
</tr>
<tr>
<td>506.</td>
<td>Further information on request</td>
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</table>

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<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
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</thead>
<tbody>
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<td>Duties of employees at major hazard facilities</td>
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701. Notification for existing major hazard facilities
702. Notification by intended operator of major hazard facility
703. Operators of certain facilities to notify Authority
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705. Authority may determine facility to be a major hazard facility
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PART 10 – AMENDMENT TO DANGEROUS GOODS (STORAGE AND HANDLING) REGULATIONS 1989

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SCHEDULE 2 – Additional matters to be included in Safety Management System
SCHEDULE 3 – Matters to be included in emergency plan
SCHEDULE 4 – Additional matters to be included in Safety Case
SCHEDULE 5 – Licence fees
APPENDIX I – DISTINGUISHING FEATURES OF THE VICTORIAN MHF REGULATIONS

The key provisions of the Victorian MHF Regulations, discussed in Chapter 3, namely:

- licence to operate as an MHF;
- submission of a Safety Case or Safety Report to the Authority;
- assessment by the Authority;
- restrictions on timing of the assessment;
- re-submissions of Safety Cases or Reports if not to the satisfaction of the Authority;
- the ability for the Authority to cease operations at the facility; and
- the requirement to have an SMS,

have been compared with other MHF and Safety Case legislation internationally, nationally and locally.

Table I.1 provides an international comparison of the Victorian MHF Regulations with the following overseas legislation against the above provisions:

- COMAH (UK) – The Control of Major Accident Hazards Regulations 1999 (Statutory Instruments 1999 No. 743),
- Seveso II (Europe) – The Control of Major Accident Hazards Involving Dangerous Substances (Council Directive 96/82/EC), and

Table I.2 contains a national comparison of the Victorian MHF Regulations with other Australian legislation against the above provisions:

- National Standard for the Control of MHFs (NOHSC:1014(1996)),
- Petroleum - Petroleum (Submerged Lands) (Management of Safety on Offshore Facilities) Regulations 1996, and

Table I.3 contains a state comparison of the Victorian MHF Regulations with the following other Victorian Safety Case regimes against the above provisions:

- Office of Gas Safety - Gas Safety (Safety Case) Regulations 1999 / Gas Safety Act (1997), and
Appendix I – Distinguishing Features of the Victorian MHF Regulations

Table I.1: International Legislative Comparison of MHF Regimes

<table>
<thead>
<tr>
<th>Provision</th>
<th>COMAH</th>
<th>Seveso II</th>
<th>OSHA (1910.119)</th>
<th>MHF (Vic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licence to operate</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Case or Report submission</td>
<td>Yes - 'report'</td>
<td>Yes - 'report'</td>
<td>No</td>
<td>Yes - case</td>
</tr>
<tr>
<td>Assessment by Authority</td>
<td>‘Yes - ‘Examination’</td>
<td>‘Yes - ‘Examination’</td>
<td>No</td>
<td>Yes – ‘satisfaction’¹⁶²</td>
</tr>
<tr>
<td>Assessment Timing</td>
<td>Yes - Regulation 17(1) ‘within a reasonable period of time of receiving a safety report’</td>
<td>Yes - Article 9 (4) ‘within a reasonable period of receipt of the report’</td>
<td>No</td>
<td>Yes - 6 months (12 months for first submission if required)¹⁶³</td>
</tr>
<tr>
<td>Re submission</td>
<td>N/A</td>
<td>N/A (Article 9(4) allows for the requesting of further information)</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Cease Operation</td>
<td>Yes - Regulation 17(1)(b) the competent authority shall within a reasonable period of time of receiving a safety report prohibit the operation or bringing into operation of the establishment or installation concerned or any part thereof in accordance with regulation 18. Regulation 18(1) The competent authority shall prohibit the operation or bringing into operation of any establishment or installation or any part thereof where the measures taken by the operator for the prevention and mitigation of major accidents are seriously deficient. 18(2) The competent authority may prohibit the operation or bringing into operation of any establishment or installation or any part thereof if the operator has failed to submit any notification, safety report or other information required by or under these Regulations within the time so required.</td>
<td>Yes - Article 17 ‘where the measures taken by the operator for the prevention and mitigation of major accidents are seriously deficient' or ‘not submitted notification, reports’ etc..</td>
<td>Not specified.</td>
<td>Yes - Regulation 808 provides for the suspension and cancellation of a licence. Regulation 801 states that only licensed or registered MHFs can operate.</td>
</tr>
<tr>
<td>SMS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes¹⁶⁴</td>
<td>Yes</td>
</tr>
</tbody>
</table>

¹⁶² To grant a licence, the Authority must be satisfied (Reg 803) that the Safety Case has been prepared in accordance with Regulation 402; the applicant has complied with the provisions of Part 3; the applicant has the ability to operate the MHF safely; the applicant has complied with the provisions of Part 5. Satisfied implies an assessment process is required.

¹⁶³ An amendment in March 2002 to the MHF Regulations allows an extension of a further 6 months to the assessment period for an operator’s first application for an MHF licence. On re-licensing only the 6 month period applies.

¹⁶⁴ While OSHA does not specifically require an SMS, the elements required in OSHA are key parts of an SMS.
## Table I.2: Australian Legislative Comparison of MHF Regimes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Licence to operate</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Safety Case or Report submission</td>
<td>Yes – report</td>
<td>Yes - case</td>
<td>Yes – case (Reg 28)</td>
<td>Yes – report (s47)</td>
</tr>
<tr>
<td>Assessment by Authority</td>
<td>Not explicitly - however the Authority is to ‘receive safety reports and give assurances to government that an appropriate level of safety applies, so long as the provisions are properly implemented’. (Section 15.1(c).)</td>
<td>Yes – ‘satisfaction’¹⁶⁶</td>
<td>Not explicitly - however the Authority must ‘accept’ the Safety Case if (a) it is appropriate to the facility and activities, and (b) complies with specified subdivisions and any validation requests (Reg 30(1)).</td>
<td>Not explicitly - Section 47 the Safety Report must be given to the chief executive for the ‘chief executive to decide whether (a) risk at the MHF is at an acceptable level, and (b) the occupier has satisfied the occupier’s obligations under this Act…’</td>
</tr>
<tr>
<td>Assessment Timing</td>
<td>N/A</td>
<td>Yes - 6 months (12 months for first submission if required)¹⁶⁷</td>
<td>Yes – 90 days (Reg 31(1)) or (Reg 31(1)(b)) within 90 days notify the operator that the Authority is unable to make a decision within the 90 days and set out a proposed timetable for its consideration of the Safety Case.</td>
<td>Not stated.</td>
</tr>
<tr>
<td>Re-submission</td>
<td>N/A</td>
<td>No</td>
<td>Yes – Reg 30(3)</td>
<td>No clear provision, however s95 provides for an authorised officer to give a directive to review the Safety Report if the officer believes the Report is inadequate.</td>
</tr>
<tr>
<td>Cease Operation</td>
<td>Not explicitly - ‘The relevant public authority may give direction to the Operator of an MHF for the purpose of ensuring the safety of people, property, the built or natural environment and any occupants in or on the facility. (Section 15.2)’</td>
<td>Yes - Regulation 808 provides for the suspension and cancellation of a licence. Regulation 801 states that only licensed or registered MHFs can operate.</td>
<td>Not explicitly - Regulation 48 requires a Safety Case to be ‘in force’¹⁶⁸ for the appropriate life-cycle stage of the facility. Reg 49 requires work on a facility to comply with the Safety Case ‘in force’ at the facility. Reg 30 provides for the Authority to reject a Safety Case, after resubmission to attempt to address deficiencies.</td>
<td>Yes - Section 97 a directive to suspend operations for unacceptable level of risk can be given ‘if an authorised officer reasonably believes risk from operations being conducted at a major hazard facility or dangerous goods location is not at an acceptable level.’</td>
</tr>
<tr>
<td>SMS</td>
<td>Yes¹⁶⁹</td>
<td>Yes</td>
<td>Yes – Reg 9(1)(c) and 9(4)</td>
<td>Yes – s45</td>
</tr>
</tbody>
</table>

¹⁶⁵ Petroleum (Submerged Lands) (Management of Safety on Offshore Facilities) Regulations 1996.

¹⁶⁶ To grant a licence, the Authority must be satisfied (Reg 803) that the Safety Case has been prepared in accordance with Regulation 402; the applicant has complied with the provisions of Part 3; the applicant has the ability to operate the MHF safely; the applicant has complied with the provisions of Part 5. Satisfied implies an assessment process is required.

¹⁶⁷ An amendment in March 2002 allows an assessment period extension of a further 6 months for an operator’s first MHF licence application. On re-licensing only the 6 month period applies.

¹⁶⁸ ‘in force’ is defined in the regulations to mean that the Safety Case has been accepted by the Authority and this acceptance has not been withdrawn (Reg 5).

¹⁶⁹ Section 6.3 (see also p 58 of Code of Practice).
### Table I.3: Victorian Legislative Comparison of MHF Regimes

<table>
<thead>
<tr>
<th>Provision</th>
<th>MHF (Vic)</th>
<th>Gas Safety 170</th>
<th>Electrical Safety 171</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licence to operate</td>
<td>Yes</td>
<td>No</td>
<td>No – however the electrical safety management scheme is 'accepted'. (s.111)</td>
</tr>
<tr>
<td>Safety Case or Report submission</td>
<td>Yes - Case</td>
<td>Yes – Case</td>
<td>Yes – safety management scheme</td>
</tr>
<tr>
<td>Assessment by Authority</td>
<td>Yes – ‘satisfaction’</td>
<td>Yes – ‘satisfied’. Under Gas Safety Act (1997) the Office of Gas Safety must ‘consider’ the Safety Case (s40(1)). The Office ‘must accept’ a Safety Case if it is ‘satisfied’ (s40(2)). Under Section 38, the Office may require the gas company to obtain an independent validation of that Safety Case (s38).</td>
<td>Yes - ‘satisfied’. s. 111 requires that ‘The Office must recommend to the Governor in Council that a scheme submitted under this Division be accepted if (a) the Office is satisfied (i) that the scheme is appropriate for the electric work to which it applies and complies with this Act and the regulations; or(ii) that the scheme is appropriate for the upstream network to which it applies and complies with this Act and regulations.</td>
</tr>
<tr>
<td>Assessment Timing</td>
<td>Yes - 6 months (12 months for first submission if required) 172</td>
<td>Not explicitly - 'with as much expedition as the requirements of this Act and the regulations and the proper consideration of the Safety Case permit' (s40(1)).</td>
<td>Not explicitly - The Office must consider a scheme submitted under this Division with as much expedition as the requirements of this Act and the regulations and the proper consideration of the scheme permit. (s. 110)</td>
</tr>
<tr>
<td>Re submission</td>
<td>No</td>
<td>Yes (s42(1)(b))</td>
<td>Yes (s112)</td>
</tr>
<tr>
<td>Cease Operation</td>
<td>Yes - Regulation 808 provides for the suspension and cancellation of a licence. Regulation 801 states that only licensed or registered MHFs can operate.</td>
<td>Not explicitly - Under the Gas Safety Act (1997) a provisional acceptance of the Safety Case can occur with limitations to the use or operation of the facility (Section 41). Section 42 states if the Office does not accept the Safety Case, it must give the operator an opportunity to modify and re-submit the Safety Case. Section 44(1) states a gas company must not commission or commence to operate a facility unless a Safety Case has been accepted or provisionally accepted.</td>
<td>No – however the accepted electrical safety management scheme can be revoked (s. 118).</td>
</tr>
<tr>
<td>SMS</td>
<td>Yes</td>
<td>Yes (s37(2)(b))</td>
<td>Yes</td>
</tr>
</tbody>
</table>

---


172 An amendment in March 2002 allows an extension of a further 6 months to the assessment period for an operator’s first application for an MHF licence. On re-licensing only the 6 month period applies.
Considerable development work was undertaken by the regulator to prepare a robust, fair and transparent assessment process (MHD 2001). The overall assessment process is driven by fourteen Management Principles (procedural foundation) (VWA 2001a) and twelve Guidance Principles (technical foundation) (VWA 2001b) as listed in Tables J.1 and J.2 respectively.

In accordance with the Management Principles presented in Table J.1, a Safety Case is assessed by a competent team, managed by a Lead Assessor, working to a plan.

**Table J.1: Safety Case Assessment Management Principles**  
(after VWA 2001a:1-3)

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP1</td>
<td>The Safety Case Assessment forms one part of the WorkSafe Victoria overall strategy for promoting the safety of MHFs.</td>
</tr>
<tr>
<td>MP2</td>
<td>The Safety Case Assessment Framework forms the basis for the Safety Case Assessment Process; it will meet the requirements of the MHF Regulations and be consistent with guidance notes.</td>
</tr>
<tr>
<td>MP3</td>
<td>The Safety Case Assessment and subsequent licence decision-making will be completed according to a dedicated project plan.</td>
</tr>
<tr>
<td>MP4</td>
<td>Each individual Safety Case Assessment will be conducted by an assessment team with appropriate skills and competencies.</td>
</tr>
<tr>
<td>MP5</td>
<td>Each Safety Case Assessment will be managed by a Lead Assessor who will be the primary responsible person for assessment and the point of contact for the operator for communications about the process.</td>
</tr>
<tr>
<td>MP6</td>
<td>The amount of assessment and verification effort for each safety case will be proportionate to the size and complexity of the facility.</td>
</tr>
<tr>
<td>MP7</td>
<td>The Safety Case Assessment Process will be subject to QA/QC and adequate technical review to ensure sound technical judgement and compliance with procedures.</td>
</tr>
<tr>
<td>MP8</td>
<td>Other Government agencies (MoU\textsuperscript{173} agencies) may contribute to the Safety Case Assessment Process consistent with the MoU agreements.</td>
</tr>
<tr>
<td>MP9</td>
<td>The delegate for licence decision-making will be assisted by the Licence Panel.</td>
</tr>
<tr>
<td>MP10</td>
<td>WorkSafe Victoria will fully explain the assessment results and required actions to the operator.</td>
</tr>
<tr>
<td>MP11</td>
<td>The invoicing total forwarded to the operator will accurately reflect the amount of time expended during the Safety Case Assessment Process, within the regulatory restrictions.</td>
</tr>
<tr>
<td>MP12</td>
<td>The Safety Case Assessment Framework will be made available to stakeholders in the process.</td>
</tr>
<tr>
<td>MP13</td>
<td>WorkSafe Victoria is committed to sharing and disseminating the knowledge and lessons from the Safety Case Assessment Process with stakeholders.</td>
</tr>
<tr>
<td>MP14</td>
<td>Information provided in a Safety Case submission is treated as confidential.</td>
</tr>
</tbody>
</table>

\textsuperscript{173} MoU is a Memorandum of Understanding agency such as the fire brigade, environmental protection agency etc.
### Table J.2: Safety Case Assessment Guidance Principles (after VWA 2001b:1-4)

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP1</td>
<td>The assessment and subsequent conclusions and decision must be transparent and auditable.</td>
</tr>
<tr>
<td>GP2</td>
<td>The assessment and subsequent conclusions must be fair, consistent and technically competent.</td>
</tr>
<tr>
<td>GP3</td>
<td>The Safety Case assessment, and any resultant decisions, must be proportionate.</td>
</tr>
<tr>
<td>GP4</td>
<td>The MHF Regulations include requirements for continual improvement and this will be considered during the Safety Case assessment and subsequent licence decision-making.</td>
</tr>
<tr>
<td>GP5</td>
<td>In general, for the purposes of assessment and licensing, WorkSafe will assume that information submitted by the operator is correct. However, WorkSafe will conduct verification of the information on-site when there is good reason to do so.</td>
</tr>
<tr>
<td>GP6</td>
<td>The assessment process will utilise sampling to assess and confirm information provided in the Safety Case.</td>
</tr>
<tr>
<td>GP7</td>
<td>The assessment process may include assessment and verification of some procedures and activities prior to the Safety Case submission.</td>
</tr>
<tr>
<td>GP8</td>
<td>Any deficiencies in the Safety Case submission or in actual safety control will require proportionate action by WorkSafe and the operator.</td>
</tr>
<tr>
<td>GP9</td>
<td>Safety Case assessment conclusion used in forming a decision regarding licensing must be linked to Regulation 803(1).</td>
</tr>
<tr>
<td>GP10</td>
<td>The adequacy of the Safety Case will be assessed based on the content of the Safety Case submission, verification activities, process oversight observations and information from previous relevant site assessments.</td>
</tr>
<tr>
<td>GP11</td>
<td>In addition to the assessment of the content of the Safety Case, the licence decision will be based on an assessment of the operator’s compliance with Parts 3 and 5 of the MHF Regulations, and on an assessment of the operator’s ability to operate the facility safely. However, WorkSafe may take into consideration any information that is relevant to any of these four factors.</td>
</tr>
<tr>
<td>GP12</td>
<td>Assessment Team and Licence Panel members will act within their allocated roles.</td>
</tr>
</tbody>
</table>
The ‘desk top’ assessment was conducted using ‘Focus Rules’ (Table J.3), which lists the regulatory requirements for the given aspect, with two levels of guidance for the assessor. The first level of guidance is referred to as ‘Assessment Principles’ or high-level statements linking to the MHF Regulations. The second level, ‘Assessment Prompts’, is a series of questions designed to assist the assessor to form an opinion regarding the Assessment Principle. Focus Rules also contain other information such as related guidance material and possible sources of information for the assessment. Focus Rules assist in achieving consistency across different assessments.

### Table J.3: VWA Focus Rules for Safety Case Assessment (after VWA 2001:5)

<table>
<thead>
<tr>
<th>Technical Aspect</th>
<th>Focus Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Case contents</td>
<td>FR06</td>
</tr>
<tr>
<td>SMS</td>
<td>FR07</td>
</tr>
<tr>
<td>Hazard identification</td>
<td>FR11</td>
</tr>
<tr>
<td>Safety assessment</td>
<td>FR14</td>
</tr>
<tr>
<td>Control measures</td>
<td>FR15</td>
</tr>
<tr>
<td>Emergency response</td>
<td>FR16</td>
</tr>
<tr>
<td>Standards</td>
<td>FR17</td>
</tr>
<tr>
<td>Asset Integrity</td>
<td>FR18</td>
</tr>
<tr>
<td>Human Factors</td>
<td>FR19</td>
</tr>
<tr>
<td>Stakeholder Involvement</td>
<td>FR21</td>
</tr>
</tbody>
</table>

Table J.3 contains the compulsory Focus Rules that must be completed during the Safety Case assessment period. Those Focus Rules shown in italics in Table J.3 are additional, or optional, focus rules to be applied as appropriate to the assessment (VWA 2001:5).
The Occupational Health and Safety (Major Hazard Facilities) Regulations 2000 stipulated the following requirements for the Safety Management System:

301. Safety Management System

(1) The operator of a major hazard facility must establish and implement a Safety Management System for the major hazard facility.

(2) The operator must use the Safety Management System as the primary means of ensuring the safe operation of the major hazard facility.

(3) The Safety Management System so established must--

(a) provide a comprehensive and integrated management system for all aspects of control measures adopted under this Part;

(b) be documented;

(c) be so set out and expressed that its contents are readily accessible and comprehensible to persons who use it.

(4) The document must--

(a) state the operator's safety policy, including the operator's broad aims in relation to the safe operation of the major hazard facility;

(b) state the operator's specific safety objectives;

(c) describe the systems and procedures by which these objectives are to be achieved;

(d) describe how compliance with this Part and Part 5 is to be achieved;

(e) include all of the matters specified in Schedule 2.

(5) The operator must review, and as necessary revise, the Safety Management System if:

(a) a modification is made to the major hazard facility;

(b) a major incident occurs at the major hazard facility; or

(c) whether or not the circumstances mentioned in paragraphs (a) or (b) arise, at least once each 5 years.

(6) An operator of a major hazard facility who fails to comply with this regulation is guilty of an indictable offence.
SCHEDULE 2

ADDITIONAL MATTERS TO BE INCLUDED IN THE SAFETY MANAGEMENT SYSTEM

1. Safety policy and safety objectives

1.1 A description of the means by which the operator’s safety policy and specific safety objectives are to be communicated to all persons who are to participate in the implementation of the Safety Management System.

1.2 The safety policy must include an express commitment to ongoing improvement of all aspects of the Safety Management System.

2. Organisation and personnel

2.1 The identification (according to position description and location) of the persons who are to participate in the implementation of the Safety Management System, and a description of the command structure in which these persons work and of the specific tasks and responsibilities allocated to them.

2.2 The means of ensuring that these persons have the knowledge and skills necessary to enable them to perform their allocated tasks and discharge their allocated responsibilities, and that they retain such knowledge and skills.

3. Operational controls

3.1 A description of the procedures and instructions for--

(a) the safe operation of plant (including as to inspection and maintenance);
(b) the mechanical integrity of plant;
(c) plant processes;
(d) the control of abnormal operations and emergency shut down or decommissioning.

3.2 Provision of adequate means of achieving isolation of the major hazard facility or any part of the major hazard facility in the event of an emergency.

3.3 Provision of adequate means of gaining access for servicing and maintenance of the major hazard facility or any part of the major hazard facility.

3.4 A description of the roles of persons and of the interfaces between persons and plant.

3.5 Provision for alarm systems.

4. Compliance with Part 3 174 & Part 5 175 of these Regulations

4.1 In relation to each part of the documented Safety Management System that describes the means of compliance with Part 3 of these Regulations, an

174 Safety duties of operators.
175 Consulting, informing, instructing and training.
annotation or cross-reference identifying the specific provision of these Regulations being complied with.

4.2 A description of the means by which the operator proposes to comply with Part 5.

5. Management of change

5.1 A description of the procedures for planning modifications to major hazard facilities.

6. Principles and standards

6.1 A statement of the principles, especially the design principles and engineering standards, being used to ensure the safe operation of the major hazard facility.

6.2 A description of any technical standards, whether published or proprietary, being relied on in relation to such principles and standards.

7. Performance monitoring

7.1 Performance standards for measuring the effectiveness of the Safety Management System, which-

(a) relate to all aspects of the Safety Management System;

(b) are sufficiently detailed to ensure that the ability of the operator to ensure the effectiveness of all aspects of the Safety Management System is apparent from the documentation;

(c) include steps to be taken to continually improve all aspects of the Safety Management System.

7.2 A description of the way in which these performance standards are to be met.

7.3 Performance indicators for the effectiveness of control measures adopted, including--

(a) tests of the effectiveness of the control measures;

(b) indicators of the failure of any control measure;

(c) actions to be taken in reporting any such failure;

(d) other corrective actions to be taken in the event of any such failure.

8. Audit

8.1 Provision for the audit of performance against the performance standards, including the methodologies, frequency and results of the audit process.
APPENDIX L – SITE DATA & MILESTONES

This appendix contains site data for the licensed Victorian MHFs from 2003 to 2005. The data is arranged by the four industry sectors; Petroleum, Plastics & Chemicals, Utilities and Logistics.

In addition, this appendix also contains a list of the key data sources and its governing protocols for each milestone in the MHF licensing process, such as initial notification of the MHF to the regulator, Safety Case preparation and development, Safety Case assessment and licensing, and post-licensing activities.
### Table L.1: Victorian MHFs in the Petroleum Sector

<table>
<thead>
<tr>
<th>MHF</th>
<th>Product</th>
<th>Activity</th>
<th>Complexity</th>
<th>Approx. number of employees</th>
<th>Other MHFs in Vic</th>
<th>Other MHFs in Aust</th>
<th>Other MHFs in UK/Europe</th>
<th>Other MHFs in USA</th>
<th>Corporate Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>LPG, crude oil &amp; hydrocarbon feedstock</td>
<td>Separation &amp; Storage</td>
<td>High</td>
<td>200</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P2</td>
<td>Natural gas and hydrocarbon feedstock</td>
<td>Complex separation</td>
<td>Very High</td>
<td>300</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P3</td>
<td>Various fuels</td>
<td>Refinery</td>
<td>Very High</td>
<td>400</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P4</td>
<td>Crude oil &amp; refined product (fuels)</td>
<td>Storage</td>
<td>Low</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P5</td>
<td>Hydrocarbon feedstock</td>
<td>Chemical production</td>
<td>Very High</td>
<td>325</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P6</td>
<td>Various fuels</td>
<td>Refinery</td>
<td>Very High</td>
<td>410</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P7</td>
<td>LPG</td>
<td>Storage</td>
<td>Low</td>
<td>5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P8</td>
<td>Crude oil &amp; refined product (fuels)</td>
<td>Storage</td>
<td>Low</td>
<td>0 (^{179})</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td><strong>Total 8 sites</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1650</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Range of employees is 0 – 410, mean is 206 and median is 250.

---

\(^{176}\) As determined by the researcher. See Table L.6 for criteria.

\(^{177}\) Obtained from notification data.

\(^{178}\) As determined by the researcher. See Table L.7 for criteria.

\(^{179}\) Operated by neighbouring refinery.
### Table L.2: Victorian MHFs in the Plastics & Chemicals Sector

<table>
<thead>
<tr>
<th>MHF</th>
<th>Product</th>
<th>Activity</th>
<th>Complexity</th>
<th>Approx. number of employees</th>
<th>Other MHFs in Vic</th>
<th>Other MHFs in Aust</th>
<th>Other MHFs in UK/Europe</th>
<th>Other MHFs in USA</th>
<th>Corporate Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&amp;C1</td>
<td>Explosives</td>
<td>Explosives manufacture</td>
<td>High</td>
<td>350</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C2</td>
<td>Non-dangerous goods</td>
<td>Chemical production</td>
<td>Medium</td>
<td>70</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Limited</td>
</tr>
<tr>
<td>P&amp;C3</td>
<td>Plastic</td>
<td>Chemical production</td>
<td>High</td>
<td>84</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C4</td>
<td>Plastic</td>
<td>Chemical production</td>
<td>High</td>
<td>52</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Medium</td>
</tr>
<tr>
<td>P&amp;C5</td>
<td>Resin</td>
<td>Chemical production</td>
<td>High</td>
<td>62</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Medium</td>
</tr>
<tr>
<td>P&amp;C6</td>
<td>Dangerous goods for manufacturing</td>
<td>Chemical production</td>
<td>High</td>
<td>200</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C7</td>
<td>Dangerous goods for manufacturing</td>
<td>Chemical production</td>
<td>Very High</td>
<td>341</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Medium</td>
</tr>
<tr>
<td>P&amp;C8</td>
<td>Explosives</td>
<td>Explosives manufacture</td>
<td>High</td>
<td>120</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C9</td>
<td>Dangerous goods</td>
<td>Chemical production</td>
<td>Medium</td>
<td>13</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>P&amp;C10</td>
<td>Agricultural products</td>
<td>Chemical production</td>
<td>High</td>
<td>320</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C11</td>
<td>Resin</td>
<td>Chemical production</td>
<td>High</td>
<td>110</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C12</td>
<td>Toxic gas</td>
<td>Chemical production</td>
<td>High</td>
<td>40</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>P&amp;C13</td>
<td>Non-dangerous goods (not chemical)</td>
<td>Chemical production</td>
<td>High</td>
<td>928</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Total 13 sites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Range of employees is 13 – 928, mean is 207 and median is 110.
### Table L.3: Victorian MHFs in the Utilities Sector

<table>
<thead>
<tr>
<th>MHF</th>
<th>Product</th>
<th>Activity</th>
<th>Complexity</th>
<th>Approx. number of employees</th>
<th>Other MHFs in Vic</th>
<th>Other MHFs in Aust</th>
<th>Other MHFs in UK/Europe</th>
<th>Other MHFs in USA</th>
<th>Corporate Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>Gases &amp; LNG</td>
<td>Gas production</td>
<td>Medium</td>
<td>40</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>U2</td>
<td>Various gases including toxic and flammable</td>
<td>Gas production</td>
<td>Medium</td>
<td>120</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>U3</td>
<td>LPG</td>
<td>Storage</td>
<td>Low</td>
<td>40</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>U4</td>
<td>LNG &amp; LPG</td>
<td>Storage</td>
<td>Medium</td>
<td>70</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>U5</td>
<td>LPG</td>
<td>Storage</td>
<td>Low</td>
<td>5</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>U6</td>
<td>Water</td>
<td>Treatment</td>
<td>Medium</td>
<td>40</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>U7</td>
<td>Water</td>
<td>Treatment</td>
<td>Medium</td>
<td>3</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>U8</td>
<td>Water</td>
<td>Treatment</td>
<td>Medium</td>
<td>5</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td><strong>Total 8 sites</strong></td>
<td></td>
<td></td>
<td></td>
<td>323</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Range of employees is 3 – 120, mean is 40 and median is 40.
### Table L.4: Victorian MHFs in the Logistics Sector

<table>
<thead>
<tr>
<th>MHF</th>
<th>Product</th>
<th>Activity</th>
<th>Complexity</th>
<th>Approx. number of employees</th>
<th>Other MHFs in Vic</th>
<th>Other MHFs in Aust</th>
<th>Other MHFs in UK/Europe</th>
<th>Other MHFs in USA</th>
<th>Corporate Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>Various fuels</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>67</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>L2</td>
<td>Various chemicals &amp; gases</td>
<td>Storage</td>
<td>Low</td>
<td>25</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>L3</td>
<td>Various chemicals</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>10</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Limited</td>
</tr>
<tr>
<td>L4</td>
<td>Various fuels</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>20</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>L5</td>
<td>Various chemicals &amp; gases</td>
<td>Storage</td>
<td>Low</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>L6</td>
<td>Various chemicals &amp; gases</td>
<td>Storage</td>
<td>Low</td>
<td>40</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Medium</td>
</tr>
<tr>
<td>L7</td>
<td>Various fuels</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>25</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Significant</td>
</tr>
<tr>
<td>L8</td>
<td>Various chemicals</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>29</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Medium</td>
</tr>
<tr>
<td>L9</td>
<td>Various chemicals</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>15</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Medium</td>
</tr>
<tr>
<td>L10</td>
<td>Various fuels</td>
<td>Storage (bulk)</td>
<td>Low</td>
<td>5</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Significant</td>
</tr>
<tr>
<td>L11</td>
<td>Various chemicals</td>
<td>Storage</td>
<td>Low</td>
<td>20</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>L12</td>
<td>Various chemicals</td>
<td>Storage</td>
<td>Low</td>
<td>40</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td><strong>Total</strong> <strong>12 sites</strong>&lt;sup&gt;180&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td><strong>306</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Range of employees is 5 – 67, mean is 26 and median is 23.

---

<sup>180</sup> 10 sites in 2003 increased to 12 sites in 2005.
### Table L.5: Victorian MHF Milestones and Key Data

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Data Generated by</th>
<th>Type</th>
<th>Governing protocols</th>
<th>Stored by</th>
<th>Checked by</th>
<th>Restricted access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notification</td>
<td>Registration</td>
<td>Report</td>
<td>Part 7 of MHF Regulations</td>
<td>VWA and MHF</td>
<td>VWA Analyst</td>
<td>Yes – VWA staff and MHF staff</td>
</tr>
<tr>
<td>Safety Case Preparation</td>
<td>MHF Site</td>
<td>Outline Report</td>
<td>Safety Case Outline protocol</td>
<td>VWA and MHF</td>
<td>VWA Analyst and VWA Principal Analyst</td>
<td>Yes – VWA staff and MHF staff</td>
</tr>
<tr>
<td>and Development</td>
<td>Personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field observations</td>
<td>VWA analysts</td>
<td>Field notes</td>
<td>Field note recording VWA Field Operations Manual (general field work)</td>
<td>VWA electronic data management</td>
<td>Lead Assessor, Technical Reviewer and Analyst Team Leader</td>
<td>Yes – VWA staff and inspectors (selective sampling as part of QA process)</td>
</tr>
<tr>
<td>Safety Case Assessment</td>
<td>VWA assessment</td>
<td>Database entries</td>
<td>Focus Rules TP 12 Safety Case Assessment: Assessment Findings Report</td>
<td>MHF has copy of their Field Report</td>
<td>Group Leader, Industry Facilitator and Group Leader</td>
<td>MHF has copy of their Field Report</td>
</tr>
<tr>
<td>and Licensing</td>
<td>team (analysts)</td>
<td>Assessment findings report</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verification</td>
<td>Verification</td>
<td>Field notes</td>
<td>Field note recording VWA Electronic document control system</td>
<td>VWA electronic data management</td>
<td>Lead Inspector, Industry Facilitator and Group Leader</td>
<td>Yes – VWA staff and inspectors</td>
</tr>
<tr>
<td>team (VWA inspectors)</td>
<td>Report</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-licensing</td>
<td>Annual inspection</td>
<td>Field notes</td>
<td>Field note recording VWA Electronic document control system</td>
<td>VWA electronic data management</td>
<td>Group Leader, Industry Facilitator, Analyst Team Leader</td>
<td>Yes – VWA staff and inspectors</td>
</tr>
<tr>
<td>Annual Inspection</td>
<td>team (VWA analysts and inspectors)</td>
<td>Annual Inspection Report</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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184 TP18 is Technical Protocol 18 – Oversight of Licensed MHFs Policy (MH/INT/02/1459).
Complexity and Corporate Support Criteria

The criteria for determining operational complexity and corporate support for the MHFs are described below.

Complexity
Operational complexity level was extracted from MHF notification data and Safety Case Outlines and has been categorised according to the type and extent of chemical processing on site (Table L.6).

Table L.6: Complexity Level Categories

<table>
<thead>
<tr>
<th>Complexity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Many complex processes (high temperatures and pressures) using a large number of different equipment items. Large range of chemicals often present.</td>
</tr>
<tr>
<td>High</td>
<td>Some complex processing (high temperatures and pressures) using a range of different equipment items. Large range of chemicals often present.</td>
</tr>
<tr>
<td>Medium</td>
<td>Several basic processes. Often only small number of chemicals present.</td>
</tr>
<tr>
<td>Low</td>
<td>No processing. Small to large range of chemicals stored.</td>
</tr>
</tbody>
</table>

Corporate Support
Corporate support level potential has been determined as a function of:

1. resources available in-house to assist with Safety Case development,
2. access to safety specialists within the organisation including SMS knowledge,
3. existence of a corporate SMS, and
4. access to other MHFs (local or international) within the same organisation.

Corporate support categories, with indicative descriptions, are contained in Table L.7. These were determined from notification data, Safety Case Outline and discussions with the VWA inspectors assigned to the MHF. It does not reflect whether or not the corporate support was accessed during the Safety Case process or whether or not the corporate SMS was effectively implemented.
### Table L.7: Corporate Support Categories

<table>
<thead>
<tr>
<th>Corporate support level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant</td>
<td>Involvement of safety specialists (both Safety Case and SMS) from within the organisation. Corporate SMS exists. MHFs with relevant regulatory experience exist within the organisation to share their experience with Safety Case development/control measures/SMS etc.</td>
</tr>
<tr>
<td>Medium</td>
<td>Some in-house safety knowledge and experience. Corporate SMS may exist. MHFs (not as experienced or relevant as ‘significant’ category) exist within the organisation.</td>
</tr>
<tr>
<td>Limited</td>
<td>Limited in-house safety knowledge and skills. Limited access to or no MHFs within the organisation with Safety Case/MHF knowledge. No corporate SMS.</td>
</tr>
<tr>
<td>None</td>
<td>No access to safety specialists. No in-house resources for the Safety Case. No access to other MHFs within the organisation. No corporate SMS.</td>
</tr>
</tbody>
</table>