Economics and Industry Standing Committee

FLNG Safety Matters

Report No. 5
May 2015

Legislative Assembly
Parliament of Western Australia
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FLNG SAFETY MATTERS

Report No. 5

Presented by
Mr I.C. Blayney, MLA

Laid on the Table of the Legislative Assembly on 7 May 2015
Chairman’s Foreword

I am pleased to present this report by the Economics and Industry Standing Committee (the Committee) on our Inquiry into Floating Liquefied Natural Gas (FLNG) safety-related matters. The impetus for this Inquiry came from the Committee’s previous work on the economic impact of FLNG on Western Australia. Shell’s Prelude FLNG facility—a pioneering project and the first of its type to begin operating in Australian waters when it is commissioned in 2017—will be anchored in Commonwealth waters off the Western Australian Kimberley coast. Woodside has also announced that its preference for developing its Browse Basin resources is to use FLNG technology, and other operators are also considering using FLNG for their projects. It seems likely, then, that while FLNG is a very new technology, it has significant appeal within the petroleum industry.

During the Inquiry into the economic impact of projects such as Prelude and Woodside’s proposed Browse Basin development, considerable concern was raised in the relation to the safety of FLNG facilities. In particular, concerns were raised about the compact nature of the working environment relative to an onshore processing plant, the fact that FLNG proponents such as Shell and Woodside do not intend to de-man their facilities during cyclones, and the adequacy of emergency evacuation infrastructure and procedures.

The Committee took these concerns very seriously. The oil and gas industry is inherently dangerous and accidents do happen. Moreover, while major incidents are relatively rare, when they do happen they are often catastrophic. Incidents such as the Alexander L. Kielland platform capsize accident, the Piper Alpha platform disaster, Mumbai High North platform incident, the Montara oil spill and the Macondo—Deepwater Horizon disaster all bear witness to that sad fact. In light of the concerns raised, the Committee determined to inquire into matters relating to the safety of FLNG projects as well as industry and governments’ capacity and preparedness to respond to a safety or environmental incident involving FLNG.

A number of key points have emerged in the course of this Inquiry. First and foremost, it is the responsibility of the FLNG facility operator to ensure that risks relating to human safety and environmental protection are reduced to as low as reasonably practicable (ALARP). In short, safety is the operator’s responsibility. It is essential that operators develop and maintain a culture of safety throughout their organisations to ensure that appropriate procedures are developed, continually enhanced, and always followed.

While safety is the operator’s responsibility, government does have a major role to play. At the Commonwealth level, it is critical that the National Offshore Petroleum
Safety and Environmental Management Authority (NOPSEMA), as the industry regulator, is properly resourced to carry out its regulatory functions. Perhaps especially because FLNG technology is new, it is critically important that NOPSEMA’s assessment and scrutiny of facilities like Prelude is rigorous and effective. It is also important that the Western Australian Government takes a more proactive role in assessing the long-term infrastructure requirements in the Kimberley region. To say that all costs associated with a project must be borne by the operator fails to adequately consider the important role that infrastructure plays in the overall development of a region such as the Kimberley.

Perhaps the question on everyone’s mind at this time is: ‘Is FLNG safe?’ That is a question that the Committee cannot answer. What the Committee can say, though, is that through this Inquiry members have become aware of the considerable efforts made by Shell in working to ensure that the risks associated with its Prelude FLNG facility are appropriately reduced. Ultimately, it is up to NOPSEMA to assess the information provided by Shell and determine whether risks are, in fact, ‘as low as reasonably practicable’.

What this report does do is provide a qualitative assessment of the evidence and add to the body of information publicly available in relation to FLNG regulation and safety. The Committee hopes that it will also serve as a useful starting point for any Members who wish to become better informed as to how workplace and environmental safety in Australia’s offshore petroleum industry—an industry that is fundamental to the Western Australian economy—is regulated.

I would like to thank my fellow Committee members, Hon Fran Logan, MLA, Deputy Chair, Mr Jan Norberger, MLA, Mr Peter Tinley, AM, MLA and Mr Shane Love, MLA. Without their significant contributions this Inquiry would not have been possible. I would also like to thank the Committee’s Principal Research Officer, Dr Loraine Abernethie, and Research Officer, Mr Michael Burton, for their assistance throughout this Inquiry.

Mr I.C. Blayney, MLA
CHAIRMAN
Contents

Executive Summary i
Ministerial Response xi
Findings and Recommendations xiii

Chapter 1 Introduction 1

Introduction 1
The Development of FLNG projects 3
Safety matters 5
Major accidents 6

  Alexander L. Kielland platform capsize accident 7
  Piper Alpha platform disaster 9
  Mumbai High North platform incident 10
  Montara Development Project wellhead platform incident 12

Macondo—Deepwater Horizon disaster 14
Applying the lessons from history 16

The Committee 17
Conduct of the Inquiry 18
Items of note 19

Chapter 2 Jurisdictions and areas of responsibility 21

FLNG technology 21
Australian maritime jurisdictions 22

  Territorial Sea Baseline 23
  Coastal waters 23
  Territorial sea 23
  Exclusive Economic Zone 23

  The development of Australia’s maritime jurisdiction 24

Federal jurisdiction 28
### Chapter 3  The Australian regulatory regime

<table>
<thead>
<tr>
<th>Sections</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Australian regulatory regime</td>
<td>39</td>
</tr>
<tr>
<td>Objective based regulation</td>
<td>40</td>
</tr>
<tr>
<td>ALARP</td>
<td>42</td>
</tr>
<tr>
<td>From prescriptive to objective-based regulation</td>
<td>45</td>
</tr>
<tr>
<td>The Robens Report</td>
<td>46</td>
</tr>
<tr>
<td>The Cullen Inquiry</td>
<td>50</td>
</tr>
<tr>
<td>Advantages of objective-based regulation</td>
<td>52</td>
</tr>
<tr>
<td>Development of Australia’s safety case regime</td>
<td>53</td>
</tr>
<tr>
<td>NOPSEMA and objective-based regulation</td>
<td>57</td>
</tr>
<tr>
<td>Occupational health and safety</td>
<td>59</td>
</tr>
</tbody>
</table>

### Chapter 4  Regulation via safety cases

<table>
<thead>
<tr>
<th>Sections</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>63</td>
</tr>
<tr>
<td>Safety cases</td>
<td>63</td>
</tr>
<tr>
<td>The Cullen Inquiry</td>
<td>64</td>
</tr>
<tr>
<td>Australia learns from history</td>
<td>65</td>
</tr>
<tr>
<td>No safety case, no facility</td>
<td>67</td>
</tr>
<tr>
<td>What is a safety case?</td>
<td>69</td>
</tr>
<tr>
<td>Required contents of a safety case</td>
<td>70</td>
</tr>
<tr>
<td>Facility description</td>
<td>70</td>
</tr>
<tr>
<td>Formal safety assessment—identification of hazards and risks</td>
<td>72</td>
</tr>
<tr>
<td>Safety management system</td>
<td>77</td>
</tr>
</tbody>
</table>
Reducing risk to ALARP levels through safety in design

Safety in design

Assessment of the safety case by NOPSEMA

Safety case assessment

Early Engagement Safety Case

Validation

Fair and technically competent assessment

Fee-for-service assessment

Monitoring of ongoing implementation of safety case

Maintaining ALARP in a safety case regime

Consultation with the workforce

<table>
<thead>
<tr>
<th>Chapter 5</th>
<th>Prelude safety in design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hull design</td>
<td></td>
</tr>
<tr>
<td>Product storage at sea—overcoming the challenge of sloshing</td>
<td></td>
</tr>
<tr>
<td>The turret mooring system</td>
<td></td>
</tr>
<tr>
<td>Designed and tested to ride out a storm</td>
<td></td>
</tr>
<tr>
<td>Designing for the metocean conditions</td>
<td></td>
</tr>
<tr>
<td>Producing LNG at sea—the importance of facility layout</td>
<td></td>
</tr>
<tr>
<td>Offloading at sea</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 6</th>
<th>Environmental management regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensuring environmental safety</td>
<td></td>
</tr>
<tr>
<td>Offshore Project Proposals</td>
<td></td>
</tr>
<tr>
<td>Environment Plans</td>
<td></td>
</tr>
<tr>
<td>Assessment</td>
<td></td>
</tr>
<tr>
<td>The Prelude Project Subsea Installation Environment Plan Summary</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
</tr>
<tr>
<td>81</td>
</tr>
<tr>
<td>85</td>
</tr>
<tr>
<td>85</td>
</tr>
<tr>
<td>87</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>91</td>
</tr>
<tr>
<td>95</td>
</tr>
<tr>
<td>97</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>105</td>
</tr>
<tr>
<td>113</td>
</tr>
<tr>
<td>114</td>
</tr>
<tr>
<td>115</td>
</tr>
<tr>
<td>117</td>
</tr>
<tr>
<td>119</td>
</tr>
<tr>
<td>121</td>
</tr>
<tr>
<td>124</td>
</tr>
<tr>
<td>130</td>
</tr>
<tr>
<td>135</td>
</tr>
<tr>
<td>135</td>
</tr>
<tr>
<td>136</td>
</tr>
<tr>
<td>137</td>
</tr>
<tr>
<td>140</td>
</tr>
<tr>
<td>144</td>
</tr>
<tr>
<td>Chapter 7</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>Emergency management: No different from other operations?</td>
</tr>
<tr>
<td>Emergency response plans</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 8</th>
<th>What happens during a cyclone?</th>
<th>161</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe weather events</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>Cyclone warnings</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>Cyclone avoidance for vessels</td>
<td>163</td>
<td></td>
</tr>
<tr>
<td>Maintain skeleton crew or evacuate?</td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>FLNG facilities in a severe weather event</td>
<td>169</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chapter 9</th>
<th>What happens if there’s an accident or other emergency?</th>
<th>179</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fires and explosions</td>
<td>179</td>
<td></td>
</tr>
<tr>
<td>Evacuation, escape, and rescue and recovery strategy</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>Emergency evacuation</td>
<td>182</td>
<td></td>
</tr>
<tr>
<td>Medical emergencies and evacuation</td>
<td>186</td>
<td></td>
</tr>
<tr>
<td>Rescue and recovery—international responsibilities</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>Search and rescue by the Australian petroleum industry</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>The need for coordination</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>Training for emergency preparedness</td>
<td>203</td>
<td></td>
</tr>
<tr>
<td>Emergency response exercises</td>
<td>203</td>
<td></td>
</tr>
<tr>
<td>Knowledge sharing</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>Operators as control authorities</td>
<td>208</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 10  What happens if there’s a loss of containment?  213
Oil pollution  213
Subsea First Response  214
Dealing with oil spill pollution  218
The role of government  224
The reality of FLNG petroleum products  226

Chapter 11  Infrastructure: Whose responsibility is it?  231
Introduction  231
Value of the petroleum industry to Western Australia  232
The Northern Carnarvon Basin  233
Tropical Cyclone Olwyn  235
The Browse Basin  237
Onshore infrastructure in the Kimberley  240
Hospital infrastructure  241
Airfield infrastructure  245
Port Infrastructure  249
Infrastructure is the responsibility of the project proponent/operator  252
Infrastructure and state development  254
FLNG presents a challenge to the expert regulator model  256
Emergency response command  258
The need for clarity  265
The need for a regional emergency response command  269
<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inquiry Terms of Reference</td>
<td>271</td>
</tr>
<tr>
<td>2</td>
<td>Committee’s functions and powers</td>
<td>273</td>
</tr>
<tr>
<td>3</td>
<td>Submissions received</td>
<td>275</td>
</tr>
<tr>
<td>4</td>
<td>Hearings</td>
<td>277</td>
</tr>
<tr>
<td>5</td>
<td>Briefings</td>
<td>281</td>
</tr>
<tr>
<td>6</td>
<td>Glossary</td>
<td>289</td>
</tr>
<tr>
<td>7</td>
<td>Browse FLNG Development Major Accident Events Summary</td>
<td>293</td>
</tr>
<tr>
<td>8</td>
<td>Example of a High Potential Incident Alert</td>
<td>295</td>
</tr>
</tbody>
</table>
Executive Summary

The Economics and Industry Standing Committee (the Committee) undertook this Inquiry into FLNG safety-related matters because of concerns raised during its previous Inquiry into the economic impact of FLNG technology on various sectors of the Western Australian economy. Chapter 1 of this report outlines those concerns and the Committee’s current focus on measures taken by FLNG proponents to ensure worker safety, the adequacy of the state’s emergency preparedness and response capacity, and the role of state and Commonwealth governments in relation to an FLNG facility emergency.

This chapter also very briefly outlines the development of FLNG technology and notes that, in time, there will possibly be a number of FLNG facilities permanently moored off the Western Australian coast, each requiring support vessels and onshore support facilities.

Chapter 1 also notes that the oil and gas industry is inherently hazardous and acknowledges the statements of commitment from major project proponents that safety and environment protection is a priority. To demonstrate the importance of safety in the offshore petroleum industry, several major incidents involving offshore petroleum facilities are described, namely the capsize of the Alexander L Kielland platform, the Alpha Piper platform explosion and fire, the Montara wellhead platform incident, and the Deepwater Horizon floating rig blowout. Overall, these and other offshore incidents have shown that major accidents do occur on offshore petroleum facilities for a variety of reasons, and with often catastrophic consequences. They also demonstrate the need for a robust regulatory regime and highlight the potential risks to energy security. Given such incidents, it is essential that the lessons of history are learned.

Attention is also drawn to the fact that, while FLNG technology presents the same risks as other offshore petroleum activities, it also has some specific characteristics that need particular consideration in relation to safety and environmental protection.

Chapter 2 provides a brief outline of the way in which Australia’s Commonwealth and state maritime jurisdictions have been determined. Generally speaking, jurisdiction over Australia’s offshore petroleum resources has been determined through a combination of the United Nations Convention on the Law of the Sea, Commonwealth legislation and the spirit of cooperative federalism. As with all states and Territories, Western Australia has jurisdiction over its coastal waters, which are mainly those waters that are within three nautical miles of the coastal low water line. As FLNG technology will most likely be used to access resources in increasingly remote locations,
FLNG facilities used to develop currently known petroleum resources off the Western Australian coastline will most likely exclusively operate in Commonwealth waters.

The development of offshore petroleum resources in Commonwealth waters is primarily regulated through the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (OPGGS Act) and its associated regulations. Chapter 2 notes that under this Act, an FLNG operation in Australian waters is defined and regulated as a petroleum ‘facility’. This chapter also briefly describes the Commonwealth and state regulatory responsibilities for the regulation of petroleum resources. It notes that the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is responsible for oversight of petroleum facilities (that is, those that are permanently anchored) in Commonwealth waters, while the Australian Maritime Safety Authority (AMSA) is responsible for the regulation of offshore petroleum infrastructure—such as support vessels and FLNG tankers—that does not meet the definition of a facility under the OPGGS Act.

Petroleum activity in Western Australian coastal waters is regulated by the Department of Mines and Petroleum (DMP) under the Offshore Petroleum (Submerged Lands) Act 1967 (WA) and its associated regulations. Clearly, some infrastructure such as support vessels will operate in both Commonwealth and state jurisdictions, and the efforts being made to minimise and/or eliminate regulatory differences are acknowledged in Chapter 2. This chapter also explains that while an offshore petroleum operator is responsible for responding to an offshore incident, the operator may seek the assistance of government through the relevant regulator, that is, through NOPSEMA or through the Department of Transport in Western Australia.

With Chapters 1 and 2 setting the broad scene for the Inquiry, Chapter 3 explains in more detail the Australian regulatory regime as it applies to offshore petroleum resources. Importantly, the underlying concept of the regulatory regime, namely objective-based regulation, is explained. This non-prescriptive method of regulation was introduced in many world jurisdictions following the 1988 Piper Alpha disaster. Objective-based regulation has two basic principles: first, the offshore facility’s operator is solely responsible for the safe operation of the facility; and second, the operator must ensure and demonstrate that its operation’s risks have been reduced to as low as reasonable practicable (ALARP).

Given the importance of the concept of ALARP, Chapter 3 details the legislative requirements for safety and environmental impacts and risks to be reduced to levels accepted by NOPSEMA as ALARP. Noting that ALARP does not mean as low as reasonably affordable, Chapter 3 also summaries two major reports, the 1972 Robens Report and the 1990 report from the Cullen Inquiry into the Piper Alpha disaster. The very significant impact these reports had on the development of the objective-based regulatory regimes in Europe and Australia is outlined.
Australia’s objective-based regulatory regime for the offshore petroleum industry rests on the obligation of operators to provide to NOPSEMA both a safety case and an environment plan, both of which demonstrate to NOPSEMA’s satisfaction that risks have been reduced to ALARP levels. The development of Australia’s safety case regime and of NOPSEMA as regulator is outlined in Chapter 3 and a brief summary of NOPSEMA’s role is provided. This chapter also notes that the occupational health and safety of workers employed on, or in relation to, an offshore petroleum facility must also be addressed as part of the facility’s safety case.

Chapter 4 concentrates on the requirement for operators to submit a safety case to NOPSEMA, and outlines the influence of the Cullen Inquiry on the development of the safety case regime. A petroleum facility cannot operate in Commonwealth waters without a safety case that has been accepted by NOPSEMA, a fact well-recognised by industry. Chapter 4 describes in detail the required contents of a safety case, including a facility description, a formal safety assessment of hazards and risks, and a detailed description of the safety management system.

Having set out the regulatory requirements, Chapter 4 also discusses the concept of ‘safety in design’, the method used by industry to incorporate safety and risk management into a facility’s design. This chapter also outlines NOPSEMA’s responsibilities in relation to assessment of safety cases, as well as its early engagement safety case policy and validation policy. The important fact that NOPSEMA’s acceptance of a safety case does not certify that the facility is guaranteed to be safe is also acknowledged here.

Given that Australia operates under an objective-based regime, with NOPSEMA having the role of expert regulator, it is essential that NOPSEMA staff are able to provide a fair and technically competent assessment. Chapter 4 notes that NOPSEMA has been given exemptions in relation to public service salary levels to allow it to recruit and retain experienced professionals. Chapter 4 also points out that NOPSEMA operates on a fee-for-service basis and provides information on the types of submissions received and assessed, including safety cases and environment plans.

Part of NOPSEMA’s responsibilities is to monitor the ongoing implementation of a safety case. NOPSEMA carries out this responsibility through a process of planned inspections and, where incidents have occurred, investigations. As Chapter 4 demonstrates, it is through this process that NOPSEMA aims to ensure that risk levels are maintained at ALARP.

Concerns were raised with the Committee in relation to the effectiveness of the safety case regime. Particular concerns were raised in relation to assessing ALARP levels for new technologies and for ensuring that ALARP levels could be amended as technology
developed. NOPSEMA’s assurance that ALARP is not fixed and that safety cases must change to reflect necessary safety improvements is also provided in Chapter 4.

Discussion of the issue of workforce participation in the development of a facility’s safety case is also included in Chapter 4. Workforce participation is a clear requirement of the legislation and is required for both new safety cases and for the revisions of existing safety cases. NOPSEMA, in assessing the safety case, must also assess whether there has been effective consultation with, and participation by, members of the workforce. This chapter also outlines the Committee’s understanding of the current level of engagement by Shell with its workforce.

With the regulatory requirements for a safety case set out in Chapter 4, Chapter 5 discusses the safety in design elements of Shell’s Prelude facility. This includes discussion of the hull design. Important elements here are the size, weight and high freeboard of the Prelude facility itself, whichponents argue add to stability and allow Prelude to withstand severe weather conditions. A further hull design element is the twin storage tank design, which aims to reduce the dangerous destabilising effect of sloshing in the tanks.

Another hull design safety element discussed in Chapter 5 is the turret mooring system. The Prelude facility will be permanently moored in position, with mooring chains and all gas flow lines attached via an immense cylindrical turret at one end of the facility. The key aspect of the turret design is the ability of Prelude to swivel around it, thus allowing the facility to weathervane according to prevailing metocean conditions. According to Shell, its design and testing of the Prelude facility for metocean conditions confirmed that the facility will be safe to inhabit during a one in 10,000 year storm. To provide a better understanding of what metocean conditions might be in the Browse Basin—the site of the Prelude facility—information on tropical cyclone formation and categorisation is also included in Chapter 5.

As well as the safety elements of the hull, the Prelude facility’s topside also includes safety in design features. The production of LNG at sea adds an additional layer of complexity to existing floating, production, storage and offloading (FPSO) vessel technology. There are specific risks associated with producing FLNG at sea and Shell’s evidence is that the Prelude facility topside was designed with safety as the paramount consideration. Chapter 5 describes the facility layout, which has been designed to limit the consequences of accidents. These include the positioning of the accommodation and helidecks at the opposite end of the facility to the production units; protective coating of the steel structures to reduce the risks associated with handling cryogenic material; the incorporation of safety gaps between topside components; and escape routes that run along the full length of the facility. Concerns voiced about the layout of the facility and whether it would ensure worker safety are also outlined in Chapter 5.
The safety in design associated with offloading cryogenic material from an FLNG facility to a carrier docked alongside is also discussed. To address this major challenge, the Prelude facility’s loading arm has been designed to adjust to, and cope with, movements from both the facility and the vessel. Stability during loading will be assisted by thrusters employed to maintain a constant fixed position for Prelude.

Finally, Chapter 5 reiterates the requirement for these safety in design features to be assessed by NOPSEMA as part of its safety case assessment and approval process.

Chapter 6 turns attention to the environmental regulation of Australia’s offshore petroleum industry. Environmental regulation occurs through the OPGGS Act and the Environment Protection and Biodiversity Conservation Act 1999 (Cth). While there are some more prescriptive elements in environmental regulation, it is largely an objective-based regime under which proponents must submit an Offshore Project Proposal and associated Environment Plans to NOPSEMA for assessment and acceptance. These must demonstrate to NOPSEMA’s satisfaction that the project will operate in accordance with Australia’s statutory environmental requirements, including the need to reduce risk to ALARP.

The requirements for an Offshore Project Proposal and associated Environment Plans are described in Chapter 6. Key amongst these are the need to demonstrate consideration of the impact on, and risks to, matters of National Environmental Significance, the requirement for an Oil Pollution Emergency Plan and a demonstration that the proponent has the financial capacity to meet the costs and any potential liabilities associated with the proposed activity. Chapter 6 also outlines NOPSEMA’s assessment responsibilities and the matters that must be addressed in Environment Plans before it can be accepted.

Summaries of Environment Plan submissions made to NOPSEMA are published on its website. To date, four Environment Plan summaries for the Prelude facility have been made available in this way. Three of these relate to drilling and the fourth to the installation of the facility’s subsea infrastructure. The Prelude Project Subsea Installation Environment Plan Summary is outlined in detail in Chapter 6 as a useful example of the type of information made publicly available. This includes a description of the physical and biological environments in which Prelude will operate; potential impacts of the proposed activities; the potential hazards and events—particularly fuel spills and loss of containment of hydrocarbons—and their control measures; corporate policies on health, safety, security and environment; key stakeholders consulted during the preparation of the Environment Plan; and Shell’s emergency response strategies and procedures.

While proponents of FLNG technology argue that there are no technical reasons why this new technology cannot be safer than other petroleum industry technology, history
shows that the offshore recovery and production of petroleum resources is an inherently risky endeavour, one that can lead to catastrophic outcomes. While such events are relatively rare, Australia’s regulatory regime requires project proponents to demonstrate via their Safety Cases and Environment Plans that they have identified risks that could lead to major accident events (MAE) or marine oil pollution (MOP), and that they have the appropriate emergency management responses in place. The requirement for offshore petroleum operations to have an evacuation, escape and rescue analysis (EERA) and a fire and explosion risk analysis (FERA) is discussed in Chapter 7.

Project proponents have advised that incident management and response processes for FLNG facilities will be the same as for other facilities they operate. However, a number of concerns about the emergency capacity and preparedness of FLNG facilities were raised. These concerns centred around evacuation procedures, lifeboat and infield support vessel capacity and the risks associated with the compression of processing facilities into a relatively small space. These concerns are also outlined in Chapter 7.

Following the brief outline of the regulatory requirements for emergency response in Chapter 7, Chapters 8, 9 and 10 discuss the procedures and resources available on an FLNG facility in the event of a cyclone, an accident or other emergency, and a loss of containment or spill, respectively. These chapters necessarily rely heavily on information provided by Shell as the Prelude facility is the most advanced at this time in terms of planning and seeking regulatory approval for operating in Australian waters. These chapters also demonstrate the importance of NOPSEMA’s role as regulator and the need for the Authority to be able to effectively fulfil its assessment and monitoring role.

FLNG facilities that will operate off the Western Australian coast will be located in a region subject to extreme weather events including cyclones. The provision of accurate and timely information is essential to the safe operation of the offshore petroleum industry and Chapter 8 briefly outlines the information Australia’s Bureau of Meteorology provides to the industry.

Generally, the safest course of action for a vessel at sea in relation to cyclones is to move position to avoid them. For other offshore infrastructure, the safest options have been to significantly reduce manning levels or to totally de-man, leaving no personnel on board. These three options, together with industry’s staged cyclone response, are discussed in Chapter 8.

Shell and Woodside FLNG facilities will not de-man during a cyclone as the Prelude-type facility has been designed to withstand a one in ten thousand year weather event. Nevertheless, this approach has been the cause of considerable concern. Most of this
centred on the fact that the design had not yet been tested in situ and on the ability of the Prelude facility’s accommodation unit to provide a safe refuge for workers. As Chapter 8 shows, both Woodside and Shell have confidence in the FLNG facility design and their policies and systems relating to cyclone preparedness and response. While offshore operators may have appropriate policies and response plans in place, Chapter 8 also raises the need for all those working on, or in support of, an FLNG facility to be trained to respond appropriately in an extreme weather event.

Again, while major accident events such as fires and explosions on offshore facilities may be relatively rare, they do happen. Chapter 9 briefly outlines the Prelude facility’s emergency response plans and strategies as they relate to fires, explosions and cold spills, as well as evacuation, escape, and rescue and recovery. The focus of Chapter 9, though, is on emergency evacuation, including medevac and search and rescue. In the event of an emergency requiring evacuation, there are three primary methods provided on the Prelude facility: helicopter, life boats and life rafts. The infield support vessels would also be used if required. The numbers of people able to be accommodated in each of these is also provided in Chapter 9. This chapter also notes that, rather than use a Billy Pugh to transfer people from the facility, a FROG crane transfer device will be used.

In relation to medical emergencies and evacuations, Chapter 9 describes the guidelines provided by the International Association of Oil & Gas Producers for managing the health of those working in the industry. These guidelines describe what the Association considers to be appropriate levels of first responder and health-care professionals, and the medical structures that should be in place to provide primary, secondary and tertiary care to injured workers. Both Shell and Woodside have stated that they will have adequate on-board medical resources for their FLNG facilities as well as the capacity to medevac injured workers to shore and, if necessary, to transfer to Perth or Darwin for further treatment. The oil and gas industry’s aero-medical evacuation service, West Australia Resources Aero Medical Evacuation (WARAME), is also described in Chapter 9.

FLNG facility operators are also required to have in place adequate search and rescue (SAR) capability. Under Australia’s objective-based regulatory regime, the onus is on the operator to ensure that adequate emergency response capability, including SAR, exists in the remote regions in which it wants to establish an offshore facility. As Chapter 9 shows, operators have come to share SAR infrastructure such as helicopters.

It is likely that most offshore petroleum facility SAR situations can be immediately handled by the operator. However, there may be occasions when an operator requests external assistance. Chapter 9 explains that the Commissioner of Western Australia Police is the Hazard Management Authority responsible for SAR in the state’s jurisdiction, while the Australian Maritime Safety Authority is responsible for SAR in
Commonwealth waters. Nevertheless, there is an Inter-Governmental Agreement on National SAR Response Arrangements which makes provision for the coordination of search and rescue in the Australian region.

As with all aspects of FLNG safety, ensuring the workforce is adequately trained and prepared to respond appropriately to an SAR emergency is essential. One favoured method to ensure response-readiness is to exercise procedures. Industry and government involvement in such training exercises is described in Chapter 9. This chapter also outlines Shell’s FLNG operator training that is taking place at the Australian Centre for Energy and Process Training (ACEPT) in Henderson, Western Australia. Given that neither industry nor government operating alone has the capacity to manage high consequence offshore incidents, the need for a collaborative approach to emergency response is also discussed in Chapter 9. While a collaborative approach is necessary, the government regulatory bodies are not emergency or pollution response agencies, and it must be remembered that the primary responsibility to respond always lies with the operator.

The third type of offshore petroleum major event considered in this report is loss of containment, and this is the subject of Chapter 10. As with matters concerning workforce and facility safety, the operator is responsible for any environmental impact arising from the development and operation of the facility. No offshore petroleum activity can occur without NOPSEMA being satisfied that the operator has the capacity and capability to respond quickly to a loss of containment and limit any environmental damage that may arise.

A loss of containment from an offshore petroleum facility, whether at the wellhead or otherwise, will result in petroleum being released into the ocean. This is potentially a very serious issue, and one that requires an immediate response. Chapter 10 describes the Australian petroleum industry’s Subsea First Response Toolkit, which consists of source control equipment such as capping and containment equipment designed to stop a petroleum spill at its source.

In the event of an oil spill there are generally four methods of treatment, depending on the composition of the petroleum, location, accessibility and metocean conditions at the time. These four methods—natural biodegradation, containment and collection, chemical dispersants, and biological agents—are described in Chapter 10. This chapter also discusses the industry’s mutual aid agreements in place under the Australian Marine Oil Spill Plan. This includes the establishment of the Australian Marine Oil Spill Centre (AMOSC), a not-for-profit company established by participating oil companies in 1991. AMOSC operates the Australian petroleum industry’s major oil spill response facilities; maintains stockpiles of oil spill equipment and supplies in Geelong, Fremantle, Exmouth and Broome; and offers training to workers in the Australian petroleum industry.
The Commonwealth and Western Australian Governments’ role in responding to oil spill pollution is also outlined in Chapter 10. This chapter concludes with a discussion of the type of natural gas hydrocarbons that will be developed by Shell’s Prelude FLNG facility—namely LNG, LPG and condensate—and the risks posed by a loss of containment of these products. It seems that these products pose less of a risk to the marine environment than is the case for heavier petroleum products, such as crude oil (although the methane component of LNG is a significant greenhouse gas). While Shell’s Prelude facility has been designed to meet current world’s best practice environmental standards and must satisfy NOPSEMA that risks have been reduced to ALARP, the threat of oil spill pollution is ever present in the production of petroleum products. This fact reinforces the need for NOPSEMA to effectively perform its regulatory functions.

Chapter 11 outlines three major pieces of infrastructure necessary to the safe operations of FLNG facilities, namely medical facilities, airports and ports. The chapter outlines the facilities and services available at the Broome Regional Health Campus, the Lombadina airport and the Broome port. In doing so, it also raises particular concerns in relation to each of these facilities. The lack of infrastructure in the Kimberley region raises the question of whose responsibility it is to provide the necessary safety-related infrastructure. As Chapter 11 notes, under Australia’s objective-based regulatory regime, the costs relating to a project, including infrastructure costs, must be borne by the project proponent. This view, which is that adopted by the Department of State Development, does not consider the potentially negative consequences a strict adherence to an objective-based philosophy might have on state development.

Chapter 11 also discusses the challenge that FLNG facilities necessarily pose for NOPSEMA as the expert regulator. Given this, it is essential that FLNG facilities project proponents and operators are particularly candid in sharing information with NOPSEMA. Only then can the authority reasonable conclude that FLNG facility safety and environmental risks have been reduced to ALARP.

The chapter concludes with a discussion of the uncertainty around the role of government authorities in offshore emergency response coordination. It also notes the lack of consideration given to the aggregate effect of multiple FLNG operations on enabling safety infrastructure and emergency response command.
Ministerial Response

In accordance with Standing Order 277(1) of the Standing Orders of the Legislative Assembly, the Economics and Industry Standing Committee directs that the Minister for State Development, the Minister for Mines and Petroleum, the Minister for Emergency services and the Minister for Transport report to the Assembly as to the action, if any, proposed to be taken by the Government with respect to the recommendations of the Committee.
Findings and Recommendations

Finding 1 Page 4
There is significant interest within the petroleum industry in using FLNG technology to
develop oil and gas reserves in Australian waters.

Finding 2 Page 27
State sovereignty generally extends to cover all land within a state’s borders and the
first three nautical miles of ocean from the low water line along the coast and offshore
islands.

Finding 3 Page 28
Regulatory responsibility for offshore petroleum resources depends on whether the
resources are located in state or Commonwealth waters. Australia’s petroleum
resources are predominantly in Commonwealth waters.

Finding 4 Page 29
Because an FLNG is permanently moored above the petroleum resource it is
developing, under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth)
it is defined and regulated as a ‘facility’ as defined in that Act.

Finding 5 Page 31
The National Offshore Petroleum Safety and Environmental Management Authority is
the Commonwealth authority responsible for the regulation of all offshore petroleum
activities involving infrastructure that is permanently fixed in some way to the sea floor
(a petroleum facility).

Finding 6 Page 32
The Australian Marine Safety Authority is the Commonwealth authority responsible for
regulating all shipping activities in Australian waters.

Finding 7 Page 32
When a ship becomes tethered to a petroleum facility, regulatory jurisdiction over that
vessel passes from the Australian Marine Safety Authority to the National Offshore
Petroleum Safety and Environmental Management Authority.

Finding 8 Page 35
Petroleum activities undertaken in Western Australian coastal waters are regulated by
the Western Australian Government.
Finding 9  
In the event of an emergency, an operator may decide to seek the assistance of government. For operations in Commonwealth waters, the coordination of the response would most likely be by either the Offshore Petroleum Incident Coordination Committee or the Australian Maritime Safety Authority, depending on the type of emergency.

For operations in state waters, an assisted response would be coordinated by either the Department of Mines and Petroleum or the Department of Transport, depending upon the scope of the emergency event.

Finding 10  
The offshore petroleum industry in Australia is subject to objective-based regulation, which makes the operator responsible for identifying the safety and environmental risks associated with its proposed activities and satisfying the regulator that these risks will be appropriately managed and mitigated.

Finding 11  
The regulatory regime that applies to Australia’s offshore petroleum industry requires operators to satisfy the regulator that identified risks have been reduced to levels that are as low as reasonably practicable.

Finding 12  
As low as reasonably practicable does not mean as low as reasonably affordable. Rather, it means assessing and adopting appropriate risk control measures until the incremental benefit of further measures is outweighed by other issues such as the cost, time and effort required to implement the measure.

Finding 13  
Offshore petroleum facilities, including FLNG facilities, cannot operate in Commonwealth waters without a safety case that has been assessed and approved by the National Offshore Petroleum Safety and Environmental Management Authority.

Finding 14  
The offshore petroleum industry regards the safety case regime as world’s best practice.

Finding 15  
A safety case is a body of evidence provided by an operator to the regulator to demonstrate that risks and hazards associated with the proposed development have been identified and that the proposed safety management system will reduce risks to a level that is as low as reasonably practicable.
Finding 16
A safety case in respect of an offshore petroleum facility must contain three main elements, being:

• a detailed description of the facility;
• a detailed description of the formal identification and assessment of the hazards and risks; and
• a detailed description of the comprehensive and integrated hazard management system.

Finding 17
As safety is crucial to any offshore petroleum project, reducing risk levels to as low as reasonably practicable requires hazard and risk management to be incorporated into the design phase of a project.

Finding 18
Under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Cth), the National Offshore Petroleum Safety and Environmental Management Authority is responsible for assessing a safety case to determine whether the identified hazards and risks have been reduced to as low as reasonably practicable.

Finding 19
The National Offshore Petroleum Safety and Environmental Management Authority’s Early Engagement Safety Case policy allows the Authority to engage with an operator proposing a new technology facility during the design process and, thus, contribute to the safer design of the proposed facility.

Finding 20
Shell engaged with the National Offshore Petroleum Safety and Environmental Management Authority through an Early Engagement Safety Case process during the Front End Engineering and Design stage of the Prelude facility.

Finding 21
The National Offshore Petroleum Safety and Environmental Management Authority may require a facility operator to provide a written statement by an independent validator in relation to the design, construction and installation of the proposed facility or any significant changes to an existing facility.

Finding 22
It is a National Offshore Petroleum Safety and Environmental Management Authority policy to always request a written independent validation in relation to a new facility.
Finding 23  Page 94
The National Offshore Petroleum Safety and Environmental Management Authority’s acceptance of a facility’s safety case does not certify the safety of the facility. Rather, it represents the Authority’s acceptance that the operator has measures in place that reduce risk to levels that are as low as reasonably practicable.

Finding 24  Page 95
The National Offshore Petroleum Safety and Environmental Management Authority uses the expert regulator model, which makes it essential for the Authority to employ industry-trained experts with the appropriate skills and competencies to allow them to conduct technically competent assessments and draw fair conclusions.

Finding 25  Page 97
The National Offshore Petroleum Safety and Environmental Management Authority operates on a cost recovery basis, with industry paying fees for the Authority’s services.

Finding 26  Page 97
The National Offshore Petroleum Safety and Environmental Management Authority monitors an operator’s continued compliance with a facility’s safety case through a system of planned inspections and risk-based assessments.

Finding 27  Page 100
The National Offshore Petroleum Safety and Environmental Management Authority’s Planned Inspection policy requires planned inspections of continuously-manned facilities to be carried out twice a year.

Finding 28  Page 103
A safety case is not a static document. As operators are required to maintain risk levels to as low as reasonably practicable, the safety case must be changed to reflect any changes on the facility and any safety improvements deemed reasonable.

Finding 29  Page 107
The Australian regulatory regime for the offshore petroleum industry requires operators to undertake effective consultation with the workforce during the development of the safety case for a facility. There is no legal requirement for this to include unions or other representative bodies.

Finding 30  Page 107
The National Offshore Petroleum Safety and Environmental Management Authority, in assessing the safety case, must be satisfied that there has been effective participation of the workforce in developing or revising a safety case for a facility.
Finding 31 Page 133
FLNG project proponents have used a safety in design process to develop design solutions that reduce the risk levels to as low as reasonably practicable.

Finding 32 Page 133
The design of any safety feature of an FLNG facility must consider both the facility’s function and its particular operating environment.

Finding 33 Page 136
Offshore petroleum facilities, including FLNG facilities, cannot operate in Australian waters without an Offshore Project Proposal, together with all associated Environment Plans, first being accepted by the National Offshore Petroleum Safety and Environmental Management Authority.

Finding 34 Page 140
An Environment Plan for a proposed offshore petroleum activity must include:

- a detailed description of the activity to be undertaken and the environment in which it will occur;
- an evaluation of the environmental risks and impacts associated with the activity;
- a thorough environmental management implementation strategy;
- an Oil Pollution Emergency Plan; and
- a demonstration of the proponent’s financial capacity to meet the costs and potential liabilities of the proposed activity.

Finding 35 Page 140
An Oil Pollution Emergency Plan must describe the steps that will be taken in the event of an oil spill, including the control measures in place, response capacity and capability, and arrangement for monitoring the effectiveness of control measures.

Finding 36 Page 150
Under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth), the National Offshore Petroleum Safety and Environmental Management Authority is required to assess and, if appropriate, accept a project proponent’s Environment Plan. For an Environment Plan to be accepted the proponent must demonstrate both an awareness of risks and potential environmental impacts, and that appropriate strategies and procedures will be implemented in the event of a loss of containment.
The focus of the offshore petroleum industry’s emergency response management on major accident events reflects the reality that, while major accidents are relatively rare, their impact is often very serious, with the potential for fatalities to occur.

The offshore petroleum industry considers that there is no technical reason why FLNG technology cannot be made safer than other hydrocarbon operations. Whether FLNG facilities are safer and environmentally less risky than other offshore operations is yet to be proven.

Proponents of FLNG facilities in Australian waters will employ the same emergency management and progressive response processes for FLNG facilities as those adopted for their other offshore installations in the region.

The Offshore Petroleum Greenhouse Gas Storage (Safety) Regulations 2009 (Cth) require a project proponent’s safety case to include an evacuation, escape and rescue analysis, and a fire and explosion risk analysis.

Reliable, accurate and timely meteorological information is essential to the safe operations of all offshore petroleum facilities. This is especially the case for FLNG facilities which are necessarily permanently moored in position and unable to move position to avoid an extreme weather event.

Offshore petroleum operations in Australian waters receive meteorological information from the Australian Bureau of Meteorology and from other private expert services.

The offshore petroleum industry is satisfied with the quality of meteorological information it receives from the Bureau of Meteorology.

During a cyclone, the infield support vessels for an FLNG facility will not remain on standby; rather, as with all vessels, they will take standard maritime cyclone avoidance measures.
Finding 45  Page 171
There is significant concern in relation to FLNG facilities not de-manning during extreme weather events.

Finding 46  Page 178
The accommodation unit of the proposed FLNG facility has been designed to provide a fully self-contained life support environment for personnel during emergency events.

Finding 47  Page 178
Proponents of FLNG facilities are confident that the facility design makes not de-manning during extreme weather events the safest course of action.

Finding 48  Page 178
It is essential that all personnel on an FLNG facility and its infield support vessels receive the necessary training to ensure they are prepared to respond appropriately during an extreme weather event.

Finding 49  Page 178
All aspects of health and safety, including the mental health of workers during extreme weather events, must be included in the safety case and assessed by the National Offshore Petroleum Safety and Environmental Management Authority.

Finding 50  Page 183
There are three main means of evacuation from an FLNG facility—by helicopter, by life raft and by using infield support vessels. The particular method(s) used during an emergency event will depend upon the prevailing circumstances.

Finding 51  Page 186
Concern has been raised in relation to the capacity and safety of evacuation methods for FLNG facilities.

Finding 52  Page 186
Emergency evacuation plans will not be accepted by the National Offshore Petroleum Safety and Environmental Management Authority unless they adequately ensure the safety of all those at risk, regardless of their location on the facility and the numbers on board.

Finding 53  Page 186
All personnel working on or around an FLNG facility must receive appropriate training to ensure they are adequately prepared to respond during an emergency evacuation.
Finding 54 Page 189
Offshore petroleum operators’ medical response and medical evacuation procedures are generally a tiered process, from basic first-aid provision on site through to evacuation for diagnosis and treatment of complex medical conditions.

Finding 55 Page 191
The number and capability of medical staff on board an FLNG facility must be appropriate to that particular facility.

Finding 56 Page 193
To help overcome the difficulties associated with medical evacuations in remote and hazardous regions in Western Australia, some oil and gas companies have formed an aero-medical service named the Western Australia Resources Aero Medical Evacuation.

Finding 57 Page 193
Emergency medical evacuations from oil and gas facilities in the north west, including FLNG facilities, will be to the nearest capable facility, most likely Perth or Darwin.

Finding 58 Page 198
An adequate and available search and rescue capability is a regulatory requirement for all offshore petroleum facilities, including FLNG facilities. The search and rescue capability requirements for an FLNG facility are necessarily dictated by international best practice and the facility’s particular location and risk characteristics.

Finding 59 Page 198
Resource companies have invested in search and rescue equipment and services, which has helped address the paucity of search and rescue infrastructure along the Kimberley coastline.

Finding 60 Page 198
One way in which offshore oil and gas operators have discharged the regulatory requirements for search and rescue capability is to collaborate in providing their search and rescue facilities and, thus, enhance each individual operation’s capability.

Finding 61 Page 200
As safety is the responsibility of an offshore facility’s operator, in the event of an emergency the operator is the Control Agency.

Finding 62 Page 200
In severe emergency situations on offshore petroleum facilities, including FLNG facilities, government assistance would be required. In Commonwealth waters, this
assistance would be coordinated by the Australian Maritime Safety Authority; in state waters it would be coordinated by Western Australia Police.

**Finding 63**

Regular collaborative exercises which allow personnel to practise their roles are a critical component of an FLNG facility's search and rescue preparedness.

**Finding 64**

It is essential that the petroleum industry continues to share information on safety lessons learned and on safety incidents.

**Finding 65**

While safety cases and environmental plans necessarily contain proprietary information, the high-potential event summaries published on the Australian Petroleum Product and Exploration Association’s website need not contain proprietary information.

**Finding 66**

High-potential event summaries could usefully be made available to regulators and to government agencies. For example, it would assist the Western Australian Government in the preparation of Westplans.

**Finding 67**

As neither industry nor government has the capacity to manage high consequence offshore incidents alone, a collaborative approach to emergency response has developed.

**Finding 68**

Neither the National Offshore Petroleum Safety and Environmental Management Authority nor the Offshore Petroleum Incident Coordination Committee are emergency or pollution response agencies. The responsibility for emergency and pollution response lies with the facility’s operator.

**Finding 69**

As the risk of oil pollution is inherent to any petroleum facility, robust regulation and management practices are critical. It is essential that industry and government have a strong focus on the regulation and management of oil pollution risk and occurrences.

**Finding 70**

In the event of a loss of containment at the wellhead, the response needs to include targeted subsea source control.
Finding 71
The offshore petroleum industry's Subsea First Response Toolkit is designed to address a petroleum spill at its source.

Finding 72
In the event of oil pollution, the deployment of the appropriate resources is as important as the speed of response. It is important that the right method of treatment for a particular spill is applied in the most efficient manner.

Finding 73
To discharge their regulatory responsibility in relation to marine petroleum spills, a number of oil companies formed the Australian Marine Oil Spill Centre, which allows for the pooling of resources to respond to loss of containment events.

Finding 74
The Australian Marine Oil Spill Centre has a suite of oil pollution response resource stockpiles strategically located around Western Australia.

Finding 75
The Australian Marine Oil Spill Centre offers oil spill response training packages, and works collaboratively with industry and government agencies to help staff develop the practical skills and knowledge to allow them to respond appropriately in the event of marine oil pollution.

Finding 76
Emergency response exercises such as those conducted and coordinated by the Australian Marine Oil Spill Centre are of significant benefit to the offshore petroleum industry as it allows the competencies of staff and the operational status of equipment to be tested and maintained.

Finding 77
An FLNG-based exercise involving all relevant stakeholders should take place once the Prelude facility is operational.

Recommendation 1
The Western Australian Government encourage the Commonwealth Government, Shell and other stakeholders to conduct an emergency response exercise based on the Prelude facility as soon as possible following its commissioning.
Finding 78  Page 232
There is no lead agency responsible for coordinating strategic development of necessary safety-related infrastructure and services, particularly those necessary to meet likely future requirements.

Recommendation 2  Page 232
The Western Australian Government place on the COAG agenda the need for a lead agency for the coordination of necessary safety-related infrastructure and services.

Finding 79  Page 248
Project proponents are responsible for the development of all infrastructure, including support infrastructure, necessary for the safe operation of their facilities.

Finding 80  Page 248
Relocating and sealing the unsealed section of Cape Leveque Road will ensure the all-year availability of fuel supplies to Lombadina Airport and local communities.

Finding 81  Page 252
There is an apparent paucity of hydrographic information for the Lombadina/Cape Leveque area.

Finding 82  Page 270
There is a lack of transparency in relation to the emergency response plan information provided by operators in their safety cases.

Recommendation 3  Page 270
The Western Australian Government place on the COAG agenda the need for increased transparency from the National Offshore Petroleum Safety and Environmental Management Authority in relation to emergency response plan information.

Finding 83  Page 270
There is a lack of certainty surrounding the command structure in place for a major emergency incident at an offshore petroleum facility, particularly an incident requiring both a safety and environmental emergency response.

Recommendation 4  Page 270
The Western Australian Government place on the COAG agenda the need to develop a program to educate stakeholders in relation to the emergency response responsibilities of government agencies.
Finding 84

The aggregate effect of multiple FLNG operations on safety infrastructure and the complexity of an emergency response involving concurrent multiple FLNG operations is currently not being considered by government.

Recommendation 5

The Western Australian Government place on the COAG agenda the need for a regional plan for offshore emergency response, one that considers the aggregate effect of multiple FLNG operations on safety infrastructure and the complexity of an emergency response involving concurrent multiple FLNG operations.
Chapter 1

Introduction

1.1 In May 2014, the Economics and Industry Standing Committee (the Committee) tabled its first report on its Inquiry into the economic impact of floating liquefied natural gas (FLNG) on particular sectors of the Western Australian economy. In that report the Committee acknowledged the high level of industry investment in FLNG technology development, but noted that design assessment and scale testing are very different from actual deployment in challenging marine environments and with confined space operations.

1.2 During that Inquiry, the Committee received evidence from industry, government and unions raising concerns about the unproven nature of FLNG facilities, their reliability and safety.

1.3 While Chevron acknowledged a place for FLNG technology for ‘smaller, more remote gas fields’, the company also expressed the view that:

there is still a lot more development work that needs to be done before we would characterise floating LNG as a proven technology. ... For us, there are still some unanswered questions, including the safety case for extreme weather locations—those locations, for example, including high or frequent cyclone areas—and questions such as: how is the vessel and the people on the vessel managed during these extreme weather events, and how are annual plant maintenance turnarounds conducted, considering the large number of people required to effectively carry out a turnaround program? With this in mind, it is unclear to us how these issues impact on the continuity of operations on a day-to-day basis—specifically, the availability and reliability of these facilities when compared with land-based plant facilities.1

1.4 The Department of Mines and Petroleum (DMP) also noted that ‘FLNG is as yet, unproven technology’.2 DMP’s evidence was that ‘significant commercial risk remains

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1 Mr Roy Krzywosinski, Managing Director, Chevron, Transcript of Evidence, 24 October 2013, p 4.
2 Submission No. 18 from Department of Mines and Petroleum, submission to Inquiry into Economic Impact of Floating FLNG on Western Australia, 30 August 2013, p 9.
Chapter 1

as a “steady state” production from an FLNG facility is not yet demonstrated.3
Furthermore, DMP expressed concerns:

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\text{around safety, particularly in regards to the close proximity of process machinery, LNG storage and offloading facilities to living quarters. It may take significant time, major reconstruction and, as a result, additional tax deductions to ensure all safety [and] environmental hazard[s] are properly managed once the FLNG starts full operation.}^4
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1.5 Concerns raised by unions whose members would be employed to work on, or in support of, FLNG facilities centred on the unproven nature of the technology, confusion about regulations that will apply and a facility’s capacity to respond to an emergency.

1.6 For example, the Australian Workers’ Union (AWU) stated that ‘FLNG is completely brand-new technology and it is completely untried and we are very concerned about the potential for something to go wrong’.5 Similarly, the Maritime Union of Australia (MUA) argued that FLNG technology ‘is to date untested as there are no such facilities operating anywhere in the world’.6

1.7 A further concern raised by the MUA was the lack of certainty in relation to regulation of FLNG facilities. The MUA submitted that:

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\text{there are no regulations that cover it [FLNG technology]. So, there is a degree of uncertainty about the safety and the regulatory requirements, whether it be AMSA [Australian Maritime Safety Authority] or NOPSEMA [National Offshore Petroleum Safety and Environmental Management Authority]. There does not appear to be any certainty and we do not believe that anything around at the moment would cover this type of operation given the high technology, high demand, isolation of work et cetera.}^7
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1.8 Emergency response capability was also a factor raised in the Committee’s previous Inquiry. Particular concern was expressed about locating the processing trains and

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3 ibid.

4 ibid.

5 Mr Stephen Price, Secretary, The Australian Workers’ Union, Transcript of Evidence, Inquiry into Economic Impact of Floating FLNG on Western Australia, 1 November 2013, p 3.

6 Submission No. 22 from Maritime Union of Australia, submission to Inquiry into Economic Impact of Floating FLNG on Western Australia, 3 September 2013, p 5. See also Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, Inquiry into Economic Impact of Floating FLNG on Western Australia, 1 November 2013, p 2.

7 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, Inquiry into Economic Impact of Floating FLNG on Western Australia, 1 November 2013, p 2. See also: Submission No. 22 from Maritime Union of Australia, submission to Inquiry into Economic Impact of Floating FLNG on Western Australia, 3 September 2013, p 5.
storage facilities on the same facility and in a relatively compressed space. According to the AWU, ‘everything is in one place. If something goes wrong on that particular vessel nobody is really sure how it will be contained and what the outcome will be’. The MUA submitted that it:

has grave concern about the ability of a FLNG facility to respond to an emergency given the remote areas where FLNGs are proposed to be located. This is a major concern given that the safety of the workforce and the safe evacuation of the workforce must be the key consideration in the event of a significant incident that could pose a risk to workers.

As noted in the Committee’s May 2014 report, safety-related matters were not within the scope of that Inquiry. However, given the concerns raised and the importance of safety in the oil and gas industry, on 15 May 2014 the Committee announced that it would inquire into and report on FLNG safety-related matters, paying particular regard to the measures taken by FLNG project proponents to ensure worker safety, the adequacy of the state’s emergency preparedness and response capacity, and the role of state and federal governments in relation to an FLNG facility emergency. The Inquiry’s full terms of reference can be found in Appendix One.

The Development of FLNG projects

Conventionally, the development of offshore natural gas resources for export has required the construction of custom-made onshore processing and liquefaction plants. While technological advances such as compression platforms and floating production, storage and offloading (FPSO) vessels have allowed some offshore processing, to date, liquefaction of gas for export has always taken place onshore.

Research into FLNG technology can be traced back to the 1970s and 1980s, and while feasibility studies showed the technology to be unviable at that time, Royal Dutch Shell continued research into the concept. In 2008 Shell formed a Basic Design Package for FLNG vessels, based on a ‘design one, build many’ principle.

In May 2011 Shell took a positive final investment decision (FID) to develop the Prelude and Concerto natural gas fields off the coast of Western Australia (WA) using its FLNG.

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8 Mr Stephen Price, Secretary, The Australian Workers’ Union, Transcript of Evidence, Inquiry into Economic Impact of Floating FLNG on Western Australia, 1 November 2013, p 4.
9 ibid.
10 Submission No. 22 from Maritime Union of Australia, submission to Inquiry into Economic Impact of Floating FLNG on Western Australia, 3 September 2013, p 5.
12 Mr Steven Kauffman, Engineering Manager, Shell Australia, Transcript of Briefing, Inquiry into Economic Impact of Floating FLNG on Western Australia, 26 June 2013, p 5.
Chapter 1

technology. This was the world’s first positive development decision based on FLNG technology. Scheduled to begin operation by 2016, Prelude will likely become the world’s second ever FLNG facility.13

1.13 In 2012 Petroleum Nasional Berhad (PETRONAS), Malaysia’s government-owned oil and gas company, took a positive FID to use FLNG technology to develop the Kanowit gas field situated off Sarawak. It is expected that the PETRONAS vessel, PFLNG 1, will be operational by the end of 2015. While this will make PFLNG 1 the world’s first operational FLNG plant, it is smaller in design than the Prelude facility. It is understood that PETRONAS may reach FID on a second FLNG project in the relatively near future.14

1.14 Woodside is also considering FLNG technology to develop its fields in the Browse Basin. In September 2013 the Browse Joint Venture partners announced that basis of design (BOD) work on a development concept using Shell’s FLNG technology had begun. Such a development of Woodside’s Browse Basin reserves is estimated to require three Prelude-type FLNG facilities.15

1.15 ExxonMobil considers an FLNG facility to be the ‘lead development option’ for its Scarborough gas field, ‘based on a balance of economic, environmental and social considerations’.16

Finding 1

There is significant interest within the petroleum industry in using FLNG technology to develop oil and gas reserves in Australian waters.

1.16 Not only will the first FLNG facility in Australian waters be permanently moored off the coast of WA, there is clearly the possibility that, over time, there will be a number of FLNG facilities situated in this region. It is also important to note that it is not only the

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16 Submission No. 1 from ExxonMobil, 10 July 2014, p 1. Note: While GDF SUEZ once intended to develop its Bonaparte gas fields using FLNG technology, and considers the technology to be ‘technically robust’, GDF SUEZ has advised that the technology did not meet the company’s ‘commercial requirements, and other development options would be pursued’. See: Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 1.
Chapter 1

FLNG facilities that will be operating off the Western Australian coast. The installation and ongoing support of FLNG facilities will require support vessels and onshore support facilities.

1.17 It is essential that all of these facilities and their associated support infrastructure operate and are maintained in a way that protects those they employ and the environment in which they operate.

Safety matters

1.18 Volume 2 of the Committee’s report into the economic implications of FLNG demonstrated the increasing prominence of LNG in the global energy mix, with natural gas forecast to increase from 22 per cent of the world’s energy in 2010 to 24 per cent by 2035.17

1.19 That report also noted that positive FIDs were made between 2009 and 2012 in relation to seven greenfield LNG projects in Australia. A similar expansion in productive capacity occurred in Qatar between 2004 and 2011. As a result, LNG from Qatar and Australia is estimated to provide about 50 per cent of global supply by 2020, up from about 20 per cent in 2000.

1.20 It is very clear that ‘offshore oil and gas resources are an important part of the global energy system and an asset of high value to many developed and developing nations’.18 Nevertheless, ‘many aspects of these operations are intrinsically hazardous and thereby pose risks to health, safety, and the environment, as well as to other societal and commercial interests’.19 In addition to those risks intrinsic to LNG operations, there is further risk potential from ‘extreme weather conditions and other natural hazards that can interfere with operations and emergency response at many drilling sites’.20

1.21 Not surprisingly, and as will be demonstrated throughout this report, ensuring the safety of oil and gas operations is a concern for project proponents and operators, governments, unions and other stakeholders. At this point, though, it is worth noting the stated commitment of major oil and gas companies to safety, as exemplified in the following statements by project proponents.

1.22 First, ExxonMobil submitted that it:

\textit{is committed to conducting business in a manner that is compatible with the environmental and economic needs of the communities in}

\begin{itemize}
  \item \textsuperscript{17} International Energy Agency, \textit{World energy outlook 2012}, 2012, p 53.
  \item \textsuperscript{19} ibid.
  \item \textsuperscript{20} ibid.
which we operate, and that protects the safety, security and health of our employees, those involved with our operations and the public.\textsuperscript{21}

Second, Woodside stated that it:

\textit{has operated under the safety case (or goal setting) regime that exists in Australia for many years. During this time Woodside has demonstrated its ability to safely operate facilities consistent with legislation and through an approach that sets broad safety goals. This approach has resulted in Woodside demonstrating year on year improvement in its health and safety performance, .... Woodside is targeting continued improvement in health and safety to support our aspiration of global top quartile performance.}\textsuperscript{22}

Third, Shell submitted that:

\textit{at Shell, the protection of people and the environment is our priority. Our goal is to achieve zero harm to people and the environment.}\textsuperscript{23}

\section*{Major accidents}

Major accidents are of particular concern, especially for offshore oil and gas facilities. While there are substantial risks throughout the entire resources sector, with possible catastrophic consequences, as Lord Cullen noted, ‘offshore installations have the unique requirement to be self-sufficient in providing immediate protection to personnel in the event of an emergency’.\textsuperscript{24}

It is no exaggeration to say that:

\textit{the history of offshore operations is marred by the sporadic occurrence of blowouts, explosions, and fires at drilling rigs and other incidents that caused multiple injuries and deaths among the workforce, destroyed company assets and other property, and caused major spills that contaminated vast offshore and coastal areas, killed wildlife, and disrupted fishing, transport, recreation, and other activities.}\textsuperscript{25}

\begin{thebibliography}{99}
\bibitem{21} Submission No. 1 from ExxonMobil, 10 July 2014, p 1.
\bibitem{22} Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 7.
\bibitem{23} Submission No. 9 from Shell Development (Australia) Pty Ltd, 11 August 2014, p 1.
\bibitem{24} Department of Energy, \textit{The public inquiry into the Piper Alpha disaster}, report prepared by The Hon Lord Cullen, for the Secretary of State for Energy, the Stationery Office, Norwich, 1990, p 4.
\end{thebibliography}
The following examples help to demonstrate why it is essential that:

- the risks associated with FLNG facilities are well understood and prepared for;
- government and industry roles and responsibilities are clearly understood; and
- adequate emergency response plans are in place.

**Alexander L. Kielland platform capsize accident**

The *Alexander L. Kielland* was an oil drilling platform designed and constructed in France as a pentagon structure and delivered to Norway in 1976.26 It was designed to work in the Ekofisk oil field located approximately 320 kilometres southwest of Stavanger in the Norwegian jurisdiction of the North Sea. The platform was supported by three legs, each with a number of bracings joining the columns to each other and/or to the platform. The *Alexander L. Kielland*, which was converted to a semi-submersible floatel,27 was initially designed to accommodate 80 people. In 1978, this was increased to 348.28 The platform was equipped with seven 50-person lifeboats and twenty 20-person rafts.

On 27 March 1980, 212 workers were off duty and situated in the accommodation area, the mess hall and the cinema. At this time the *Alexander L. Kielland* had just been removed from the Ekofisk Edda production platform. The reported weather conditions were driving rain, mist, wind gusts up to 40 knots or 74 km/hr and waves up to 12 metres high.29

At approximately 6.30 pm workers on the *Alexander L. Kielland* ‘felt a “sharp crack” followed by “some kind of trembling”’ as the rig listed 30 degrees then stabilised. This initial movement was caused by the failure of one of the leg bracings and was followed by all but one of the bracings on that leg failing, causing the platform list to increase. When the remaining bracing snapped some 20 minutes later, the rig capsized.30

Of the four lifeboats launched, ‘only one managed to release from the lowering cables. A fifth lifeboat came adrift and surfaced upside down; its occupants righted it and


27 A floatel is a semisubmersible accommodation and construction support vessel.


Chapter 1

gathered 19 men from the water.\(^{31}\) Two of the Alexander L. Kielland’s rafts were detached and three men were rescued from them. Thirteen people were rescued from two 12-man life rafts that had been thrown from the Edda platform, seven were rescued by supply boats and seven swam to Edda. The standby vessel was not able to rescue anyone as it took an hour to reach the location.\(^{32}\) This incident resulted in 123 fatalities, making it Norway’s worst offshore disaster since World War Two.\(^{33}\)

1.32 Investigations into the incident revealed fatigue failure of one brace due to a gross fabrication defect (pre-existing cracks in the fillet welds) as the initial cause, followed by a fracture of the brace and subsequent failure of the remaining braces joining the leg to the platform.\(^{34}\) Progressive flooding and inadequate evacuation and rescue operations were also seen as causes of the incident. These include:

- evacuation not planned for an accident of this kind
- lack of life boats, survival suits
- long mobilizing time for rescue vessels/helicopters.\(^{35}\)

1.33 In short, the inquiry found:

\(\text{Deficiencies and errors in the execution and control in all phases of the platform (planning, building, and operations); [and]}\)

\(\text{Regulations pertaining to manning boat manoeuvres and drills were clearly not met on board, [with] poor execution of emergency drills.}\(^{36}\)

\(^{31}\) ibid.
\(^{32}\) ibid.
It was also found that ‘the 14 minutes between the initial failure of the leg and the rig’s eventual capsize left a window in which most of the personnel on board could have escaped, given a more effective command structure. But it would seem that no one took charge on that night’.37 The Alexander L. Kielland accident led to the ‘tightening of command organization on offshore installations in the North Sea so that there was a clear source of authority for ordering abandonment in crises’.38

The Petroleum Safety Authority Norway acknowledges the particular significance of this incident for the country’s petroleum industry, stating that it had enormous impact on ‘safety developments on the [Norwegian Continental Shelf]—including the regulations, the regulatory regime and the division of regulatory responsibilities’.39

**Piper Alpha platform disaster**

The Piper Alpha platform was constructed to develop the Piper Field, and was located in the North Sea approximately 177 kilometres north-east of Aberdeen. The platform provided ‘the facilities to drill wells to the producing reservoir and extract, separate and process the reservoir fluids, a mixture of oil, gas and water’.40 The platform consisted of, from the top down, a helideck, living quarters, various modules (such as storage, mud and pods), four production modules, drill deck and pipe deck, deck support frame and diving area. The platform, which was linked by three gas and one oil pipelines to three other platforms, was designed with a production capacity of 250,000 barrels of oil per day. As at 7 am on 6 July 1988, the 24 hour average production was recorded as some 119,000 barrels per day.41

On the night of 6 July 1988, an explosion occurred on the production deck of the platform, ‘followed immediately by a fire at the west end of B Module and a fireball which erupted from its west face. ... The initial explosion was followed by a series of smaller explosions’.42

Fast rescue craft were launched from standby vessels such as the Silver Pit and the Sandhaven, and from the Tharos, a large fire fighting and rescue platform. A further

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38 Ibid.
40 Department of Energy, The public inquiry into the Piper Alpha disaster, report prepared by The Hon Lord Cullen, for the Secretary of State for Energy, the Stationery Office, Norwich, 1990, p 13.
41 Ibid, pp 40–41. Lord Cullen’s report also details the condensate flow and the export flow between platforms for that period.
42 Department of Energy, The public inquiry into the Piper Alpha disaster, report prepared by The Hon Lord Cullen, for the Secretary of State for Energy, the Stationery Office, Norwich, 1990, p 43.
Chapter 1

massive explosion later that evening destroyed the Sandhaven’s fast rescue craft, killing two of its three crew and the six men it had rescued. 43

1.39 At the time of the disaster there were 226 people on the platform, 62 on duty, with most of the off-duty personnel in the living quarters. A total of 167 people died as a result of the Piper Alpha disaster, 165 from the platform and two crew members from the Sandhaven. 44

1.40 The report of The public inquiry into the Piper Alpha disaster (Lord Cullen’s Report) revealed that ‘most of the emergency systems of the platform, including the fire water system, failed to come into operation’. 45 Lord Cullen’s Report also found ‘serious deficiencies’ in the ‘working of the permit to work system’ on the Piper Alpha, and that ‘there were a number of respects in which the laid down procedure was not adhered to and unsafe practices were followed’. 46 Emergency induction and training was ‘cursory’ and inconsistent, with management failing to ensure necessary training was provided, and adopting a ‘superficial attitude to the assessment of the risk of major hazard’. 47 In effect, while safety policies and procedures were established, they were not adequately implemented.

1.41 Lord Cullen was also critical of the Department of Energy’s regulatory regime, finding the Department’s inspections ‘superficial to the point of being of little use as a test of safety on the platform’, and questioning the effectiveness of such a regime in assessing or monitoring operators’ safety management. 48

Mumbai High North platform incident

1.42 The Mumbai High Basin, 160 kilometres west of the Mumbai coast, is divided into the north and south blocks. The northern block was an oil and natural gas production complex comprising four bridge-linked platforms—a small wellhead platform, a residential platform, a processing platform and a process platform. 49 The Mumbai High North platform of the northern block was a 30 year old, seven-storey structure with

43 ibid, p 44.
45 Department of Energy, The public inquiry into the Piper Alpha disaster, report prepared by The Hon Lord Cullen, for the Secretary of State for Energy, the Stationery Office, Norwich, 1990, p 43.
46 ibid, p 191 and p 2.
47 ibid, p 3.
48 ibid, p 3 and p 254.
Chapter 1

80,000 plus barrels of oil per day production capability. The steel structure housed ten fluid import risers and five gas-injection risers.50

On 27 July 2005, a cook working on the *Samundra Suraksha*, a multi-purpose support vessel, cut off the tips of two of his fingers. Due to the monsoon rains, high winds and high seas at the time, the injured person could not be evacuated by helicopter to the Mumbai High North platform. Other platforms and jack-ups in the area were not able to offer the necessary assistance. The vessel master and the Mumbai High North Offshore Installion Manager (OIM) agreed to a man-riding basket transfer between the vessel and the platform, using the platform’s crane.51

The injured person was successfully transferred to the platform. However, as the *Samundra Suraksha* moved away from the platform, due to the unfavourable weather conditions 'the vessel experienced a strong heave, and the helideck struck the risers (export gas lift)'.52 This caused a gas leak which quickly ignited, spreading flames to adjacent risers. The flow of hydrocarbons in several risers was not contained by the emergency shutdown valves. The resulting explosion and fire destroyed the processing and residential platforms, with the balance being severely affected by heat radiation.53

While 362 people were rescued, 22 people died in this disaster. According to the UK Health and Safety Executive:

*the fire significantly affected rescue, with only two out of the eight complex lifeboats able to be launched, and only one out of ten life rafts. Similarly, only half of the NCY’s [the jack-up, Noble Charlie Yester’s] rescue craft could be launched.*54

At the time of the Mumbai High North disaster, India did not have a regulatory body responsible for the governance of its offshore oil and gas industry.55 The estimated damages were in excess of US$200 million. Furthermore, because India produced

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50 ibid, p 2; and Bailey, Colin, Case studies: Historical fires: Mumbai High North platform fire’, nd. Available at: http://www.mace.manchester.ac.uk/project/research/structures/strucfire/CaseStudy/HistoricFires/Other/default.htm. Accessed on 8 December 2014.


Chapter 1

50 per cent of its crude domestically and the Mumbai High North complex produced the majority the country’s oil, the Indian government was forced to search for alternative supplies from other jurisdictions.\(^5^6\)

**Montara Development Project wellhead platform incident**

1.47 The Montara Development Project is located in the Timor Sea, in Australian Commonwealth waters, approximately 250 km north-west of the Western Australian Kimberley coast and 690 km west of Darwin. Located in the Bonaparte basin, the Montara Development Project comprises the Montara, Skua, Swift and Swallow fields.\(^5^7\) There are a total of ten wells—nine oil production wells and one gas injection well—in the Montara development project.

1.48 With recoverable reserves of 24 million barrels, at full production the Montara Development Project is expected to produce between 30,000 and 35,000 barrels of light, low-sulphur crude oil per day. Production commenced in June 2013, with the project having an expected 12 year life span.\(^5^8\)

1.49 According to Mr David Borthwick, Commissioner to the Montara Comission of Inquiry, ‘the objective of the Montara Development Project is to extract petroleum [oil and gas] from the Montara Oilfield using four production wells (H1, H2 H3 and H4) and to re-inject gas into the Montara Oilfield using the GI well’.\(^5^9\) There are also ‘two production wells in the Skua Oilfield and three production wells in the Swift/Swallow Oilfield’.\(^6^0\)

1.50 Facilities at the Montara Oilfield include ‘an unmanned four-legged well-head platform and the Montara Venture’, an FPSO vessel with an operational storage capacity of 750,000 barrels and accommodation for 58 people.\(^6^1\)

1.51 Construction of offshore infrastructure required to produce the Montara resources began in 2007. On 21 August 2009, what was described as ‘a small “burp” of oil and

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56 ibid, p 6.
60 ibid, p 36.
gas’ escaped from the H1 Well at the Montara wellhead platform (WHP).62 This initial ‘burp’ was followed some two hours later by the H1 Well:

kick[ing] with such force that a column of oil, fluid and gas was expelled from the top of the well, through the hatch on the top deck of the WHP, hitting the underside of the West Atlas drilling rig and cascading into the sea.63

1.52 The leak from the H1 Well was estimated at between 400 and 1,500 barrels of oil per day, plus unknown quantities of gas, condensate and water, ‘until the Relief Well operations were successful in “killing” the well over ten weeks later’.64

1.53 This means that for over 10 weeks, ‘oil and gas continued to flow unabated into the Timor Sea, approximately 250 kilometres off the northwest coast of Australia. Patches of sheen or weathered oil could have affected at various times an area as large as 90,000 square kilometres’.65

1.54 The Montara Commission of Inquiry found the blowout was most likely caused by hydrocarbons entering the H1 Well, with the primary well control barrier failing to prevent the flow up the casing. While this was the initial cause of the blowout, the Commission of Inquiry also found a lack of ‘sensible oilfield practice’ in that there were ‘no tested and verified barriers in place at the time of the Blowout’.66

1.55 Investigating further, the Commission found a number of ‘systemic and interrelated factors indirectly contributed to the Blowout’.67 These included ambiguous and inappropriate well construction standards, a lack of understanding of rig personnel in relation to well construction standards, deficient decision-making and judgement of senior rig and onshore personnel, defective records and communication management, and a failure in communications between the project and rig operators.68

1.56 Commissioner Borthwick concluded that:

the Blowout was not a reflection of one unfortunate incident, or of bad luck. What happened with the H1 Well was an accident waiting to happen; the company’s systems and processes were so deficient and

63 ibid.
64 ibid, p 38.
65 ibid, p 5.
66 ibid, p 7 and p 8.
67 ibid, p 8.
68 ibid, pp 8–11.
Chapter 1

its key personnel so lacking in basic competence, that the Blowout can properly be said to have been an event waiting to occur.69

1.57 In addition to the operator’s systemic problems, the Commission of Inquiry also revealed errors made by the Northern Territory Department of Resources (NT DoR), the regulator responsible for oversight of well-integrity requirements in that jurisdiction. The regulatory practices of the NT DoR were found to be ‘totally inadequate’ and ‘little more than a “tick and flick” exercise’.70

Macondo—Deepwater Horizon disaster

1.58 The Macondo oil and gas field is located in the United States Exclusive Economic Zone of the Gulf of Mexico, off the coast of Louisiana. It was originally estimated to contain approximately 50 to 100 million barrels of oil, but the operator later stated the size of the field was ‘undetermined’.71 It was reported that the Macondo oil well could be one of the largest in the world, possibly containing ‘as much as 1 billion barrels of oil’.72

1.59 Initial drilling of the Macondo well began in October 2009 using the drill rig Marianas. However, following damage sustained by the Marianas in Hurricane Ida, the Deepwater Horizon floating oil rig was selected as the replacement. In February 2010, the Deepwater Horizon began its drilling of the Macondo well.73

1.60 By 8 March 2010, the Deepwater Horizon drilling had reached 8,000 feet (approximately 2,440 metres). At this time there was a ‘serious well control event—unexpectedly the well formation fluids “flowed” into the well bore and the influx went unnoticed for approximately 33 minutes’.74 The operator implemented a well control event and the Deepwater Horizon drilling continued.

1.61 On the evening of 20 April 2010, ‘an uncontrolled flow of water, oil mud, oil, gas, and other materials came out of the drilling riser and possibly the drill pipe’ on the Deepwater Horizon’.75 This was shortly followed by a series of explosions and an enormous fire, which engulfed the vessel and continued burning for two days.

69 ibid, p 11.
70 ibid, p 14.
74 ibid.
75 ibid, p 6.
Indications are that drilling had reached 13,000 feet (3,962 metres) below the seabed or 18,000 feet (5,486 metres) below the sea surface.\textsuperscript{76}

1.62 According to an investigation of the Macondo blowout, ‘the emergency disconnection system meant to allow separation of the Deepwater Horizon from the blowout preventer at the sea floor could not be activated; thus trapping the unit under and in the hydrocarbons coming from the well below’.\textsuperscript{77}

1.63 The Deepwater Horizon lost its capacity to generate power; emergency power systems could not be started; and critical emergency control equipment could not be, or were not, activated, or were damaged. The Deepwater Horizon ‘was in the dark, without power, and without the dynamic positioning thrusters to maintain its location’.\textsuperscript{78}

1.64 Survivors evacuated to lifeboats, but ‘some of the lifeboats were not fully filled and some could not be accessed’, and crew also evacuated by jumping into the ocean where they were rescued by support vessels and first responders.\textsuperscript{79} While the Deepwater Horizon was abandoned soon after the fire began, 11 of the 126 people aboard died and the vessel sank 36 hours later. The riser and drill pipe also sank to the seabed and continued to discharge oil and gas into the ocean.\textsuperscript{80}

1.65 Over the ‘next 83 days, a series of attempts were made to stop the oil from enter[ing] the Gulf of Mexico’.\textsuperscript{81} However, ‘all of the approved plans and preparations for controlling and mitigating the blowout repeatedly failed or were ineffective’.\textsuperscript{82} A series of ‘ad hoc systems were engineered, constructed and put in place’ until a way was found to pump mud and cement into the well, thus killing the flow.\textsuperscript{83}

1.66 An investigation of the Macondo oil well disaster was scathing of the operator, stating that it did not have a ‘functional Safety Culture’ and its system was not oriented to the objective of ‘maximum safety’; instead it was ‘geared toward a trip-and-fall compliance mentality rather than being focused on the Big-Picture’.\textsuperscript{84} Furthermore, the operator’s system:

‘forgot to be afraid.’ The system was not reflective of one having well-informed, reporting, or just cultures. The system showed little evidence of being a high-reliability organization possessing a rapid learning
culture that had the willingness and competence to draw the right conclusions from the system's safety signals.

The Macondo well disaster was an organizational accident whose roots were deeply embedded in gross imbalances between the system's provisions for production and those for protection.85

As well as the loss of human life, the Macondo well disaster resulted in huge amounts of toxic reservoir fluids and gases escaping into the Gulf of Mexico, both on and below the surface waters. While 'unprecedented amounts of dispersants' applied near the seafloor prevented an enormous amount of oil from reaching the surface, and thus reduced the environmental impacts on nearby wetlands, wildlife and communities, it allowed the dispersed toxic fluids to be taken by strong currents to other parts of the Gulf of Mexico.86

The 2010 investigation noted that the equipment and processes used for clean-up and containment of hydrocarbons in the ocean have proven to be 'relatively ineffective'.87 According to that investigation, the Macondo well disaster was a 'cascade of failures', a 'disaster unprecedented in the history of the offshore oil and gas industry'.88 It resulted in costs to human lives, injuries, property and productivity, the affected communities and their industry and environment. The Macondo well disaster was found to 'exceed by several orders of magnitude those previously experienced or thought possible'.89

Applying the lessons from history

Technological advances, such as those represented by FPSOs and FLNG, have extended the oil and gas industry’s capacity to explore and develop resources in previously inaccessible locations, and to process those resources offshore.

FLNG facilities will be subject to the same risk events as other offshore operations, including accidents, blowouts, collisions, adverse weather events and any other circumstances unique to their particular location. However, as will be examined in more detail throughout this report, there are a number of significant differences between more conventional offshore infrastructure and an FLNG facility that require specific consideration in relation to their impact on safety.

85 ibid.
86 ibid, p 8.
87 ibid.
88 ibid.
89 ibid, p 9.
1.71 In particular, the fact that FLNG facilities:

- are permanently moored;
- are not de-manned during cyclones;
- have processing trains, and storage and offloading infrastructure on the same facility, and in a reasonably compressed space; and
- situate process machinery and LNG storage facilities in close proximity to living quarters

means that the risk profile of such facilities is different from existing offshore operations.

1.72 As the above summaries of the Alexander L. Kielland, Piper Alpha, Mumbai High North, Montara and Macondo disasters demonstrate, it is essential that:

- the risks are understood and prepared for by industry and governments;
- the roles and responsibilities of industry and of state and federal government agencies are well understood and appropriate emergency plans are in place;
- operators develop and maintain a culture of ‘safety first’ throughout their entire organisational structure and systems; and
- regulators undertake their roles effectively so that they fulfil more than a simple ‘tick and flick’ function.

1.73 The possible consequences of inadequate operator systems, training and practices, ineffective regulation and a lack of capacity to respond to emergency situations are catastrophic in terms of human life, the environment, energy security, the economy and investor confidence. It is for these reasons that the Committee determined to undertake this Inquiry.

**The Committee**

1.74 The Economics and Industry Standing Committee is a portfolio-related Committee of the Legislative Assembly of the Parliament of Western Australia. The Committee was appointed on 9 May 2013.

1.75 Pursuant to the Legislative Assembly’s Standing Order 287(3) the Speaker determined that the Committee would have the portfolio responsibilities of: State Development, Mines and Petroleum, Fisheries, Regional Development, Lands, Tourism, Transport,
Chapter 1


Conduct of the Inquiry

In accordance with Standing Order 287(2), on 15 May 2014 the Committee announced that it would conduct an Inquiry into safety-related matters relating to FLNG projects in Australian waters off the Western Australian coast.

An advertisement containing the Inquiry terms of reference and calling for public submissions was placed in The West Australian on 24 May 2014. In addition to this, the Committee invited submissions from specific state and federal government agencies, major oil and gas companies, and professional associations, including trade unions.

In total, the Committee received 28 submissions, as listed in Appendix Three.

The Committee also conducted documentary research and held 16 formal evidence hearings. Those who provided evidence at hearings are listed in Appendix Four.

The Committee received funding for three members and one staff member to travel to the Netherlands, Norway and Scotland in July 2014 to gather information in relation to safety and regulation in the oil and gas industry.91 During this travel the Committee received briefings from government agencies, professional associations and industry. This travel provided the Committee with a greatly enhanced understanding of the regulation of the oil and gas industry in Europe generally, and in relation to safety and environment matters in particular.

In August 2014, the Committee also travelled to Goeje in South Korea to inspect the Prelude facility and to meet with representatives of Shell and Samsung Heavy Industries.

In March 2015 the Committee travelled to Darwin and Broome to visit the supply base for the Prelude facility, the Darwin port facilities, and the Broome port, hospital and search and rescue helicopter base. This travel also allowed members to meet with various stakeholders to discuss emergency preparedness in the region.

A list of briefings is contained in Appendix Five.

90 Hon. Michael Sutherland, MLA, Speaker of the Legislative Assembly, Western Australia, Western Australia, Parliamentary Debates (Hansard), 16 April 2013, p 36.

91 This travel also assisted the Committee in relation to its ongoing inquiry into the economic impacts of FLNG technology on the Western Australian economy. A separate report will be tabled in the Legislative Assembly.
1.84 Proponents of FLNG facilities that will operate in Australian waters are currently continuing to develop their safety and environment plans for submission to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). In light of this, the Committee’s report cannot, and should not, be read as a definitive statement on the level of safety achieved by the offshore petroleum industry in Australia, in general or in relation to FLNG technology, in particular. Rather, this report adds to the body of safety-related information available about the sector as a whole and underlines the Committee’s conviction that FLNG safety matters.

1.85 It also needs to be noted that this report presents a qualitative assessment of the evidence. In doing so it provides a voice of caution to those who argue that there is no difference between FLNG technologies and existing technologies. FLNG technology is different and the first FLNG facility in the world is yet to be commissioned.

1.86 The Committee’s findings in this report should not be taken to mean that the Committee has no concerns about the safety of FLNG facilities. The Committee is not in a position to state that FLNG technology is now, or will always be, 100 per cent safe.

1.87 It should also be noted that this Inquiry is largely based on FLNG technology developed by Shell—that is, by one project proponent, rather than a generic technology developed by the oil and gas industry. It is also important to recognise that because there is currently no FLNG facility operating anywhere in the world, this report should be read as a snapshot of the situation as it is in 2015 and based on the information currently available.

1.88 Nevertheless, what can be said is that the Committee is reassured that Shell appears to have taken great care and made considerable investment in safety in design for its Prelude FLNG facility.

1.89 Reviewing the evidence to this Inquiry as a whole revealed a number of key themes that necessarily recur throughout the report and, consequently, allows a number of important conclusions to be reached. In brief, it is essential that operators develop and maintain a culture of safety throughout their organisations to ensure that procedures are not only developed, but are followed. It is also critical that NOPSEMA, as the industry regulator and inspector, is properly resourced to carry out its regulatory functions. It is equally critical that NOPSEMA’s assessment and scrutiny is rigorous and effective.
Chapter 2

Jurisdictions and areas of responsibility

2.1 Floating LNG (FLNG) technology allows the refinement and liquefaction of natural gas to occur at sea, and the resulting commodities to be exported direct from the facility. This chapter briefly explains FLNG technology and demonstrates why most, if not all, FLNG facilities operating off the Western Australian coast will be moored in Commonwealth waters. Following this, the chapter provides an outline of the Commonwealth and Western Australian marine jurisdictions and the main agencies responsible for regulating the offshore petroleum industry.

FLNG technology

2.2 The safe and commercially viable development of offshore petroleum resources has been a challenging undertaking since offshore drilling began at around the turn of the twentieth century.92 Developing an oil or gas field located at sea requires working in remote locations and in conditions that can be both harsh and unpredictable. In a continued effort to overcome these challenges, numerous technologies have been developed that enhance both the safety and efficiency of offshore petroleum recovery.

2.3 Yet while technological development has enhanced our ability to recover offshore petroleum resources, as those fields that are closest to land become exhausted, offshore activities must occur in increasingly remote locations.93 This remoteness is especially challenging when the petroleum resource in question is natural gas. Unlike liquid hydrocarbons, natural gas does not readily lend itself to efficient transport in its natural state and must either be conveyed through vast pipelines or, where pipelines are not feasible, liquefied for shipping overseas.

2.4 The liquefaction process reduces a given quantity of natural gas to around $\frac{1}{600}$ of its original volume. Producing LNG from raw natural gas requires significant and complex

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93 Submission No. 15 from Shell in Australia, submission to Inquiry into Economic Impact of Floating LNG on Western Australia, 30 August 2013, p 8.
Chapter 2

infrastructure because the gas must first undergo an extensive process of refinement before being chilled to -161°C Celsius and becoming a liquid.94

2.5 The Committee has previously observed that ‘conventionally, the development of offshore natural gas resources for export has required the construction of custom-made onshore processing and liquefaction plants,’ and that while ‘technological development had ‘increased the extent to which gas and oil is processed and refined offshore ... the liquefaction of gas for export has always taken place onshore’, for a range of reasons.95 FLNG technology, however, enables this liquefaction process and various necessary processes of gas refinement to occur at sea.

2.6 FLNG technology is succinctly described by Woodside in the following terms:

*FLNG technology involves the placement of conventional offshore processing and gas liquefaction facilities, or ‘topsides’, on a large floating structure which is then permanently moored over a gas field. The FLNG topsides and processing facilities comprise of gas and condensate reception and separation facilities, condensate stabilisation and rundown, acid gas removal and dehydration, natural gas liquids extraction, fractionation and liquefaction using established LNG technology.*96

2.7 In essence, FLNG technology avoids the need to pipe natural gas to land for onshore processing. It thus represents a possible method for developing remote petroleum resources, especially those with limited total reserves, for which pipeline infrastructure would be too costly. Where a particular resource either holds greater reserves or is located closer to land, it seems likely that onshore processing would remain an attractive proposition.97 As such, while field size and location are technically irrelevant to the application of FLNG technology, in all likelihood the technology will find its greatest application in developing more remote resources that are far out to sea. In the Australian context, this is a space of almost exclusive Commonwealth jurisdiction.

**Australian maritime jurisdictions**

2.8 An appreciation as to why FLNG facilities will likely only be subject to Commonwealth jurisdiction begins with an understanding of how jurisdiction over the waters surrounding Australia is determined.

96 Submission No. 8 from Woodside, 8 August 2014, p 4.
Territorial Sea Baseline

2.9 The seaward limits of Australia’s maritime zones are measured from the ‘Territorial Sea Baseline’ (TSB), which is generally the low water line along the coast (that is, the coastline). It is from the TSB that the jurisdictional boundaries are set.

Coastal waters

2.10 Jurisdiction over the first three nautical miles seaward from the TSB is vested in the adjacent state or territory ‘as if the area formed part of that State or Territory’.98 Waters in state jurisdiction are commonly referred to as ‘coastal waters’.99 Jurisdiction to regulate the development of any resources, including subsea petroleum resources, located in or under coastal waters is held by the relevant state or territory.

Territorial sea

2.11 Australia’s ‘territorial sea’ is a belt of water 12 nautical miles wide, measured seaward from the TSB. Geoscience Australia explains that ‘Australia’s sovereignty extends to the territorial sea, its seabed and subsoil, and to the air space above it’, with the only ‘major limitation on Australia’s exercise of sovereignty in the territorial sea [being] the right of innocent passage for foreign ships’.100 The territorial sea includes all coastal waters, meaning that exclusive Commonwealth jurisdiction covers what is a nine nautical mile width of water, from the limit of coastal waters to the limit of the territorial sea.

Exclusive Economic Zone

2.12 There is one further body of water—the ‘Exclusive Economic Zone’ (EEZ)—over which the Commonwealth can exercise its jurisdiction in a specific way. According to Geoscience Australia, the EEZ ‘is an area beyond and adjacent to the territorial sea,’ the outer limit of which ‘cannot exceed 200 [nautical miles] from the [TSB]’.101 Within the EEZ, ‘Australia has sovereign rights for the purpose of exploring and exploiting,


100 ibid.

101 ibid.
Chapter 2

conserving and managing all natural resources of the waters superadjacent to the seabed and of the seabed and its subsoil'.

**The development of Australia’s maritime jurisdiction**

2.13 Australia's maritime jurisdiction began to take shape following the Second World War. In 1953, Australia proclaimed its jurisdiction and control of over the country’s adjacent continental shelf.\(^{103}\) This jurisdiction was confirmed in 1958 at the First United Nations Convention on the Law of the Sea (UNCLOS).\(^{104}\) At that UNCLOS, it was also essentially agreed that the sovereignty over the sea would extend to a distance of three nautical miles from the coastline of the adjacent nation.\(^{105}\) In a practical sense, this meant that the sovereignty of any nation with a maritime boundary extended three nautical miles out from the coastline, that the water beyond was ‘international waters,’ but that a nation would have exclusive rights to resources (such as fish and petroleum) that went out to the continental shelf (a distance of no more than 200 nautical miles out to sea), even in international waters.

2.14 A further complexity agreed at the first UNCLOS was that in certain places—such as deeply indented areas of coastline or coastal areas with a nearby fringe of islands—a nation’s TSB would be expanded to ‘close off’ any such geographic features.\(^{106}\) In some cases, this had the effect of moving the TSB out quite some distance. In Western Australia, for example, the TSB was drawn around Barrow Island, to include all of the water between Barrow Island and the mainland. Waters located on the land side of the TSB—sometimes referred to as ‘internal waters’—are considered coastal waters in Australia and, as such, are an area of exclusive state jurisdiction. This is illustrated in Figure 2.1:

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102 ibid.
105 ibid.
To confirm Australia’s maritime jurisdiction in relation to petroleum resources in the EEZ, in 1967 the Commonwealth Government enacted the *Petroleum (Submerged Lands) Act 1967* (Cth). Critically—as it avoided any need to consider the constitutional jurisdiction of the Commonwealth to enact such legislation—this was done in agreement with the States, and vested regulatory power over offshore petroleum resources in a relevant ‘Designated Authority’ for each state.\(^{108}\) Shortly thereafter it was decided that the national interest would be better served if the constitutional position regarding jurisdiction over offshore areas was resolved. Ultimately this led to the passage of the *Seas and Submerged Lands Act 1973* (Cth), which was immediately challenged in the High Court of Australia by the State of New South Wales (with all other States intervening in support).\(^{109}\) In that case, the High Court determined that the Commonwealth, by virtue of the external affairs head of power, had exclusive jurisdiction over all water from the beach out to the limits of the continental shelf.\(^{110}\)

However, in the spirit of ‘cooperative federalism,’ the Commonwealth sought ‘to share resources and responsibilities for offshore areas with the States,’ for two main reasons.\(^{111}\) First was the ‘practical exigencies of the federal system’ and, second, the difficulties of managing offshore areas without sufficient ‘appreciation of local

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\(^{108}\) s 14 *Petroleum (Submerged Lands) Act 1967* (Cth) (Repealed). The Designated Authority is the relevant State minister.


\(^{110}\) *New South Wales v Commonwealth* (1975) 135 CLR 337.

This situation was resolved in 1979 when the States and the Commonwealth met and agreed to the Offshore Constitutional Settlement 1979, which was later enacted in the *Coastal Waters (State Powers) Act 1980 (Cth)*. This Act conferred jurisdiction over Australia’s territorial sea upon each adjacent state.

In 1980 the completion of the third UNCLOS added yet another element into the maritime jurisdiction equation, with the definition of a nation’s ‘territorial sea’ being extended out from three to twelve nautical miles. It is for this reason that Australia has ‘coastal waters’ that run from the coastline out to the three nautical mile mark and then a ‘territorial sea’ that covers the next nine nautical miles of ocean. This change did not affect the existing conferral of Australian waters into state jurisdiction, so the water between Barrow Island and the mainland, for example, though extending beyond three nautical miles, has remained under Western Australia’s jurisdiction. This has proven to be quite critical as that part of the Indian Ocean—which runs roughly between Exmouth and Karratha—has long been the epicentre of numerous petroleum industry activities in Western Australia.

Furthermore, Western Australia’s jurisdiction extends to cover coastal waters surrounding any land formations in the Indian Ocean that are part of the state’s territory. Significantly, this territory includes Scott Reef, which lies over a major portion of the Torosa gas field in the Browse Basin. Woodside Energy has long held the petroleum titles that cover the Torosa gas field, and FLNG is now the preferred technology to use to develop that resource. The areas of state and Commonwealth jurisdiction are highlighted in Figure 2.2:

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112 ibid.
113 ibid, p 51. The Commonwealth used the previously dormant s 51(xxxviii) of the Constitution—an exercise of Commonwealth power at the request of the states.
Chapter 2

Figure 2.2: Australia’s maritime jurisdiction off the Western Australian coast

Finding 2
State sovereignty generally extends to cover all land within a state’s borders and the first three nautical miles of ocean from the low water line along the coast and offshore islands.

2.19 In summary, any petroleum industry activity taking place either within the belt of coastal waters that surround the Western Australian mainland or else within coastal waters surrounding land formations off the coast of Western Australia would occur within an area of exclusive state jurisdiction. Any such activity would, therefore, be regulated by the Western Australian Government through the Department of Mines and Petroleum (DMP). This regulatory regime is discussed toward the end of this chapter.

2.20 All other petroleum industry activity occurring off the Western Australian coast within Australia’s EEZ would take place in an area of federal jurisdiction and, as such, would be regulated by the Commonwealth Government. Two points can be made here. First, the area of federal maritime jurisdiction vastly exceeds that of state jurisdiction. Second, almost all known petroleum resources are located in areas of federal jurisdiction. Given
this, it seems likely that the use of FLNG technology to develop currently known offshore petroleum resources within Australia’s EEZ will mostly, if not always, occur in an area of federal jurisdiction.

Finding 3
Regulatory responsibility for offshore petroleum resources depends on whether the resources are located in state or Commonwealth waters. Australia’s petroleum resources are predominantly in Commonwealth waters.

Federal Jurisdiction

The development of offshore petroleum resources located in Commonwealth waters is principally regulated through the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGS Act). As DMP explained, ‘approval is required under the OPGGS Act ... to construct, operate and decommission a petroleum facility’.  

DMP further explained that this approval process can involve both state and Commonwealth Ministers. According to DMP:

> the current situation that applies in Commonwealth offshore areas is that the State Minister for Mines and Petroleum has an equal right, in the first instance, to approve major decisions with his Commonwealth counterpart. However, the Commonwealth Minister can override the State if he chooses to do so. Section 59(2) of the [OPPGS Act] provides the Commonwealth Minister power to override the State.  

Before any such approval can be given to a prospective operator wishing to develop an offshore petroleum resource located in Commonwealth waters a number of distinct administrative elements must be satisfied. This includes obtaining a production licence (under which the holder has the legal right to recover petroleum from a specified area) and an infrastructure licence (under which the holder is entitled to construct and/or operate an infrastructure facility in a specified area). The operator is also required to prepare and have accepted both a safety case and an environmental plan in relation to the intended offshore activities that are to be undertaken. These are discussed in detail in Chapters 4 and 6.

It is also important to note that ‘infrastructure facilities’ are specifically defined at s 15 of the OPGGS Act to be structures used in the process of developing offshore petroleum resources that either rest on, or else are affixed to, the seabed—irrespective of whether any element of the facility (or indeed the facility itself) floats on the surface.
of the ocean. That is, a distinction is drawn between offshore petroleum industry infrastructure that operates in a specific location for an extended period of time (which are regulated under the terms of the OPGGS Act) and other infrastructure required in the process of developing a resource such as tanker vessels (which are regulated by Commonwealth maritime legislation such as the Australian Maritime Safety Authority Act 1990 (Cth) (AMSA Act)). Because FLNG facilities will be affixed to the seabed by moorings, their operation will be regulated under the terms of the OPGGS Act.

Finding 4

Because an FLNG is permanently moored above the petroleum resource it is developing, under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) it is defined and regulated as a ‘facility’ as defined in that Act.

Responsible agencies and authorities

National Offshore Petroleum Safety and Environmental Management Authority

In addition to stipulating how offshore petroleum resource development is regulated, Part 6.9 of the OPGGS Act establishes the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) as the statutory authority responsible for administering those regulations. In a submission provided to a previous Committee Inquiry, NOPSEMA explained that it ‘is an independent Commonwealth statutory authority [responsible for] regulating the health and safety, well integrity and environmental management of offshore petroleum activities in Commonwealth waters, and in coastal waters where state and Northern Territory functions have been conferred’. Notably, regulatory functions in Western Australian coastal waters have not been conferred upon NOPSEMA; these waters remain under the regulation of DMP (see below).

NOPSEMA was previously the National Offshore Petroleum Safety Authority (NOPSA), which had no environmental management responsibilities. The Final Government Response to the Report of the Montara Commission of Inquiry recommended that NOPSA’s remit be extended to include environmental management. NOPSEMA was created as a result and began operations on 1 January 2012.

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118 Mr Stuart Smith, Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 2. See also Submission No. 9 from Shell in Australia, 11 August 2014, p 2.
119 Submission No. 36 from National Offshore Petroleum Safety and Environmental Management Authority, submission to Inquiry into Economic Impact of Floating LNG on Western Australia, 22 November 2013, p 1.
NOPSEMA’s legislated functions are stipulated at s 646 of the OPGGS Act. The functions are outlined by NOPSEMA as being:

- to promote the OHS [occupational health and safety] of persons engaged in offshore petroleum operations or offshore greenhouse gas storage operations;

- to develop and implement effective monitoring and enforcement strategies to ensure compliance under the OPGGS Act and Regulations

- to investigate accidents, occurrences and circumstances relating to OHS, well integrity and environmental management

- to advise on matters relating to OHS, well integrity and environmental management

- to make reports, including recommendations, to the responsible Commonwealth minister and each responsible state/Northern Territory (NT) minister; and

- to cooperate with other Commonwealth and state/NT agencies or authorities having functions relating to regulated operations.  

There are a number of ways in which NOPSEMA works to meet its legislated functions. These include, but are not limited to:

- assessing an operator’s safety case and environment plan;

- conducting facility inspections to monitor compliance with safety cases and environment plans;

- undertaking inspections following incidents; and

- administration of Well Operations Management Plans (WOMPs) and the approval of well activities.

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122 Submission No. 36 from National Offshore Petroleum Safety and Environmental Management Authority, submission to Inquiry into Economic Impact of Floating LNG on Western Australia, 22 November 2013, p 1.
2.29 The administration of WOMPs and approval of well activities are authorised under Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cth).

2.30 The work NOPSEMA undertakes to fulfil its functions is discussed throughout relevant chapters of this report.

Finding 5
The National Offshore Petroleum Safety and Environmental Management Authority is the Commonwealth authority responsible for the regulation of all offshore petroleum activities involving infrastructure that is permanently fixed in some way to the sea floor (a petroleum facility).

Australian Maritime Safety Authority

2.31 Infrastructure involved in the development of an offshore petroleum resource that does not meet the definition of an infrastructure facility under s 15 of the OPGGS Act—such as, for example, support vessels and petroleum tankers—is generally not regulated by NOPSEMA. There is, however, one critical exception: when a petroleum tanker is tethered to an infrastructure facility—for example, when an LNG tanker is being loaded with LNG from an FLNG facility—under s 15(1)(c) of the OPGGS Act, the tanker becomes part of the facility for the purposes of the Act. When a tanker or support vessel is not tethered to an infrastructure facility, however, it comes under the jurisdiction of the Australian Maritime Safety Authority (AMSA).

2.32 AMSA is a statutory authority established under the AMSA Act and has the following four principal functions:

- promoting maritime safety and protection of the marine environment
- preventing and combating ship-sourced pollution in the marine environment
- providing infrastructure to support safety of navigation in Australian waters
- providing a national search and rescue service to the maritime and aviation sectors.\(^{123}\)

2.33 According to AMSA, its ‘primary role is to minimise the risk of shipping incidents and ship sourced pollution in Australian waters through ship safety and environment

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Chapter 2

protection regulation and services and maximise people saved from maritime and aviation incidents through search and rescue coordination’.124

2.34 As noted above, regulation of offshore facilities and installations is NOPSEMA’s role, and AMSA is not involved in this regulation. AMSA submitted that its:

safety and marine environment protection regulatory role is clearly limited to vessels or ships used in navigation, and in the case of FLNG facilities, the application of Australian and international maritime laws is a developing matter.125

2.35 AMSA’s role in relation to FLNG technology appears to be no different from its role in relation to the current export of LNG from onshore plants or its role in relation to any of the numerous Floating, Production, Storage and Offloading (FPSO) facilities presently operating off the coast of Western Australia (WA). According to AMSA:

in the Australian context, when a FLNG facility is being constructed or is operating as a ship, AMSA may be involved under the auspices of the Navigation Act 2012. When a FLNG facility is operational and is 'connected to a riser' it is not subject to the Navigation Act 2012. However it is subject to the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act).126

2.36 AMSA’s role is discussed further in Chapter 9.

Finding 6

The Australian Marine Safety Authority is the Commonwealth authority responsible for regulating all shipping activities in Australian waters.

Finding 7

When a ship becomes tethered to a petroleum facility, regulatory jurisdiction over that vessel passes from the Australian Marine Safety Authority to the National Offshore Petroleum Safety and Environmental Management Authority.

Western Australian regulation

2.37 Petroleum industry activity in coastal waters occurs under the jurisdiction of the Western Australian Government. Any such activity is principally regulated by DMP under the terms of the Offshore Petroleum (Submerged Lands) Act 1967 (WA)

124 Submission No. 21 from Australian Maritime Safety Authority, 5 December 2014, p 1.
125 ibid.
126 ibid.
(OPSL Act) and the associated Offshore Petroleum (Submerged Lands) Regulations 1996 (WA) (OPSL Regulations).127

2.38 This means that while NOPSEMA regulates petroleum industry activities in areas of Commonwealth jurisdiction, DMP has regulatory responsibility in areas under Western Australian jurisdiction. Any practical differences between Commonwealth and Western Australian Government regulation of the petroleum industry, though, appear to be minor. According to DMP’s Executive Director, Department of Resources Safety, Mr Simon Ridge, there are minor differences in the wording, but from the requirements and outcomes, there would be no difference.128

2.39 The Committee welcomes the fact that state and federal agencies are working toward developing common wording in their regulations.

2.40 In providing an overview of how offshore petroleum industry activities are regulated in areas of either state or federal jurisdiction, DMP likened FLNG technology to that of FPSO facilities and advised that, as at July 2014, there were a total of twelve such facilities ‘operational in Western Australian waters’.129 However, none of these facilities operate exclusively in the state’s jurisdiction.130

2.41 This raises the question as to what, if any, practical differences in regulations there would be if an FLNG facility were to operate exclusively in WA’s coastal waters; that is, who the regulator would be and what responsibility they would have. DMP’s Director, Petroleum Safety, Mr Ross Stidolph, explained that any such difference would be difficult to specify. According to Mr Stidolph:

the principles would be very similar. I do not think [DMP] would be doing anything that different to what NOPSEMA are doing, because the practices are generally quite well established in terms of the safety case and the safety management system that physically manages behind it. The principles are exactly the same.131

2.42 It was further explained that efforts are being made to minimise and/or eliminate any regulatory difference that does exist. On this point, Mr Ridge stated that DMP was

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127 Submission No. 4 from the Department of Mines and Petroleum, 14 July 2014, p 2.
128 Mr Simon Ridge, Executive Director, Resources Safety, Department of Mines and Petroleum, Transcript of Evidence, 7 November 2014, p 9.
129 Submission No. 4 from the Department of Mines and Petroleum, 14 July 2014, p 1.
130 Mr Simon Ridge, Executive Director, Resources Safety, Department of Mines and Petroleum, Transcript of Evidence, 7 November 2014, p 5.
131 Mr Ross Stidolph, Director, Petroleum Safety, Department of Mines and Petroleum, Transcript of Evidence, 7 November 2014, p 6.
Chapter 2

taking the important step of ‘endeavouring to actually clean up those minor differences’.\textsuperscript{132} This was important:

\begin{quote}
\textit{because there are other vessels that come across the boundaries quite regularly, and it would be nonsensical for us to have a requirement over and above what NOPSEMA have that would cause issues for those operators coming across that boundary when there would be no substantial value added. So we do need to make sure they are lined up and reviewed regularly and any of these minor things do not become more major over time.}\textsuperscript{133}
\end{quote}

2.43 Mr Ridge further explained that DMP has ‘given an undertaking to maintain [Western Australia’s] laws so that they are reflective of [Commonwealth laws]’\textsuperscript{134} and that:

\begin{quote}
\textit{there is a process ongoing at the moment to look at bringing [DMP regulatory practices] in line with NOPSEMA to get common terminology and common outcomes ... Certainly in the next 18 months we should end up with a process that enables us to be back on the same track.}\textsuperscript{135}
\end{quote}

2.44 According to DMP’s Director General, Mr Richard Sellers, however, often the only practical difference in state and Commonwealth regulation related to issues of nomenclature or basic procedure. To emphasise that actual differences in regulatory practices are minimal, Mr Ridge gave the example of pipelines:

\begin{quote}
A good example is our pipelines. They are out in Commonwealth waters, they come into our waters and then they come on land. Obviously, it would be nonsensical to have three safety cases for those different zones. So in general terms, NOPSEMA would receive a safety case and we would go through it, but we would not place an additional regulatory burden by requiring a separate one. In general terms, we try to minimise the red tape around that sort of problem. It is certainly our intent in all cases to minimise those sorts of issues.\textsuperscript{136}
\end{quote}

2.45 Western Australian Government agency involvement in offshore incident response is further discussed in Chapters 9 and 10.

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\textsuperscript{132} Mr Simon Ridge, Executive Director, Resources Safety, Department of Mines and Petroleum, Transcript of Evidence, 7 November 2014, p 9.
\textsuperscript{133} ibid.
\textsuperscript{134} ibid, p 6.
\textsuperscript{135} ibid.
\textsuperscript{136} ibid.
Finding 8
Petroleum activities undertaken in Western Australian coastal waters are regulated by the Western Australian Government.

Incident response

A final important point relates to incident response. In the event of an emergency involving an offshore petroleum facility the operator is responsible for responding to the incident; that is, the operator is the control agency, the combat agency and the coordinator of the response. This is discussed in more detail in Chapters 9 and 10.

Depending on the severity of the incident, though, an operator may decide to seek the assistance of government. This is where the responsibilities for coordination of emergency responses become more complex. In the wake of the Montara incident, the Commonwealth Government agreed that a ‘central incident coordination committee’ was necessary to respond to future offshore petroleum incidents. This led to the establishment of the Offshore Petroleum Incident Coordination Committee (OPICC), which is chaired by a Deputy Secretary of the Department of Industry. The Department of Industry, in consultation with other agencies and regulators, also makes the decision to activate the OPICC.

The composition of the OPICC is determined by the Chair, and membership may change depending on the nature of the particular incident for which an OPICC-coordinated response is required. Membership of the OPICC can comprise senior representatives from the relevant government agencies and from industry. Relevant government agencies include the Department of Infrastructure and Regional Development, NOPSEMA, AMSA, the Department of the Environment, the Department of Foreign Affairs and Trade, Geoscience Australia, the National Offshore Petroleum Titles Administrator (NOPTA), the Department of the Prime Minister and Cabinet, the Department of Immigration and Border Protection, the Australian Customs and Border Protection Service, the Attorney-General’s Department, the Crisis Coordination Centre, other government agencies as required. OPICC’s roles and responsibilities are outlined in Chapter 9.

Furthermore, according to the Australian Government Crisis Management Framework (AGCMF), ‘leadership of the Australian Government’s response to a crisis will, in the first instance, be the responsibility of the relevant portfolio minister’. Consequently, for a significant petroleum incident in Commonwealth waters, the Minister for Industry would be the lead Commonwealth Minister.

The AGCMF is also ‘intended to interface with other emergency incident response/coordination frameworks’. These include operators’ Oil Pollution Emergency Plans, the National Plan for Maritime Environmental Emergencies (the National Plan), the
Chapter 2

Commonwealth Government’s various Crisis Management Plans and state and territory contingency plans as appropriate.

2.51 The complexity of these arrangements and the confusion that exists in relation to jurisdictional responsibilities, particularly in relation to the overall command of an emergency response involving government agencies, is discussed further in Chapter 11.

2.52 The situation is slightly different for an offshore emergency event occurring in an area of state jurisdiction. The Department of Transport (DoT) explained that emergency management in WA is ‘covered under the Emergency Management Act 2005 [WA] and the Emergency Management Regulations 2006 [WA]’.137 State emergency management plans, referred to as ‘WestPlans’, are prepared by the State Emergency Management Committee.

2.53 In WA, the DoT is responsible for developing and maintaining WestPlans for either a ‘Maritime Transport Emergency’ (MTE) or a ‘Maritime Oil Pollution’ (MOP) incident in state waters. According to the DoT, these WestPlans ‘set out the roles and responsibilities of government agencies in relation to prevention and mitigation, preparedness, response and recovery’.138 Both of these WestPlans stipulate the emergency management arrangements that are in place for each type of incident, before detailing the strategies for prevention and mitigation, and the preparedness and response procedures that would follow were such an incident to occur.

2.54 The DoT’s General Manager, Maritime Safety, Mr Raymond Buchholz, characterised the WestPlan MTE as planning for ‘ships getting in trouble,’ and the WestPlan MOP as planning for ‘ships or facilities actually polluting through oil and noxious substances’.139 According to Mr Buchholz, an intergovernmental agency agreement between agencies at both Commonwealth and state level:

commits the state of Western Australia to nominate a responsible jurisdictional authority to manage marine oil pollution in state waters and nominate a state marine pollution controller. The Emergency Management Act 2005 and associated regulations effectively prescribed the marine safety general manager of the Department of Transport as the hazard management agency for both maritime transport emergencies and for marine oil pollution. In effect, this prescribes the Department of Transport as the jurisdictional authority for those two hazards.140

137 Submission No. 2 from the Department of Transport, 11 July 2014, p 2. Italics in original.
138 ibid.
139 Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, p 2.
140 ibid.
Mr Buchholz also explained that his personal designation as ‘hazard management authority’ means that he is:

responsible for ensuring, developing, implementing and reviewing both the Westplan MTE and the Westplan MOP [... and he has] overall responsibility for ensuring that MTE and MOP have adequate prevention, preparation, response and recovery arrangements and strategies in place and that they are implemented as required. Those obligations placed upon my position are direct from the State Emergency Management Act and the regulations.¹⁴¹

It must also be noted, however, that notwithstanding the central role of the DoT in relation to both the WestPlan MTE and the WestPlan MOP, the statutory responsibilities of DMP for regulating petroleum industry activities in coastal waters means that DMP would, in conjunction with the relevant operator, coordinate the response to an emergency involving an infrastructure facility operating in an area of state jurisdiction.

**Finding 9**

In the event of an emergency, an operator may decide to seek the assistance of government. For operations in Commonwealth waters, the coordination of the response would most likely be by either the Offshore Petroleum Incident Coordination Committee or the Australian Maritime Safety Authority, depending on the type of emergency.

For operations in state waters, an assisted response would be coordinated by either the Department of Mines and Petroleum or the Department of Transport, depending upon the scope of the emergency event.

¹⁴¹ ibid.
Chapter 3

The Australian regulatory regime

3.1 This chapter outlines the regulatory regime that applies to the activities of the petroleum industry when operating in Australian jurisdictions. After setting out the legislation and regulations that apply, the chapter details the objective-based regime that applies and the requirement for operators to achieve and maintain risk levels to as low as reasonably practicable (ALARP).

3.2 Following this, to provide context for the balance of the report, the development of the current system of regulations is briefly explained and the National Offshore Petroleum Safety and Environmental Management Authority’s (NOPSEMA’s) role as regulator is outlined.

The Australian regulatory regime

3.3 Australian petroleum industry activities occurring in areas of Commonwealth jurisdiction are subject to the provisions of the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (OPGGS Act) and its associated regulations. There are four sets of regulations, each pertaining to a particular aspect of safe offshore operation:

- The Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009, (OPGGSS Regulations) which regulate the occupational health and safety standards for workers on offshore petroleum facilities;

- The Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (the OPGGSE Regulations), which aim to ensure that offshore petroleum activities are carried out in a manner that is ecologically sustainable, and by which the level and risk of environmental impact has been appropriately minimised;

- The Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011, which aim to ensure that offshore petroleum activities are carried out in a manner that is transparent to government and in accordance with good oilfield practice; and

- The Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Regulations 2004, which enable and clarify the levies that are applied to various offshore petroleum activities to fund the government’s regulatory role.
Chapter 3

3.4 The OPGGS Act and its subsidiary regulations are detailed, lengthy and complex. Occupational health and safety laws for the purposes of offshore petroleum operations are, for example, comprised of:

- the OPGGSS Regulations 2009;
- Sections 603 and 609 of the OPGGS Act; and
- Schedule 3 to the OPGGS Act. 142

Objective based regulation

3.5 The complexity of this legislative framework belies an inherent simplicity. In Australia, as in much of the petroleum-producing world, regulation of offshore petroleum activities is referred to as objective or performance-based regulation. Under an objective-based regime:

*the onus is placed on the operator, not the regulator, to demonstrate through a safety case that they have reduced the risks associated with their operations to as low as reasonably practicable (ALARP).* 143

3.6 According to NOPSEMA, such a regulatory regime ‘is recognised as international regulatory best practice’ because it ensures that:

- those who create the risk are responsible for managing that risk;
- risk management is tailored so that it is appropriate for the specific activity in question; and
- there is flexibility to allow for the implementation of new and emergent technologies as they become available, which can lead to continuous improvement in health and safety, and environmental performance. 144

3.7 Until the early 1990s, Australia’s offshore petroleum industry was regulated through prescriptive legislation at both state and Commonwealth level. This regulation took the

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143 Submission No. 11 from Australian Petroleum Production and Exploration Association, 20 August 2014, p 11.

144 Submission No. 36 from National Offshore Petroleum Safety and Environmental Management Authority, submission to Inquiry into Economic Impact of Floating LNG on Western Australia, 22 November 2013, p 1.
form of specific legal requirements that offshore petroleum industry operators were required to comply with. Under this regime, the regulator was required to identify the safety of various operative practices for the industry.

3.8 In brief, this prescriptive regulation changed in the aftermath of the 1988 Piper Alpha disaster in the North Sea, which is discussed in Chapters 1 and 4. Like all petroleum producing nations, Australia considered what lessons could be drawn from the Piper Alpha disaster. Along with other countries, Australia decided to introduce the ‘safety case’ approach, now commonly used by petroleum producing nations throughout the world. The transition from a prescriptive to an objective-based regulatory regime is described in a separate section of this chapter.

3.9 NOPSEMA explained that the objective-based method of regulation is informed by two guiding principles:

- the operator of an offshore facility is responsible for the safe operation of the petroleum facility; and
- the onus is placed on the industry to ensure and demonstrate to regulators that risks relating to oil and gas operations are reduced to ‘as low as reasonably practicable’ (ALARP).145

3.10 That is, with some limited exceptions,146 Australia’s offshore petroleum industry regulations do not prescribe safety standards that must be met, or specific safety measures that must be taken by operators.

3.11 In line with the above two guiding principles, Australia’s regulatory regime for offshore petroleum activity is fundamentally based upon the submission and adherence to human and environmental safety commitments made by project operators. In relation to human safety, this model is underpinned by the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Cth) (OPGGSS Regulations).147 Similar regulations relating to environmental safety are contained within the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth) (OPGGSE Regulations).

3.12 Before any proposed offshore petroleum activity can commence, the operator must submit to NOPSEMA for assessment a detailed risk management plan for the project, comprised of both the relevant safety case and corresponding environment plan. These

145 ibid.
146 The Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Cth) do specify a number of elements that must be included within any safety case; these regulations also contain some requirements relating to worker capacity and command structures.
Chapter 3

document and demonstrate how the operator will manage the risks and impacts of their proposed offshore activities to the required levels, including how incident response and preparedness will be addressed.148

3.13 The safety case, as the primary mechanism through which operators meet their objectives and legal requirements, is discussed in detail in Chapter 4. Environmental regulation is discussed further in Chapter 6. These chapters also detail NOPSEMA’s role in relation to monitoring and inspecting facilities, including those using FLNG technology.

Finding 10

The offshore petroleum industry in Australia is subject to objective-based regulation, which makes the operator responsible for identifying the safety and environmental risks associated with its proposed activities and satisfying the regulator that these risks will be appropriately managed and mitigated.

ALARP

3.14 It is an object of the OPGGSS Regulations ‘to ensure that the risks to the health and safety of persons and facilities are reduced to a level that is as low as reasonably practicable’ (ALARP).149 Similarly, one objective of the OPGSE Regulations is to ‘ensure that any petroleum activity or greenhouse gas activity carried out in an offshore area is ... carried out in a manner by which the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable’.150

3.15 Under s 9 of Schedule 3 of the OPGGS Act an operator of a facility:

(1) [...] must take all reasonably practicable steps to ensure that:

(a) the facility is safe and without risk to the health of any person at or near the facility; and

(b) all work and other activities carried out on the facility are carried out in a manner that is safe and without risk to the health of any person at or near the facility.

3.16 Regulation 10A of the OPGGSE Regulations states that ‘the criteria for acceptance of an environment plan are that the plan’:

(b) demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable; and

148 Submission No. 36 from National Offshore Petroleum Safety and Environmental Management Authority, submission to Inquiry into Economic Impact of Floating LNG on Western Australia, 22 November 2013, p 2.
150 r 3(b) Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth).
(c) demonstrates that the environmental impacts and risks of the activity will be of an acceptable level.

3.17 During a hearing attended by NOPSEMA representatives, the Committee sought clarification on the practical difference between the risk amelioration standards for human and environmental safety. NOPSEMA’s General Manager, Environment, Mr Cameron Grebe confirmed that the difference is minor:

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\text{[I]t is the same. The ALARP principle is embodied in our [environmental] regulations in a similar fashion [to human safety], obviously, related to environmental risk versus risk to people at facilities. Environment extends to include social and economic features of the environment in our legislation. There are additional decision-making criteria [for environmental safety] that include also to-acceptable levels. That is due to the nature of environmental impacts and risks versus safety risks.}\]

3.18 The legal definition of ALARP was provided by Lord Justice Asquith in 1949:

‘Reasonably practicable’ is a narrower term than ‘physically possible’ and ... implies that a computation must be made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed in the other; and that if ... there is a gross disproportion between them—the risk being insignificant in relation to the sacrifice—the defendants discharge the onus on them. Moreover, this computation falls to be made by the owner at a point of time anterior to the accident.

3.19 This definition has been confirmed in Australian courts. For example, drawing from decided cases, the High Court of Australia in Slivak v Lurgi (Australia) Pty Ltd (2001) stated that there were ‘three general propositions’ contained in the term ‘reasonably practicable’:

- the phrase ‘reasonably practicable’ means something narrower than ‘physically possible’ or ‘feasible’;
- what is ‘reasonably practicable’ is to be judged on the basis of what was known at the relevant time;

151 Mr Cameron Grebe, General Manager, Environment, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 7.

to determine what is ‘reasonably practicable’ it is necessary to balance the likelihood of the risk occurring against the cost, time and trouble necessary to avert that risk.\textsuperscript{153}

According to the UK Health and Safety Executive (HSE), ensuring a risk is ALARP ‘is about weighing the risk against the sacrifice needed to further reduce it’.\textsuperscript{154} For operators to avoid having to make this sacrifice, they must demonstrate:

that it would be grossly disproportionate to the benefits of risk reduction that would be achieved. Thus, the process is not one of balancing the costs and benefits of measures but, rather, of adopting measures except where they are ruled out because they involve grossly disproportionate sacrifices.\textsuperscript{155}

NOPSEMA’s ALARP guidance note states that determining what ALARP means for a risk requires ‘an assessment of the risk to be avoided, and an assessment of the sacrifice (in money, time and effort) involved in taking measures to avoid that risk, and a comparison of the two’.\textsuperscript{156} Logically, the greater the level of risk, the greater is the level of effort necessary to show that this risk has been reduced to ALARP. However, as NOPSEMA advises, ‘just because the initial level of risk may be low doesn’t mean it may not be reasonably practicable to reduce it further’.\textsuperscript{157}

The risk/sacrifice comparison involves a test of ‘gross disproportion’. NOPSEMA’s ALARP guidance note states that:

if a measure is practicable and it cannot be shown that the cost of the measure is grossly disproportionate to the benefit gained; then the measure is considered reasonably practicable and should be implemented.\textsuperscript{158}

It is important not to confuse ‘reasonably practicable’ with ‘reasonably affordable’ as ‘justifiable cost and effort is not determined by the budget constraints/viability of a project’.\textsuperscript{159}

Simply put, to reduce a level of risk to ALARP ‘means to adopt available and suitable control measures until a point is reached when the incremental benefit of further risk

\textsuperscript{153} Slivak v Lurgi (Australia) Pty Ltd (2001).
\textsuperscript{155} ibid.
\textsuperscript{156} National Offshore Petroleum Safety and Environmental Management Authority, ALARP, Guidance note N–04300–GN0166, June 2014, p 5.
\textsuperscript{157} ibid.
\textsuperscript{158} ibid.
\textsuperscript{159} ibid.
control measures is outweighed by other issues such as cost, for example, or degree of difficulty of implementing the measure.  

3.25 Evidence to this Inquiry demonstrates that oil and gas operators, including those proposing to develop petroleum resources using FLNG technology, are aware of the obligation they have to reduce risk to ALARP levels. For example, Woodside submitted that it has demonstrated its ‘capability of operating within an objective based (or goal setting) regulatory regime as exists in Australia’, which requires it to demonstrate that risk management controls for a development ‘are effective and fit-for-purpose and that such risks are reduced to as low as reasonably practicable (ALARP).’

3.26 Similarly, in discussing regulatory requirements for risk identification and control, a submission by GDF SUEZ Bonaparte notes that this is an ‘iterative process’ that continues until ‘risk has been reduced to a level that is as low as reasonably practicable, ALARP.”

3.27 In relation to its FLNG technology, Shell submitted that ‘safety is the primary focus, with multiple, formal safety assessments completed and recommendations incorporated into the design to ensure the design and risk levels are ALARP’.

Finding 11

The regulatory regime that applies to Australia’s offshore petroleum industry requires operators to satisfy the regulator that identified risks have been reduced to levels that are as low as reasonably practicable.

Finding 12

As low as reasonably practicable does not mean as low as reasonably affordable. Rather, it means assessing and adopting appropriate risk control measures until the incremental benefit of further measures is outweighed by other issues such as the cost, time and effort required to implement the measure.

From prescriptive to objective-based regulation

3.28 Having outlined the current regulatory regime for the Australian offshore petroleum industry, its objective-based philosophy and the concept of ALARP, it is useful here to summarise the international influences on the shift from the former prescriptive regime.

161 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 4. See also: Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 2.
162 Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 4.
163 Submission No. 9, Shell Development (Australia) Pty Ltd, 11 August 2014, p 1.
Chapter 3

3.29 Australia’s regulation largely reflects the outcomes of two major inquiries instigated by the UK government, namely the Robens Report and the Lord Cullen Inquiry. As GDF SUEZ Bonaparte submited:

- the shortcomings of prescriptive-based regulation as applied to major hazard industries were identified in the Cullen Inquiry [into the Piper Alpha disaster] in 1990 and, prior to that, in the Robens Report [on occupational health and safety generally] in 1972. These shortcomings remain equally valid today and are particularly relevant in the context of this inquiry into safety matters relating to a new and evolving technology.164

The Robens Report

3.30 The Robens Report is the 1972 report of the Committee on Safety and Health at Work, which was chaired by Lord Alfred Robens and was an important development in the history of occupational health and safety law globally.

3.31 By 1970 concern had arisen in the UK that ‘the traditional system of regulation … was too rigid and complex and unable to keep pace with social, economic and technological change’.165 Therefore, the Committee on Safety and Health at Work was appointed to review workplace health and safety, and determine what legislative or voluntary changes were required, and how the public might be protected from industrial, construction and commercial site hazards.166

3.32 The Robens Report found that there was:

- too much law relating to health and safety at work and the detailed prescription of every aspect of work had the effect of persuading people that health and safety was purely a matter of government regulation and not of individual responsibility.167

3.33 Part of the reason why there was too much law was that at that time there were ‘nine separate groups of health and safety statutes’, with enforcement of these divided

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164 Submission No. 5 from GDF SUEZ Bonaparte, 14 July 2014, p 2.
between five government departments and ‘a number of separate legal authorities’.168 This was clearly a major disadvantage to those trying to address health and safety in the workplace.169

3.34 Another major factor was that whenever a new technology was developed, the relevant regulatory agency imposed a ‘new set of detailed rules’.170 This also relates to another problem noted by the Robens Report, that is, that ‘too much of the existing law was irrelevant to real problems’.171

3.35 The Robens Report observed that prescriptive regulations ‘which lay down precise methods of compliance have an intrinsic rigidity, and their details may be quickly overtaken by new technological developments’.172 This observation led to the recommendation that, where possible, ‘regulations should be confined to statements of broad requirements in terms of the objectives to be achieved,’ because:

methods of meeting the requirements may often be highly technical and subject to frequent change in the light of new knowledge. They should, therefore, appear separately in a form which enables them to be readily modified.173

3.36 An important element of this view concerned the time ordinarily taken to amend statutory regulation. Describing the ‘question of the desirable balance between the use of statutory regulations and the use of non-statutory codes of practice’ as ‘controversial,’ the Robens Report explained that while ‘statutory regulations ... express unequivocal legal obligations, and can be strictly enforced,’ their inherent inflexibility is problematic because they also ‘often take a long time to make, technical details can quickly become out of date, and in practice once made they are seldom easy to revoke’.174

3.37 APPEA explained this situation as follows:

For industries subject to rapid technological change and which operate in dynamic, high risk environments, prescriptive regulation is likely to

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171 ibid.
173 ibid.
174 ibid.
Chapter 3

become quickly outdated and worse, counterproductive in ensuring safe operations.175

3.38 Similarly, GDF SUEZ Bonaparte explained that:

prescriptive regulations and standards tend to be a distillation of past experience and are based upon the best engineering practices at the time of establishing the regulation or standard. The evolution of best engineering practices, especially with new or emerging technology, such as FLNG, occurs at a pace that prescriptive standards can quickly become deficient.176

3.39 By contrast, as the Robens Report noted:

non‐statutory codes of practice and standards are more flexible. They are easier to introduce and to revise. They are more progressive in that they need not be restricted to minimum standards, and they are less likely to inhibit new developments.177

3.40 Ultimately the Committee on Safety and Health at Work expressed support for the use of codes of practice, explaining that these had proven especially effective ‘in areas where the framing and implementation of effective statutory regulations might have proved difficult or impossible’.178 As the Robens Report explained:

We [the Committee on Safety and Health at Work] are in no doubt that as a general rule a non‐statutory code or standard is to be preferred to a statutory regulation in the interests of intelligibility and flexibility, and as a means of providing practical guidance towards progressively higher standards.179

175 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 5.
176 Submission No. 5 from GDF SUEZ Bonaparte, 14 July 2014, p 2.
178 ibid.
179 ibid.
Accordingly, the Robens Report found that ‘greater emphasis should be placed in future on standard-setting by means of non-statutory codes of practice and standards’, and recommended that:

*as a general rule, statutory regulations should only be made when the alternative of a non-statutory code or standard has been fully explored and found wanting.*

In discussing what it found wrong with the existing system, the Robens Report also notes that ‘the subject of safety is one which produces an apathetic response, and that many practical implications flow from this’. Furthermore, it notes that ‘health and safety too often evoke a positive reaction from management only when they are either financially or emotionally frightened’.

Overall, the Robens Report called for:

*better systems of safety organisation, for more management initiatives, and for more involvement of work people themselves. The objectives of future policy must therefore include not only increasing the effectiveness of the state’s contribution to health and safety at work but also, and more importantly, creating conditions for more effective self-regulation.*

The Report recommended that a ‘three tiered’ approach to occupational health and safety law be adopted. This model would first specify broad, overarching general duties (tier one), backed by more detailed provisions in regulations (tier two) and industry codes of practice (tier three).

In the United Kingdom, the observations and recommendations contained within the Robens Report led to the enactment of the *Health and Safety at Work Act 1974 (UK)*, which continues to define the structure and authority for the promotion, regulation and enforcement of occupational health and safety law there.

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180 ibid.
182 ibid.
Australian law was also influenced by this change in approach, with the various jurisdictions each enacting new occupational health and safety statutes based on the three tiered approach.\footnote{185 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 10.}

**The Cullen Inquiry**

Despite these early 1970s developments in workplace health and safety law generally, some industries—including the offshore petroleum industry—continued to be largely governed by prescriptive safety regulations. However, the 1988 Piper Alpha disaster in the North Sea served as the catalyst for a shift away from prescriptive regulation.

In the aftermath of that disaster, a public inquiry conducted by Lord William Cullen (the Cullen Inquiry) emphasised the severe shortcomings of using prescriptive regulation for the petroleum industry, and paved the way for the adoption of objective-based regulation within that industry worldwide.

According to GDF SUEZ Bonaparte:

> the Cullen Inquiry highlighted that the prescriptive regime in place prior to the Piper Alpha incident had resulted in industry and the regulators failing to recognise, understand and control the high consequence, low likelihood hazards which can be unique to every different application.\footnote{186 Submission No. 5 from GDF SUEZ Bonaparte, 14 July 2014, p 2.}

In short, Lord Cullen’s inquiry found:

- serious deficiencies in the way in which the permit to work system operated;
- set safety policies and procedures were not followed on the platform;
- cursory and inconsistent emergency induction and training for workers;
- the operator’s management had a superficial attitude toward the assessment of major hazard risks; and
- the government’s regulatory regime was not an effective means of assessing or monitoring operators’ safety management.

In tabling the Cullen Inquiry report in 1990, the then UK Secretary of State for Energy, Mr John Wakeham, noted Lord Cullen’s observations on the ‘significant flaws in the way in which safety was managed’ by the operator and his belief that ‘the existing
system did not give sufficient emphasis to the auditing of [ ... the operator’s] management of safety’. 187

3.52 Mr Wakeham also explained that ‘the primary responsibility for safety has always been, and will always remain, with the operator’. 188 APPEA also observes that a key finding of the Cullen Inquiry was that ‘in complex, dynamic and high risk activity such as hydrocarbon processing facilities, it is essential that the responsibility for managing the risks lies at the point of operations’. 189

3.53 According to Mr Wakeham ‘the main thrust of Lord Cullen’s report’ was to:

propose a new approach, under which the operator would retain the primary responsibility for safety, and would be required to prepare a comprehensive safety case. The regulator would be responsible for continuously reviewing the case. Lord Cullen believes that that is the best way to prevent any recurrence of such failings in the future, and the Government accept his conclusions’. 190

3.54 Subsequent to the conclusion of the Cullen Inquiry, offshore petroleum industry regulation in the UK was amended, with the government there adopting a goal setting approach to legislation, implementing a safety case regime within that approach and creating an independent offshore health and safety regulatory body. Australia quickly followed suit, with the Consultative Committee on Safety in the Offshore Petroleum Industry recommending that:

- the safety case regime be adopted in Australia; and
- the existing prescriptive safety rules contained in the Petroleum (Submerged Lands) Act 1967 (Cth) be replaced with new, performance-based regulations. 191

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187 Mr John Wakeham, Secretary of State for Energy, United Kingdom, House of Commons, Parliamentary Debates (Hansard), 12 November 1990, column 329.
188 ibid.
189 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 11.
190 Mr John Wakeham, Secretary of State for Energy, United Kingdom, House of Commons, Parliamentary Debates (Hansard), 12 November 1990, column 329.
Advantages of objective-based regulation

3.55 Generally speaking, the petroleum industry sees advantages inherent in an objective-based regulatory regime. As APPEA explained:

regulation of petroleum operations should reflect leading practice and be objective-based. ... [R]egulations need to set clear objectives and leave it to operators to determine how these objectives are to be achieved and to provide robust justification (or case for safety, environment and structural integrity) to an independent and competent regulator. 192

3.56 For APPEA:

a policing style of regulation where finding blame is the main game and prescriptive requirements are ticked off does not and cannot contribute to best industry practice and performance through sharing of lessons and experiences. 193

3.57 APPEA also described how the objective-based regulatory regime functions to ensure that advances in safety by individual operators are quickly adopted by the industry as a whole:

It is imperative in high hazard industries such as petroleum operations that experiences and lessons are shared across the industry as effectively and rapidly as possible. This open approach is highly dependent on having in place a mature regulator(s) engaged with industry to share and problem solve, backed up by clear objective based regulation and firm but fair enforcement. 194

3.58 Notwithstanding these comments, it is clear that there is some tension inherent to relying upon an apparently collaborative model to regulate a competitive industry. When questioned on this point, however, NOPSEMA argued that disseminating knowledge of improved safety techniques (even where that knowledge may be proprietary) was routine work for the regulator. 195 This is discussed further in Chapter 4.

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192 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 5.
193 ibid.
194 ibid.
195 Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 11.
Development of Australia’s safety case regime

3.59 Describing ‘the most significant outcome from the Cullen inquiry’ as being the move from ‘a prescriptive regulatory approach that attempted to enforce minimum compliance to a goal setting regime,’ APPEA submited that:

*the onus is [now] placed on the operator, not the regulator, to demonstrate through a safety case that they have reduced the risks associated with their operations to as low as reasonably practicable (ALARP).* \(^{196}\)

3.60 The introduction of a safety case obligation into offshore petroleum industry activities is said to ‘strengthen the implementation of the Robens style duty of care regime’ by introducing the principle of ‘continuous improvement’ to the regulatory model. \(^{197}\) In fact, the safety case model is the centrepiece of Australia’s objective-based regulatory regime that places the onus for safety upon the operator.

3.61 Legislation to amend the *Petroleum (Submerged Lands) Act 1967* (Cth) was introduced in 1992, and the safety case regime was in full effect in Australia by 1996. \(^{198}\) Oversight of this regime, however, was inconsistent. As there was no federal regulatory authority, it was left to the states and the Northern Territory to carry out day to day offshore petroleum safety regulation using prescriptive legislative rules augmented by the safety case approach. \(^{199}\) Amid concerns about the consistency of this method of regulation, in 1999 the Commonwealth Government commissioned a review to examine the situation.

3.62 The review was managed and coordinated by the Offshore Safety Section of the Department of Industry, Science and Resources, with oversight from a steering committee comprising representatives of the Commonwealth and state and territory governments, the offshore petroleum industry and the workforce. \(^{200}\) The review itself was ‘conducted by an international team of offshore safety experts … whose report

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196 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 11.
197 Ibid.
was submitted to the Commonwealth on 30 March 2000’. The report, entitled Future arrangements for the regulation of offshore petroleum safety, was critical of the complexity and inconsistence of Australia’s framework of laws and regulations.

According to APPEA, those who had conducted the review found that:

- the Australian legal and administrative framework, and the day to day application of this framework, for regulation of health, safety and environment in the offshore petroleum industry is complicated and insufficient to ensure appropriate and cost efficient regulation of the offshore petroleum industry;

- there were too many acts, directions and regulations regulating offshore petroleum activities, their boundaries were unclear and application inconsistent;

- the role of the Designated Authorities was unclear and undefined;

- the regulators appeared to have inconsistent philosophies, procedures and approaches to regulation, both in regard to the discharge of their role in safety case development and assessment, and in regard to auditing activities; and

- resourcing all of the regulators with competent and experienced personnel to work with what are often complex work activities was a real concern, and salary levels made it difficult to recruit and retain a critical mass.

In light of these findings, the report recommended a total revision of the way in which Australia’s offshore petroleum industry activities were regulated, beginning with the establishment of a national petroleum safety regulatory authority. In September 2002, the Ministerial Council on Mineral and Petroleum Resources, comprising various Ministers responsible for petroleum safety across Australia, ‘endorsed the formation of an independent national offshore safety authority’. In order to ensure consistent regulation across all jurisdictions, it was agreed that the authority—which would be known as the National Offshore Petroleum Safety Authority (NOPSA)—would be given responsibility for regulating Commonwealth and state waters, and would be accountable to the Commonwealth, State and Northern Territory Ministers.
NOPSA was established with the passage of the Petroleum (Submerged Lands) Amendment Bill 2003, the explanatory memorandum for which explained that the Authority would ‘deliver a uniform national safety regulatory regime for Australia’s offshore petroleum industry and ... reduce the regulatory burden faced by industry participants’. It was further explained that amendment to the Petroleum (Submerged Lands) Act 1967 (Cth) was necessary because:

the occupational health and safety (OHS) requirements in Schedule 7 of the Act do not [currently] apply to Commonwealth waters adjacent to a State or the Northern Territory if the law of that State or Territory “provides, to any extent, for matters relating to the occupational health and safety of persons employed in the area”. In that case, the OHS laws of the State or Territory apply.

As a result of this provision, the application of occupational health and safety laws at sea differed by jurisdiction, which was deemed to be an unnecessary and unhelpful burden upon offshore petroleum operators. Amending the Petroleum (Submerged Lands) Act 1967 made NOPSA solely responsible for administering the safety case regulatory model within the Commonwealth’s offshore petroleum industry and streamlined the application of occupational health and safety law at sea. The safety case was also explained as a regulatory model by which ‘operators can achieve those objectives by developing systems and procedures that best suit their needs and agreeing those with the regulator’. The safety case itself was described as:

the rules by which the operation of the facility is governed, [including] details of safety management arrangements and risk assessment studies, which, once submitted to and accepted by the regulator, sets both the standards to be achieved and the mechanism for achieving them.

NOPSA began operations on 1 January 2005. Though the Petroleum (Submerged Lands) Act 1967 (Cth) was replaced by the OPGGS Act, NOPSA’s regulatory role remained largely unchanged until the OPGGS Act was amended in 2009. At this time, in response to a pair of reports concerning the offshore petroleum industry, the OPGGS Act was amended to expand NOPSA’s regulatory role. In addition to its existing duties, NOPSA was given ‘responsibility for non-OHS structural integrity of facilities, including

205 Explanatory memorandum to the Petroleum (Submerged Lands) Amendment Bill 2003 (Cth).
206 ibid
207 ibid.
208 ibid.
Chapter 3

pipelines, wells and well-related equipment. NOPSA’s role (and indeed, its name) was further expanded in the aftermath of the Montara oil spill in the Timor Sea.

The Montara oil spill—which was subsequently acknowledged as being ‘the worst of its kind in Australia’s offshore petroleum industry history’—occurred in August 2009. In response, the Commonwealth Government appointed the Montara Commission of Inquiry to investigate and report upon the disaster; following a seven-month inquiry the Commission, having identified a number of significant deficiencies in Australia’s regulation of offshore petroleum industry activities, provided a report containing 100 findings and 105 recommendations to the Government.

It is worth noting that while the Montara Commission of Inquiry voiced broad support for objective-based regulation within the offshore petroleum industry, this support was expressed with a note of caution. In its report, the Commission observed that:

while it is the case that industry, under the current regime, has a greater level of responsibility for itself than exists under more prescriptive regimes, a regulator must still ensure that a company’s procedures meet the statutory standard of good oilfield practice.

The view expressed within the Commission report was that the practices of the Northern Territory’s Department of Resources (the authority responsible for regulating well integrity at the time of the Montara oil spill) ‘fell well short of what good contemporary regulatory practice required in relation to the regulation of matters bearing upon well integrity in the offshore area it was responsible for’. The Commission’s view was that:

while the movement toward a more objective-based regulatory regime is appropriate, it demands that more effort be devoted to carefully ensuring that what is proposed by an operator is not approved unless it is consistent with good oilfield practice and such approval is followed up with targeted monitoring, audit and compliance activities. The regulator needs to actively probe and inquire; it should not be passive; the regulator needs to ask questions of the owner/operator and be

209 ibid.
213 ibid, p 232.
prepared to engage in a technical debate with an operator about what truly is 'good oilfield practice'.  

This led to the important and influential finding that:

- the Inquiry supports the objective (rather than prescriptive) approach to regulation now followed in Australia. However, the pendulum has swung too far away from prescriptive standards. In some areas relating to well integrity there needs to be minimum standards.

In April 2010, with the Montara Commission of Inquiry drawing towards its conclusion, the petroleum industry was again met with another offshore disaster. In the Gulf of Mexico, the Macondo Deepwater Horizon disaster claimed the lives of 11 offshore workers, and resulted in the largest marine oil spill in history. Two offshore disasters within the space of eight months meant that regulatory reform within the Australian petroleum industry was inevitable and, ultimately, the vast majority of the recommendations made by the Commission were accepted by the Commonwealth, with NOPSA being given the additional responsibility of regulating environmental management practices within the offshore petroleum industry. In 2011 the OPGGS Act was amended to turn NOPSA into the National Offshore Petroleum and Environmental Management Authority—NOPSEMA—Australia’s national regulator for safety, well integrity and environmental management in relation to offshore petroleum activities.

**NOPSEMA and objective-based regulation**

Before a safety case, a well operations management plan or an environment plan can be submitted for validation, it must also have been verified by an independent assessor. As a part of this process, the operator is required to satisfy NOPSEMA ‘that each person who undertook the validation had the necessary independence, competence, ability and access to data, in respect of each matter being validated, to arrive at an independent opinion on the matter’.

Once a safety case for a particular facility has been validated and submitted, NOPSEMA’s role:

- is to provide independent assurance that health and safety risks are properly controlled by challenging the operator’s risk management arrangements during safety case assessment and then verifying by

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214 ibid, p 15.
215 ibid, p 232.
Chapter 3

planned inspection that the operator has implemented its risk management commitments documented in the safety case.217

3.75 A similar process is undertaken in relation to an operator’s well operations management plans and environment plans.

3.76 The introduction of a safety case and environment plan obligation on operators, and a regulatory obligation on NOPSEMA, complements duty-based occupational health and safety laws by ensuring that standards are improved as knowledge and understanding of risk amelioration improves.

3.77 Though each of these responsibilities is created pursuant to a different set of regulations, because each set of regulations is objective-based, NOPSEMA generally discharges its safety, well integrity and environmental management responsibilities in much the same way. Worker safety is regulated by the safety case regime, well integrity is regulated by what is known as the ‘well operations management plan’ regime and environmental management practices are subject to regulation through the ‘environment plan’ regime. Again, each regime requires the operator to prepare and submit detailed plans of how it will manage the risks associated with its operations, and these plans must be approved by NOPSEMA before any offshore activities can take place. In turn, NOPSEMA holds operators accountable to the commitments contained within their approved plans.

3.78 Further detailed discussion of NOPSEMA’s role is contained in Chapter 4 on the safety case regime in Australia and Chapter 6 on environmental regulation.

3.79 At this point, though, it is useful to note the steady increase in the number of annual inspections undertaken by NOPSEMA (and its immediate predecessor, NOPSA) since 2005, which is illustrated in Figure 3.1 below.

The marked increase in annual inspections since 2010 would reflect, in part, a response to increased offshore petroleum industry activities and NOPSEMA’s new environmental management responsibilities. It is also likely that the 2009 Montara disaster has had an influence on the frequency with which inspections are conducted. Whatever the reason, it is clear that inspection rates have increased markedly since 2005.

In the Australian context, the Montara oil spill made it clear that the assessment process is perhaps the most critical element of successful objective-based regulation. While the requirements associated with preparing and submitting safety cases, well operations management plans and environment plans place significant responsibility on the operator, it is critical that the regulator is equipped with the resources and expertise necessary to fully test and assess the claims contained within each plan. Indeed, the importance of being able to take such a rigorous approach is underscored by the role played by NOPSEMA in assessing each of these plans.

**Occupational health and safety**

Given that concerns relating to the occupational health and safety of those employed on FLNG facilities or in support roles were the motivation for this Inquiry, and while occupational health and safety issues must be addressed in an operator’s safety case, the issue warrants some further discussion.

Notwithstanding NOPSEMA’s regulatory duties and expertise, it is important to understand that the primary responsibility for the health and safety for those working

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on an offshore petroleum facility falls to the operator of the facility in question. NOPSEMA observes that the regulation of occupational health and safety within Australia’s offshore petroleum industry ‘is a performance-based regime typical of all modern OHS regimes, whether applying offshore or more generally at workplaces’. According to NOPSEMA:

those regimes impose general duties on parties to the regime, especially operators and employers. The principle underlying these performance-based, general duties regimes is: the primary responsibility for ensuring health and safety should lie with those who create risks and those who work with them.

In relation to occupational health and safety, this situation is most clearly reflected in the composition and content of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (OPGGSS Regulations). The OPGGSS Regulations ‘strengthen the implementation of the duty of care regime’ within the OPGGS Act by imposing upon each facility operator a ‘safety case obligation’.

The guiding principle of Australia’s offshore petroleum industry regulation in this area can be found within Schedule 3 to the OPGGS Act, which makes it clear that the operator of an offshore facility is duty-bound ‘to take all reasonably practicable steps to ensure the facility and its activities are safe and without risk to health’.

Within Schedule 3 to the OPGGS Act, Clauses 9–15 set out a series of duties that must be at all times discharged by facility operators, employers of facility workers, manufacturers and suppliers of equipment and substances used on facilities, petroleum and/or greenhouse gas titleholders’ operating wells, and persons working at or on facilities. Clause 16A defines each of these duties as a ‘health and safety requirement,’ and Clauses 16B and 16C enforce the discharge of these duties by making it an offence—punishable by civil penalty—to breach a health and safety requirement, whether recklessly or through negligence.

Schedule 3 also seeks to promote a culture of safety within Australia’s offshore petroleum industry, with a series of further clauses aimed at ensuring ‘that expert advice is available on occupational health and safety matters,’ for all offshore facilities, and that the ‘occupational environment for members of the workforce at such facilities

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220 ibid.
221 ibid.
222 ibid.
... is adapted to their needs relating to health and safety'. To achieve this objective, Schedule 3 outlines a process by which workers on offshore petroleum facilities are able to raise any safety concerns they may have, with the aim of fostering a consultative relationship between all relevant persons concerning the health, safety and welfare of members of the workforce at those facilities'.

A final important aspect of Schedule 3 is that it empowers NOPSEMA officers to, ‘at any reasonable time,’ enter and inspect an offshore facility in order to determine whether the specified occupational health and safety laws are being complied with. NOPSEMA's inspection activities are discussed further in Chapter 4 on safety cases.

The merits of objective-based occupational health and safety regulation depend very much on the skill, expertise and rigour with which the regulator discharges its duties. Therefore, while Australia has had an objective-based regulatory regime in place for the best part of two decades, a feature of this model has been, and should remain, its capacity to continually evolve.

Furthermore, data presented by APPEA suggests that this continual evolution has been to good effect. According to APPEA, ‘since the introduction of APPEA’s modern safety performance reporting in 1996, the safety performance of the Australian offshore oil and gas industry has steadily improved’. APPEA further submit that the safety performance of the Australian petroleum industry ‘has consistently been the best performer of any industry in Australia—particularly when compared to similar risk profile industries such as mining and manufacturing’.

In support of this claim, APPEA provided data on the ‘total injury frequency rate’ in the offshore petroleum industry between 1996 and 2013, as well as the ‘lost time injury frequency rate’ over the same period. This information is provided in Figures 3.2 and 3.3 below.

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224 ibid.
225 ibid.
227 ibid.
Figure 3.2: Total injury frequency rate (per million hours worked)\textsuperscript{228}

Figure 3.3: Lost time injury frequency rate (per million hours worked)\textsuperscript{229}

Both sets of data show an industry with a continually improving safety record. It is incumbent on industry, with appropriate support from NOPSEMA, to ensure that this trend continues.

\textsuperscript{228} ibid, p 7.
\textsuperscript{229} ibid.
Chapter 4

Regulation via safety cases

Introduction

4.1 As noted in Chapter 2, the Australian regulatory regime for the oil and gas industry is an objective-based or goal-oriented regime. Prior to the development of this objective-based regime, Australia’s regulation was prescriptive, with government responsible for specifying the required safety measures in legislation. Now, though, rather than being prescriptive, the broad safety objectives or goals are set out in legislation and the operator is responsible for developing the ‘most appropriate methods of achieving those goals’. In other words, an operator is primarily responsible for the safety of an oil and gas facility, the health and safety of those who work on or near it, and safeguarding the environment in which the facility will operate. Chapter 2 also outlined the concept of ALARP and the operators’ responsibility to ensure that risks relating to human safety and environmental protection are reduced to levels that are as low as reasonably practicable (ALARP).

4.2 In accordance with the Offshore Petroleum Greenhouse Gas Storage (Safety) Regulations 2009 (Cth) (OPGGSS Regulations), the safety case is the primary mechanism through which operators, including those using FLNG facilities, demonstrate that they have identified, assessed and reduced risks to human safety to ALARP levels, and that they will monitor and maintain such risks to an ALARP level.

Safety cases

4.3 The underlying rationale for Australia’s safety case regime for the offshore petroleum industry reflects the outcomes of two major inquiries instigated by the UK government, namely the Robens Report and the Lord Cullen Inquiry. The general impact of these reports on Australia’s offshore petroleum regulatory regime was explained in Chapter 3. At this stage, an outline of the Cullen Inquiry’s particular influence on the development of the safety case regime is useful.

Chapter 4

The Cullen Inquiry

4.4 As outlined in Chapter 1, the Cullen Inquiry was the UK government’s response to the Piper Alpha disaster in the North Sea in 1988. Lord Cullen’s report contained 106 recommendations. Of particular importance here are those relating to the safety case (nos. 1–13), legislation (nos. 17–22) and the regulatory body (nos. 23–26).

4.5 Recommendation 1 was that ‘the operator should be required by regulation to submit to the regulatory body a Safety Case in respect of its installations’.\(^{231}\) For facilities such as those involved in processing hydrocarbons, where activities are ‘complex, dynamic and high risk’, the Cullen Report found that ‘it is essential that the responsibility for managing the risks lies at the point of operations’.\(^{232}\)

4.6 Recommendation 2 proposed that the safety case show that particular objectives are met, including:

(i) that the safety management system of the company (SMS) and that of the installation are adequate to ensure that (a) the design and (b) the operation of the installation and its equipment are safe (paras 17.36 and 21.56–57);

(ii) that the potential major hazards of the installation and the risks to personnel thereon have been identified and appropriate controls provided (para 17.37); and

(iii) that adequate provision is made for ensuring, in the event of a major emergency affecting the installation (a) a Temporary Safe Refuge (TSR) for personnel on the installation; and (b) their safe and full evacuation, escape and rescue (paras 17.37–38, 19.109, 19.157 and 20.8).\(^{233}\)

4.7 Recommendation 4 suggested that the operator’s safety case should demonstrate that ‘so far as is reasonably practicable hazards arising from the inventory of hydrocarbons’ on the facility and the associated risers and pipelines ‘have been minimised’.\(^{234}\) It also

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231 Department of Energy, *The public inquiry into the Piper Alpha disaster*, report prepared by The Hon Lord Cullen, for the Secretary of State for Energy, the Stationery Office, Norwich, 1990, p 387.


234 ibid, p 388.
called for a demonstration that platform workers’ exposure to ‘accidental events and their consequences’ have been minimised ‘so far as is reasonably practicable’.  

4.8 The remaining safety case recommendations provide information on what should be covered in a safety case, with recommendation 10 calling for safety cases to be updated between three and five years from their previous assessment, and recommendation 11 stating that operators should advise the regulator of any modifications to installations, equipment or procedures prior to implementing them so as to determine any necessary amendments to the safety case.

4.9 The Cullen Inquiry report recommended that ‘the principal regulations in regard to offshore safety should take the form of requiring that stated objectives are to be met (referred to as ‘goal-setting’ regulations’) rather than prescribing that detailed measures are to be taken’.  

Furthermore, while there would still need to be some ‘prescribed detailed measures’, guidance notes to the goal-setting regulations:

> should give non-mandatory advice on one or more methods of achieving such objectives without prescribing any particular method as a minimum or as the measure to be taken in default of an acceptable alternative.

4.10 In relation to government regulation, the report’s recommendation 23 clearly stated that ‘there should be a single regulatory body for offshore safety’.  

Further recommendations (nos. 24–26) were that the regulation of offshore safety should be ‘discharged by a discrete division’ of the HSE, which ‘should employ a specialist inspectorate and have a clear identity and strong influence in the HSE’.

**Australia learns from history**

4.11 The Australian Petroleum Production and Exploration Association (APPEA) submitted that ‘the weaknesses identified [ ... ] by the UK’s Robens Report also existed in Australia’s approach to safety regulation’.  

There is no doubt that the Lord Robens and Lord Cullen inquiries have heavily influenced Australian offshore oil and gas regulations. As APPEA noted, in the 1980s and 1990s, ‘each of the Australian jurisdictions enacted new occupational health and safety (OHS) statutes based, to varying degrees, on the model proposed by Robens’.  

Furthermore, following Lord

235 ibid.
236 ibid, p 390–391.
237 ibid.
238 ibid, p 390–391, Recommendation 17.
239 ibid, p 391.
240 ibid, p 392.
242 ibid.
Chapter 4

Cullen’s report, Australia adopted a safety case approach, again firmly placing the responsibility for ongoing facility safety management with the operator, rather than the regulator.

4.12 In December 1993, the Petroleum (Submerged Lands) Act 1967 (Cth) was amended to formalise the application of the safety case regime to operators of oil and gas facilities in Commonwealth waters.243

4.13 As well as adopting the safety case approach, Australia ‘also retain[ed] the OHS general duty of care provisions’.244 In this way, regulation of the offshore petroleum industry addresses two separate, yet related, issues: protecting workforce health and safety, and preventing ‘significant events that could result in multiple casualties/fatalities and significant damage to assets and the environment’, together with their mitigation if such an event were to occur.245

4.14 In 2001, the final report of the Australian Offshore Petroleum Safety Case Review (the AOPSC Review) proposed that there should be one single safety authority responsible for the regulation of safety in Commonwealth waters.246 That single authority would be directly answerable to a federal minister, would use uniform policy and procedures throughout, and offer pay and conditions to allow the recruitment and retention of staff with the necessary skills and experience.247

4.15 The AOPSC Review also found that there were ‘too many Acts, Directions and Regulations regulating the Australian offshore petroleum activities’ and that ‘their boundaries are unclear and application is inconsistent’.248 Furthermore, it found overlaps in the legislation, that requirements ‘were open to inconsistent interpretation by regulators’ and guidelines were ‘often applied as if they were compulsory regulations’.249

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243 Department of Industry Science and Resources, Future arrangements for the regulation of offshore petroleum safety, Commonwealth of Australia, Canberra, 2001, p 72. Note: This review was commissioned in 1999.
244 Submission No. 11 from Australian Petroleum Production and Exploration Association, 20 August 2014, p 10.
245 ibid.
247 ibid.
248 ibid, p 36.
249 ibid See also: Submission No. 11 from Australian Petroleum Production and Exploration Association, 20 August 2014, pp 11–12.
4.16 Importantly for the purpose of this chapter, the AOPSC review endorsed the formation of one independent national offshore safety authority and confirmed that the safety case regime was a sound model, one that was applicable to the oil and gas industry.\textsuperscript{250}

4.17 NOPSEMA argues that regulators in other jurisdictions such as the United Kingdom and Norway ‘have been successfully administering safety case regimes for many years’.\textsuperscript{251}

**No safety case, no facility**

4.18 It is an object of the OPGGSS Regulations to:

> ensure that facilities are designed, constructed, installed, operated, modified and decommissioned in Commonwealth waters only in accordance with safety cases that have been accepted by the Safety Authority.\textsuperscript{252}

4.19 This means that a facility, including an FLNG facility, cannot operate in federal waters without a safety case that has been approved by NOPSEMA. NOPSEMA’s role in assessing and approving safety cases is discussed further below.

4.20 Evidence to this Inquiry suggests that this is well-recognised by the petroleum industry. For example, APPEA submitted that ‘in Commonwealth waters, a facility—including a Floating LNG facility—cannot be constructed, installed, operated, modified or decommissioned without a safety case in force for that stage in the life of that facility’.\textsuperscript{253}

4.21 ConocoPhillips advised that ‘with any development we have a safety case that we put together. That is pretty much the best practice across industry and it is something we do hear mostly in the Australian area’.\textsuperscript{254}

4.22 In noting that ‘the objective-based regulatory framework in place under the OPGGS Act [Offshore Petroleum Greenhouse Gas Storage Act 2006 (Cth)] is not ‘self-regulation’,

\textsuperscript{250} Department of Industry Science and Resources, *Future arrangements for the regulation of offshore petroleum safety*, Commonwealth of Australia, Canberra, 2001, p 31 and p 38. See also: Submission No. 11 from Australian Petroleum Production and Exploration Association, 20 August 2014, p 12. While the National Offshore Petroleum Safety Authority (NOPSA) was established in 2005 and superseded by NOPSEMA in 2012, there is not one single regulator for petroleum facilities in federal, state and territory waters. This is discussed further in Chapter 2.


\textsuperscript{252} r 1.4(1), Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Cth).

\textsuperscript{253} Submission No. 11 from Australian Petroleum Production and Exploration Association, 20 August 2014, p 12.

Chapter 4

GDF SUEZ Bonaparte Pty Ltd are also aware that industry is obliged to submit a safety case to the regulator for ‘review and acceptance’. 255

4.23 Woodside submitted that it had operated under the safety case regime ‘for many years’ and that:

during this time Woodside has demonstrated its ability to safely operate facilities consistent with legislation and through an approach that sets broad safety goals. This approach has resulted in Woodside demonstrating year on year improvement in its health and safety performance.256

4.24 Not only is the oil and gas industry aware of the regulatory requirements for a safety case under the OPGGS Act, evidence to the Inquiry demonstrates that this is seen as world’s best practice, something that actually improves safety. For example, Mr Luke Musgrave, Vice President, LNG for ExxonMobil stated that the:

value of having a safety-case approach is that it lifts the standard across the entire industry. [...] We welcome the safety case approach. We do not see it as a burden or as onerous; we see it as complimentary to what we are doing. I think approaches like the safety case approach evolved out of problems that occurred previously in the industry and it is there to ensure that all players in the industry at least meet some sort of acceptable standard.257

4.25 GDF SUEZ Bonaparte submitted that:

the safety case processes that have been established to support the development of offshore fields in Commonwealth waters, in conjunction with the integrated approach to workforce involvement, will result in the development and operation of an FLNG facility, or any other facility type, with suitable measures in place to protect the health and safety of the workers.258

4.26 ConocoPhillips also stated that the ‘safety case regime is the way to go’ and that the regime had ‘served industry well’.259

255 Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 2.
256 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 7.
258 Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 7. The issue of worker involvement in the development of a safety case is discussed further in this chapter.
Finding 13
Offshore petroleum facilities, including FLNG facilities, cannot operate in Commonwealth waters without a safety case that has been assessed and approved by the National Offshore Petroleum Safety and Environmental Management Authority.

Finding 14
The offshore petroleum industry regards the safety case regime as world’s best practice.

What is a safety case?

Safety cases are based on the above-mentioned principle that ‘those who create the risk must manage it’. This is largely because, as the Cullen Inquiry report found, ‘in complex, dynamic and high risk activity such as hydrocarbon processing facilities, it is essential that the responsibility for managing the risks lies at the point of operations’. Furthermore, as NOPSEMA stated, ‘it is the operators’ job to assess their processes, procedures and systems to identify and evaluate risks and implement the appropriate controls, because the operator has the greatest in-depth knowledge of their installation’.

Citing the UK Defence Standard 00–56, GDF SUEZ Bonaparte submitted that, ‘in general terms’:

a Safety Case is a structured argument, supported by a body of evidence, that provides a compelling, comprehensible and valid case that a system is safe for a given application in a given environment.

The safety case document allows the operator and the regulator to be confident that the operator ‘has the ability and means to control major accident risks effectively. It provides an extra level of regulatory control on top of regulations’.

This confidence is generated through the required contents of the safety case, the operator’s development of the safety case, the regulator’s assessment of the safety

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263 Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 2.
Chapter 4

case and the monitoring of the continued implementation of the safety case provisions. The balance of this chapter elaborates on these aspects of the regulation of Australia’s offshore petroleum industry.

Finding 15
A safety case is a body of evidence provided by an operator to the regulator to demonstrate that risks and hazards associated with the proposed development have been identified and that the proposed safety management system will reduce risks to a level that is as low as reasonably practicable.

Required contents of a safety case

4.32 As APPEA submitted, ‘the safety case regulatory regime applying to all Australian offshore petroleum facilities addresses process safety as well as personal safety’. 265 This is achieved through the specific requirements for the contents of a safety case, as prescribed in Division 1 of the OPGGSS Regulations.

4.33 According to NOPSEMA, there are ‘three aspects to the safety case as defined in [the] regulations’, namely a description of the facility, a detailed description of the formal identification of hazards and risks, and a detailed description of the safety management system. 266 The following section provides an overview of each of these safety case aspects.

Facility description

4.34 Regulation 2.5(1) provides that a safety case must contain a detailed description of the facility. This description ‘defines the intended range or scope of operation of the facility’. 267 Clear definition of the scope of operation is essential as it delimits the range of operations possible at or in connection with the facility and, as NOPSEMA states, ‘operation contrary to the safety case in force is not permitted’. 268

4.35 The facility description must also describe ‘the physical arrangement of the facility, all of the activities on the facility, surrounding activities near the facility, and the numbers of people present involved in each type of activity’. 269 For a facility that is a pipeline, r 2.5(1)(d) provides that details of the pipeline’s route corridor, the compositions of the petroleum to pass through the pipeline and the safe operating limits for those compositions must also be included in the facility description.

266 Mr Gavin Guyan, General Manager, Safety and integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 4.
268 ibid.
269 ibid.
According to Mr Gavin Guyan, General Manager, Safety and Integrity, NOPSEMA, a description of the activities to be undertaken at the facility would include:

the obvious ones around processing the hydrocarbons that you would expect and understand, but it might also, for instance, address diving activities in relation to inspection; it might address other maintenance work or it might address aspects around helicopter operations that are clearly essential for crewing the vessel.\(^{270}\)

According to NOPSEMA’s Safety case content and level of detail guidance note:

the purpose of the facility description is to provide the factual information regarding the physical layout, the controls and proposed activities required to understand the major accident events that have been identified and assessed in the FSA [Formal Safety Assessment], the arrangements for managing the risks of those MAEs [Major Accident Event] and the interactions between those risk control measures and the safety management system.\(^{271}\)

Facility design and risk assessment are clearly iterative processes, and this is also reflected in the safety case description. The ‘factual information’ in the facility description section of the safety case provides the foundation for the Formal Safety Assessment (FSA) and some of the safety management system. As the development of the FSA may lead to design modifications, the facility description ‘also documents some of the outputs of the FSA development processes’.\(^{272}\)

The facility description covers both design and operating ranges for facility systems, with descriptions linked to ‘performance standards set for control measures and demonstration that machinery and equipment is fit for its function’.\(^{273}\) According to NOPSEMA, as well as including the output of the design process, the facility description should also describe the ‘design basis and philosophy’ of the facility, including the ‘potential uses of the facility’ or ‘what the facility is physically capable of’.\(^{274}\) The facility description also outlines ‘the physical systems in place to ensure that the design envelope is not breached, or if it is, the measures in place for bringing the situation back under control’.\(^{275}\)

\(^{270}\) Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 4.


\(^{272}\) ibid.

\(^{273}\) ibid. p 17.

\(^{274}\) ibid.

\(^{275}\) ibid.
Chapter 4

4.40 The importance of the layout of an oil and gas facility in relation to safety is clearly recognised by industry. For example, Woodside submitted that ‘the layout of any hydrocarbon facility has a major effect on the consequences of major events and on the arrangements required for emergency response’.276 Shell advised that ‘process safety has been the single most important guiding principle for developing the FLNG facility’s layout’.277

Formal safety assessment—identification of hazards and risks

4.41 OPGGSS r 2.5(2) states that a facility safety case must also describe in detail ‘the formal safety assessment for the facility’ (FSA). This assessment (or series of assessments) is conducted by the operator and:

(a) identifies all hazards having the potential to cause a major accident event; and

(b) is a detailed and systematic assessment of the risk associated with each of those hazards, including the likelihood and consequences of each potential major accident event; and

(c) identifies the technical and other control measures that are necessary to reduce that risk to a level that is as low as reasonably practicable.

4.42 NOPSEMA’s guidance note states that an FSA provides evidence of:

- an understanding of the factors that influence risk and the controls that are critical to managing risk;
- the magnitude and severity of the consequences arising from major accident events for the range of possible outcomes;
- the likelihood of potential major accident events;
- clear linkages between hazards, the major accident events, control measures and the associated consequences and risk; and
- a prioritised list of actions that reduce risks to a level that is ALARP.278

276 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 10.
277 Submission No. 9, Shell Development (Australia) Pty Ltd, 11 August 2014, p 4.
The FSA process is shown in Figure 4.1 below.

**Figure 4.1: The FSA Process**

**Steps**

- Identify hazards and potential causes of events
- Acknowledge inherent controls in place
- Assess consequences
- Identify and scrutinise existing control measures
- Conduct the initial risk assessment (likelihood of consequence) to assess the level of risk, taking existing controls into account
- Identify potential additional controls
- Assess adequacy of controls and ensure all reasonably practicable steps to reduce risk have been considered
- Identify Major Accident Events (MAEs)
- Conduct the final risk assessment—assess the level of risk taking into account both existing controls and any additional controls (identified improvement actions) SHOW RESIDUAL RISK ALARP
- Prepare performance standards and ensure procedures/audits are in place

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279 ibid p 39.
Woodside’s formal safety assessment process, which it stated is ‘consistent with Australian safety regulations and industry good practice guidance notes’, provides an example of an operator’s approach to this aspect of the safety case. Woodside submitted that its formal safety assessment process:

- ‘systematically identifies hazards’;
- ‘identifies and assesses the control measures to be adopted’; and
- is comprised of ‘a number of standard studies’ that ‘mirror the requirements of current Australian safety regulations’.

The following are the key areas addressed in Woodside’s formal safety assessment of its oil and gas facilities:

- **Hazard identification studies (including MAE) and accompanying hazard registers**;

- **An assessment of fire and explosions hazards**;

- **Detailed assessment as required to assess other MAE scenarios, for example dropped objects, ship collision risk and structural integrity**;

- **An assessment of escape, temporary refuge, evacuation and rescue provisions, including emergency response arrangements**; and

- **Assessment of key control measures and development of associated performance standards**.

Identifying hazards that could lead to a Major Accident Event (MAE) is a complex process, particularly as one MAE may have ‘several independent hazards or combinations of hazards, each of which could lead to that incident, as well as several control measures which ... may impact on one or more of those hazards’.

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280 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 9.
281 ibid.
282 ibid.
As noted above, r 2.5(2) states that the risk assessment must be detailed and systematic. This means that the risk assessment must:

- ‘cover all hazards having the potential to cause a major accident event’;
- ‘address all parts of the facility (identified in the hazard identification)’;
- ‘address all of the aspects of risk for each MAE (nature, likelihood, consequence, etc.)’;
- ‘employ a logical, transparent and reproducible process’ which allows a comparison of ‘the range of undesirable events’ and the identification of ‘the most important contributors’ to the facility’s overall risk profile.  

While NOPSEMA recognises that ‘uncertainty cannot always be eliminated’, the uncertainty contained in the risk assessment, and any assumptions made due to uncertainty, must be described in the safety case.

Not only must hazards be identified and associated risks considered, a safety case must show that the risks, individually or in combination, are eliminated or reduced to ALARP. As noted above, an MAE may have several independent hazards and control measures, and the risk assessment should demonstrate an operator’s ‘understanding of the total likelihood of each MAE and the relative importance of each separate hazard and control measure’.

Control measures include a facility’s physical layout and ‘elements of the operator’s management system’ for the facility, and ‘can take many forms including physical equipment, process control systems, management processes, operating or maintenance procedures, the emergency plan, key personnel and their actions’. There is a hierarchy of control measures, with elimination being the highest priority, followed by prevention, reduction and mitigation.

As well as discussing the technical and other control measures selected to reduce risk to ALARP, the safety case must discuss those measures considered but not selected, and the reasons they were not considered appropriate.

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284 ibid, p 41.
285 ibid.
286 ibid, p 42.
288 ibid.
A formal safety assessment is a complex process, one that involves ‘understanding the linkages between the control measure and the hazards giving rise to the MAE or other hazardous event’. It is essential that the way in which a control works in relation to the risk is understood. This includes understanding:

the nature, scale and range of hazards and outcomes that each control measure is designed to address, and the relationship of the control measure to the hazard, the possible MAEs or undesirable health and safety outcomes and other control measures.

One common and useful approach to representing complex hazard/controls/MAE relationships is to use a bowtie or cause-consequence diagram. As Figure 4.2 shows, a bowtie approach is based on having proactive controls and barriers to prevent incidents or events from happening, and reactive controls and recovery or mitigating barriers following an incident.

Figure 4.2: Bowtie diagram

The bowtie approach to risk assessment is used by operators and regulators, and this is discussed further below.

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291 ibid.
292 ibid.
Safety management system

OPGGSS r 2.5(3) requires that the safety case include a detailed description of the safety management system that demonstrates that the system:

(a) is comprehensive and integrated; and
(b) provides for all activities that will, or are likely to, take place at, or in connection with, the facility; and
(c) provides for the continual and systematic identification of hazards to health and safety of persons at or near the facility; and
(d) provides for the continual and systematic assessment of:
   (i) the likelihood of the occurrence, during normal or emergency situations, of injury or occupational illness associated with those hazards; and
   (ii) the likely nature of such injury or occupational illness; and
(e) provides for the reduction to a level that is as low as reasonably practicable of risks to health and safety of persons at or near the facility including, but not limited to:
   (i) risks arising during evacuation, escape and rescue in case of emergency; and
   (ii) risks arising from equipment and hardware; and
(f) provides for inspection, testing and maintenance of the equipment and hardware that are the physical control measures for those risks; and
(g) provides for adequate communications between the facility and any relevant [facility, vessel, aircraft or on-shore installation]; and
(h) provides for any other matter that is necessary to ensure that the safety management system meets the requirements and objects of these Regulations; and
(i) specifies the performance standards that apply.

OPGGSS r 2.5(3) also notes that ‘the safety management system must provide for all hazards and risks to persons at the facility, not just risks of major accident events’. NOPSEMA stresses that all safety management systems (SMSs) ‘must provide a management focus on the specific control measures required for safe operation of the
Chapter 4

particular facility with regard to major accident events and occupational health and safety hazards. 293

4.57 Thus the SMS for a facility, as the ‘operational and procedural systems of control to ensure safe operation of the facility’, is the ‘principal tool’ through which an operator achieves the overall objectives of the OPGGSS Regulations. 294

4.58 The safety case description of the SMS should demonstrate that the SMS is ‘comprehensive and integrated’ as well as ‘accessible, comprehensible, documented, facility-wide, realistic, dynamic and continuously improving’. 295 A comprehensive safety case can include:

- Identifying the control measures;
- Defining their performance requirements;
- Implementing the measures themselves, including the provision of any associated training, etc.;
- Monitoring and maintaining the control measures against the performance requirements;
- Rectifying any shortcomings that may arise; and
- Reviewing and improving the control measures. 296

4.59 An integrated SMS ‘recognises the fact that failures in complex systems often stem from a complex combination of circumstances’, and must ensure that:

- ‘hazards are linked with relevant control measures’;
- control measures ‘work together effectively as a whole’; and
- control measures ‘do not conflict with each other’, and ‘provide layers of protection’. 297

296 Ibid.
297 Ibid.
4.60 A facility’s SMS ‘must specify the performance standards that apply. The performance standards are the parameters against which control measures for MAEs are assessed to ensure they reduce the risks to ALARP on an on-going basis’. 298 For NOPSEMA:

the performance standards are key to the effectiveness of all of the controls. Those are specified, so on a facility-by-facility basis, of course, that changes. Each has its application and are very effective, so there are a number of ways that these can be tested and assessed.

4.61 Importantly, the SMS should include compliance audits against its requirements and systems audits to provide assurance that it is achieving intended health and safety outcomes. 300 According to NOPSEMA, the SMS ‘should provide a communication, decision-making and action process which is on the look-out for interactions within the system which could combine to cause major accident events, or pose threats to health and safety’. 301

4.62 An operator should ensure that ‘all critical information and decisions’ are adequately documented to form ‘an audit trail’ to provide assurance to NOPSEMA that the SMS ‘is functioning effectively and is being implemented in practice’. 302

4.63 In relation to identifying deficiencies in an SMS, r 2.6 requires a safety case to demonstrate effective means of ensuring not only the SMS’s implementation, but the ‘continual and systematic identification of deficiencies’ in the SMS and its ‘continual and systematic improvement’, which involves monitoring, audit and review.

4.64 There are three aspects to monitoring an SMS:

• checking that its activities are being undertaken;

• measuring the performance of SMS elements/activities; and

• comparing actual performance against performance standards and targets. 303

4.65 Auditing an SMS involves ‘checking that the overall established SMS is understood and is being complied with and that the management framework (in particular the

299 Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 10.
301 ibid.
302 ibid.
303 ibid, p 15.
monitoring and corrective action processes) is being implemented and is effective.\(^\text{304}\)
The required checks are that:

- ‘activities occur’;
- ‘activities are being performed to a suitable standard’; and
- ‘systems, procedures, controls etc are achieving the desired results’.\(^\text{305}\)

**Finding 16**

A safety case in respect of an offshore petroleum facility must contain three main elements, being:

- a detailed description of the facility;
- a detailed description of the formal identification and assessment of the hazards and risks; and
- a detailed description of the comprehensive and integrated hazard management system.

**Reducing risk to ALARP levels through safety in design**

4.66 As outlined above, there is a requirement for oil and gas project operators to reduce risks to ALARP, with the safety case being the mechanism through which operators must demonstrate that process and personal safety risks have been identified, assessed and reduced to ALARP.

4.67 This same regulatory regime applies to an FLNG facility, and an operator of an FLNG facility must comply with the regulatory requirements to provide a safety case.

4.68 As noted in Chapter 1, Shell’s *Prelude* FLNG facility is scheduled to begin operation by 2017 and Woodside has announced it has commenced basis of design (BOD) work for its Browse Basin fields as an FLNG project. In light of this, the following discussion draws largely from evidence in relation to these two FLNG projects.\(^\text{306}\)

4.69 Evidence to this Inquiry shows that reducing risks to ALARP levels is largely through the concept of safety in design and through the use of the bowtie approach to adverse event prevention and mitigation.

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\(^{304}\) ibid. Evaluating the degree of compliance against standards can also be included in the audit process.

\(^{305}\) ibid.

\(^{306}\) The Committee note the speculation that due to the recent fall in oil prices Woodside’s Browse Basin project will be delayed.
Safety in design

4.70 Based on evidence gathered throughout this Inquiry, the industry view is that if risk reduction to ALARP levels is to be achieved, ensuring safety through hazard and risk management needs to be incorporated into the design; that is, safety is inherent to the project, beginning with its design phase.

4.71 For example, ExxonMobil explained that it has an Operations Integrity Management System (OIMS) for addressing risks and ‘application of the OIMS Framework is required across all of ExxonMobil, with particular emphasis on design, construction and operations’. While development of the Scarborough field is in its initial stages, ExxonMobil’s early project activities have been guided by two elements of its OIMS Framework: Risk Assessment and Management; and Facilities Design and Construction. Mr Luke Musgrave advised that ExxonMobil’s:

preliminary facility concept design [for Scarborough] has been underpinned by a range of technical studies including a close understanding of metocean and other environmental conditions at the location of the Scarborough field, but further work is still to be done, which will support future development of a detailed risk assessments and emergency response plans along with the facility safety cases required by the relevant legislation.

4.72 According to Woodside, ‘inherent safety design is an approach to design in which the hazards associated with materials and operations have been reduced or eliminated’ through risk management controls identified and selected based on the following hierarchy:

- Elimination of risk by removing the hazard;
- Substitution of a hazard with a less hazardous one;
- Prevention of potential events;
- Separation of people from the consequences of potential events;
- Control of the magnitude and frequency of an event;
- Mitigation of the impact of an event on people; and
- Emergency response and contingency planning.

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307 Submission No. 1 from ExxonMobil, 10 July 2014, p 1.
308 Mr Luke Musgrave, Vice President, LNG, ExxonMobil, Transcript of Evidence, 10 November 2014, p 2. See also: Submission No. 1 from ExxonMobil, 10 July 2014, p 3.
309 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 8.
Chapter 4

4.73 This hierarchy of prevention principles is promoted by NOPSEMA in its ALARP guidance note and has been adapted from the Health and Safety Executive, United Kingdom (HSE) regulatory regime.  

4.74 Woodside submitted that 'eliminating hazards, followed by the implementation of prevention measures is the most effective approach to minimising risk in a design and achieving inherently safer outcomes'.

4.75 Woodside has developed and applied five inherently safer design goals to its Browse project. These are set out in Figure 4.3 below.

Figure 4.3: Woodside's inherently safer design goals

Figure 2: Inherently Safer Design Goals

4.76 Woodside's 'internal processes require early development of a design safety case during the develop phase of a project to provide internal assurance to key stakeholders that risks can be managed'. According to Woodside, the design safety case allows the company to 'demonstrate that the health and safety risks are tolerable and as low as reasonably practicable (ALARP).'

311 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 8.
312 Ibid.
4.77 Shell also stressed the importance of safety in design, stating that Shell’s design process is ‘a fundamental deeply-held process in terms of delivering safety in the base case for ourselves and anyone else’. The company’s General Manager for Health, Safety, Security and Environment (HSSE), Mr Andrew Doherty, described Shell’s approach to safety in design as follows:

*In regards to demonstrating safety in the design case for ALARP, we evaluate the major hazards and we present through the design case a demonstration that we have managed these risks to as low as reasonably practicable and we also provide through the multiple reviews and assessments a reassurance that indeed those things are being tested thoroughly as part of the process.*

4.78 Mr Ian Jewitt, Shell’s FLNG HSSE Team Leader, also advised that the company’s FLNG safety philosophies were identified in 2003 and safety was incorporated into the design and tested with regulators and organisations such as Lloyds.

4.79 During its visit to the Maritime Research Institute Netherlands (MARIN) testing facility and Shell in the Netherlands, the Committee learned of the iterative nature of the safety in design process. This will be discussed below in relation to individual safety issues considered.

4.80 As noted above, companies often use a bowtie approach to risk assessment and identifying hazards and MAE’s. Woodside’s design safety case bowtie is provided at Appendix Seven. This identifies 12 MAEs and describes the preventative barriers to stop the event from happening and the mitigative barriers to lessen the event’s consequences.

4.81 The information generated by an operator’s safety in design processes can then be incorporated into its safety case for submission to the regulator. As Shell has progressed the Prelude safety case its approach provides a useful example.

4.82 Taking advantage of NOPSEMA’s Early Engagement Safety Case Assessment Policy, during Front End Engineering Design (FEED) for Prelude, Shell provided NOPSA (now NOPSEMA) with ‘a sequence of deliverables detailing the rigorous approach to safety in

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316 ibid.
317 Mr Ian Jewitt, FLNG HSSE Team Leader, Shell, The Hague, Committee Briefing, 22 July 2014.
design’. These deliverables resulted in the design safety case which ‘included the Design Integrity and ALARP demonstration of the Prelude FLNG Facility’.  

During the Committee’s meeting with Shell in the Netherlands, Mr Ian Jewitt explained that the safety in design approach for Prelude has allowed Shell to summarise the identification and assessment of risks, and understand how to control the risk, and how to recover the situation. This includes those 'normal' hazards for any LNG facility, such as helicopter accidents, shipping accidents, environmental spills and other similar general risks, together with risks that are peculiar to FLNG facilities, such as those associated with having processing trains in relatively close proximity to living quarters.

Shell advised that there are three phases to the submission of the Prelude FLNG safety case to NOPSEMA. The first phase, relating to subsea infrastructure installation, was submitted in April 2014 and accepted in September 2014. The second phase will be the hook-up and commissioning. The third phase ‘specifies the technical and operational integrity controls ready for start-up and operate phase’.

As the diagram at Appendix Seven shows, there are a number of MAEs considered during the design phase of an FLNG facility and both preventative and mitigative barriers developed to reduce risk to ALARP levels. These include loss of containment of hydrocarbons, loss of control of suspended load, loss of marine vessel separation, loss of structural integrity, loss of stability and position, loss of controlled flight, occupational hazards and accommodation fire.

Based on their safety in design process, Woodside and Shell advised that they have developed particular design solutions to reduce risk levels to ALARP, including, but not limited to, facility layout, hull design and the turret mooring system. These design solutions are discussed in Chapter 5.

**Finding 17**

As safety is crucial to any offshore petroleum project, reducing risk levels to as low as reasonably practicable requires hazard and risk management to be incorporated into the design phase of a project.

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318 Submission No. 9, Shell Development (Australia) Pty Ltd, 11 August 2014, p 9. NOPSEMA’s Early Engagement Safety Case Assessment Policy is discussed in the section on the regulator’s assessment of safety cases.

319 ibid. In accordance with NOPSEMA policy, this was before the Final Investment Decision (FID) was taken.

320 Mr Ian Jewitt, FLNG HSSE Team Leader, Shell, The Hague, Committee Briefing, 22 July 2014.

Assessment of the safety case by NOPSEMA

4.87 As noted previously, a facility, including an FLNG facility, ‘cannot be constructed, installed, operated, modified or decommissioned without a safety case in force for that stage in the life of the facility’. 322

4.88 Under the OPGGSS Regulations, NOPSEMA must ‘assess a range of documents provided by proponents or duty holders’, with these ‘permissioning documents’ including safety cases, well operations management plans (WOMPs) and environment plans, including oil spill contingency plans. 323

4.89 Under OPGGSS r 2.24, ‘if an operator wants to have a safety case accepted for a facility’ that safety case must be submitted to NOPSEMA for assessment and a decision made as to whether the safety case is accepted or rejected. As discussed above, operators are required by Commonwealth legislation to reduce risk to ALARP. In addition to this, under the OPGGSS Regulations an operator must ‘commit to ongoing improvement of all aspects of the operator’s safety management system’ and, under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGSE Regulations), operators must ‘carry out activities in a manner consistent with the principles of ecologically sustainable development’. 324

Safety case assessment

4.90 Mr Gavin Guyan, General Manager, Safety and Integrity, NOPSEMA, described the Authority’s assessment process as follows:

Our assessment process is to assess the documentation received against the contents requirements of the regulations. The principal, but not the only, criteria for acceptance or rejection of the safety case is whether or not the safety case meets contents requirements of the regulations, which go to identifying the hazards and risks and a


Chapter 4

demonstration that those risks have been reduced to as low as is reasonably practicable.325

4.91 NOPSEMA’s Safety case assessment policy describes its three part assessment of the safety case against the OPGGSS regulations. Part 1 involves NOPSEMA assessing ‘whether, in general terms, the safety case is appropriate to the facility and the activities to be conducted at the facility […] and complies with all items required […] for each state of the life of the facility in respect to which the safety case is submitted’.326

4.92 Part 2 of the assessment process is comprised of three sub-parts. First is a detailed assessment of specific regulations that NOPSEMA will always assess:

• whether the operator’s formal safety assessment identifies all hazards that potentially could cause an MAE, is detailed and systematic in its assessment of the risks associated with those hazards, and identifies the control measures necessary to reduce risk levels to ALARP (as per OPGGSS r 2.5(2)); and

• whether the description of the safety management system shows that it is comprehensive and integrated (as per OPGGSS r 2.5(3)(a)); and provides for health and safety risks to be reduced to ALARP levels (as per OPGGSS r 2.5(3)(e)).

4.93 NOPSEMA’s policy is that as it is ‘impractical’ to assess every aspect of a safety case in detail in relation to OPGGSS rr 2.5(2), 2.5(3)(a) and 2.5(3)(e), this is done as part of the topic-based sampling component of the assessment, which is outlined further below.

4.94 This general assessment of specific regulations also includes an assessment of the requirements for effective consultation with members of the workforce in relation to the development of the safety case (OPGGSS r 2.11(1)(a)) and in relation to workforce awareness of ‘the risks and hazards they may be exposed to on the facility’ (OPGGSS r 2.11(1)(b)). This issue of workforce consultation is also discussed further below.

4.95 As well as this general detailed assessment of specific regulations, the second part of NOPSEMA’s assessment of safety cases also involves sampling of selected topics. This applies to new safety case submissions and five-yearly revisions, and involves ‘a detailed assessment of three or more topic areas’, with at least two of these topic areas, where possible, ‘being focused on particular MAEs’.327

325 Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 4.
327 ibid, p 4.
The scope of NOPSEMA’s topic-based assessment component is, where possible:

informed by relevant prior assessments, inspections and investigations and consider factors such as (but not limited to): levels of risk, uncertainty, use of novel technology, and the timing and geographical location of particular activities.328

For facilities that can be disconnected from the production riser, NOPSEMA, in conjunction with the Australian Maritime Safety Authority (AMSA), also assesses whether the command structure complies with OPGGSS r 2.8.329

Mr Guyan explained that a number of methods were available to NOPSEMA to assess whether a risk has been reduced to ALARP.330 In essence, both qualitative and quantitative assessments of risk are made, then the risk is reduced ‘down to a level where any further reduction would require a grossly disproportionate expenditure of resources to achieve that matched increment of reduction’.331

The starting point in the process involves an assessment of the credible risks, and consideration of the likelihood of the risk eventuating and the possible feasible controls that can be put in place. This includes consideration of elimination of the risk, engineering controls, and administration and procedural controls.332

According to Mr Guyan, ‘the follow-on questions become what is grossly disproportionate in relation to any risk reduction and that becomes a matter of what actually is feasible and at what stage in the life of the facility’.333

Finding 18
Under the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Cth), the National Offshore Petroleum Safety and Environmental Management Authority is responsible for assessing a safety case to determine whether the identified hazards and risks have been reduced to as low as reasonably practicable.

Early Engagement Safety Case

The OPGGSS Regulations apply to offshore oil and gas facilities ‘regardless of whether the technology is new or not’, with NOPSEMA processes devised ‘around a design already being complete for a facility. It may or may not already be built; however, the

328 ibid.
329 ibid.
330 Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 7.
331 ibid.
332 ibid.
333 ibid.
Chapter 4

design is available and, therefore, you can go some way down the road and look at the standards that have been or will be applied’.334

4.102 Clearly this does not address issues that may have arisen during the design stage, and these may be important to NOPSEMA’s assessment of a project proponent’s reduction of risks to ALARP. By way of an example, Mr Guyan noted that NOPSEMA’s policy to require a validation for a proposed FLNG facility’s safety case:

\[
\text{does not address any of the conceptual issues that might arise during consideration of different designs. That may be at the fundamental level of what type of facility should be used here and, having decided that, what should the layout be and what are the key factors—those types of things. It is difficult to get to that within the current regulations.}^{335}
\]

4.103 Therefore, the early engagement safety case (EESC) policy was developed as a mechanism whereby NOPSEMA could:

\[
\text{engage with an operator coming with a new technology facility in particular where NOPSEMA could provide advice to the proponent and have an exchange about the likely risks and the things that need to be considered in the design of the facility in the context of how these would need to be addressed in a safety case that could be accepted by NOPSEMA at some point in the future.}^{336}
\]

4.104 An EESC submission is a voluntary submission to NOPSEMA of a safety case for the operations stage of a proposed offshore petroleum or greenhouse gas storage facility. An EESC is submitted ‘soon after the project concept selection stage and prior to a Final Investment Decision is made and/or detailed design for the facility is commenced’.337

4.105 For NOPSEMA, the objectives of submission and assessment of an EESC are as follows:

- to realise potential benefits to the workforce, in terms of lower risk, of early regulatory engagement with an operator of a proposed facility;
- to provide a facility operator with a mechanism for regulatory risk mitigation prior to making a Final Investment Decision or commencing detailed design; and

334 ibid, p 4.
335 ibid.
336 ibid, pp 4–5.
• to provide NOPSEMA with the opportunity to challenge an operator’s concept selection, design and consideration of inherent safety at an appropriately early stage in a facility’s lifecycle.\textsuperscript{338}

4.106 As noted above, during the FEED stage for Prelude, Shell provided NOPSEMA with a series of deliverables as evidence of its safety in design approach. Thus, in doing so, Shell took advantage of NOPSEMA’s EESC policy.

4.107 NOPSEMA confirmed that the Authority has engaged in the EESC process with Shell in relation to the Prelude facility. According to Mr Guyan, Shell provided NOPSEMA with:

\begin{quote}
submissions that were essentially safety-case submissions, but in the context that because the facility was not designed and was not complete and all the material that is required by the regulations to be within the safety case that could be accepted by NOPSEMA, it was always understood that the outcome would be an exchange of information identifying areas that would require work to be included in any future submission of a safety case, which has not yet been received.\textsuperscript{339}
\end{quote}

4.108 During NOPSEMA’s EESC process with Shell over the past two years, the Authority has received submissions in ‘four significant tranches’ and has provided feedback in the form of questions on some 180 issues, asking for information on how Shell intends to address them.\textsuperscript{340} Through this process a number of issues have been resolved and some have been:

\begin{quote}
parked for further study and analysis, but all of which have been identified for inclusion in the future safety case. I suggest that the engagement has been substantial and documented.\textsuperscript{341}
\end{quote}

4.109 In working to reduce risk levels to ALARP, the EESC process allows the operator and NOPSEMA to ‘contemplate the risks before a facility has been not only designed but built and application-ready to operate’.\textsuperscript{342} Clearly, considering changes at the design stage is much less expensive than leaving this until much later in the process. Thus, NOPSEMA’s EESC submission process, as a design notification process, has considerable benefit to operators and project proponents.

\textsuperscript{338} ibid.
\textsuperscript{339} Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, \textit{Transcript of Evidence}, 12 November 2014, p 6.
\textsuperscript{340} ibid.
\textsuperscript{341} ibid.
\textsuperscript{342} ibid, p 7.
Chapter 4

Finding 19
The National Offshore Petroleum Safety and Environmental Management Authority’s Early Engagement Safety Case policy allows the Authority to engage with an operator proposing a new technology facility during the design process and, thus, contribute to the safer design of the proposed facility.

Finding 20
Shell engaged with the National Offshore Petroleum Safety and Environmental Management Authority through an Early Engagement Safety Case process during the Front End Engineering and Design stage of the Prelude facility.

Validation

4.110 The third area of NOPSEMA’s safety case assessment is validation. Under OPGGSS r 2.4(1), NOPSEMA may require the operator of a facility to provide a validation in relation to a proposed facility or a significant change to an existing facility. However, it is NOPSEMA policy to ‘request a validation in respect of all proposed facilities and all significant changes to a facility’. This was confirmed by Mr Guyan, who stated:

*the regulations say that NOPSEMA may request a validation in relation to a facility. As a matter of policy, NOPSEMA will always request a validation in relation to a new facility.*

4.111 For a proposed facility, under OPGGSS r 2.40(2), a validation is:

*a statement in writing by an independent validator in respect of the design, construction and installation (including instrumentation, process layout and process control systems) of the facility, to the extent that these matters are covered by the scope of the validation agreed between the Safety Authority and the operator.*

4.112 The validation for a proposed facility must assure NOPSEMA that ‘the design, construction and installation (including instrumentation, process layout and process control systems) of the facility incorporate measures that are not only ‘consistent with the formal safety assessment for the facility’, but ‘will protect the health and safety of persons at the facility’.

4.113 For a significant change to an existing facility, r 2.40(3) provides that a validation is ‘a statement in writing by an independent validator in respect of the proposed change, to

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345 r 2.40(4)(a) OPGGSS Regulations.
the extent required by the scope of the validation agreed between the Safety Authority and the operator. This validation must also assure NOPSEMA that after any changes, measures will be incorporated ‘that will protect the health and safety of persons at or near the facility’.

According to NOPSEMA’s Validation policy ‘validation deals with hardware, firmware and software whereas the safety case pertains to the facility and the activities conducted at the facility’. As Mr Guyan explained:

*the definition of a ‘validation’ is specified in the regs and it goes to standards that will protect the health and safety of personnel at the specific facility. However, it does not address any of the conceptual issues that might arise during consideration of different designs.*

Assurance to NOPSEMA in the form of a validation ‘forms part of the safety case acceptance criteria’ and, therefore, must be completed and provided to NOPSEMA prior to the end of the safety case assessment period.

**Finding 21**

The National Offshore Petroleum Safety and Environmental Management Authority may require a facility operator to provide a written statement by an independent validator in relation to the design, construction and installation of the proposed facility or any significant changes to an existing facility.

**Finding 22**

It is a National Offshore Petroleum Safety and Environmental Management Authority policy to always request a written independent validation in relation to a new facility.

**Fair and technically competent assessment**

Regulation 2.26 of the OPGGSS Regulations provides that NOPSEMA must accept a safety case ‘if it is appropriate to the facility and to the activities conducted at the facility’, and it complies with the relevant sections of the regulations. This means, in

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346 r 2.40(4)(a)OPGGSS Regulations. A validator must meet criteria specified in the regulations and the operator must demonstrate the validator selection process, the validator’s independence and competence, and the validator’s free access to data.


Chapter 4

effect, that for a safety case to be accepted by NOPSEMA, the Authority must be
‘satisfied that the arrangements set out in the document demonstrate that the risks
will be reduced to as low as is reasonably practicable (ALARP)’. 351

4.117 Working on the ‘fundamental assumption’ that the information in the safety case is
correct, ‘the lead assessor will make judgements on the adequacy of the safety case
based on the content of the safety case submission ... and, where applicable, further
written information that may be requested by NOPSEMA during the course of the
assessment’. 352

4.118 Two important points need to be noted here. First, NOPSEMA’s assessment does not
allow the Authority to say whether or not the facility is totally safe or that there are no
risks. What is does allow is for NOPSEMA to make an assessment on whether the
operator has measures in place that reduce risk, particularly risks associated with
MAEs, to ALARP levels.

4.119 This is also the approach taken in other jurisdictions. For example, as HSE advised, the
UK government accepts the demonstration of safety, but does not certify the safety of
the technology. 353 In the Netherlands, companies are also responsible for safety, and to
get a licence, and before being allowed to operate, they must demonstrate their safety
to the State Supervision of Mines. 354 Similarly, the Petroleum Safety Authority Norway
advised that its basic principal is that government is not responsible for safety; safety is
the responsibility of companies. This means that rather than the Petroleum Safety
Authority Norway approving an activity or technology, it consents to activities, with
consent meaning that something may be used on a facility. The safety responsibility for
assessed activities remains with the company. Consents for a sea bed installation, the
use of installations or modifications, for example, are given to operators at various
milestones and signal the Authority’s confidence in the operator’s ability to manage the
particular activity. 355

351 Regulation 2.26(b) requires the safety case to comply with Subdivisions A, B and C of Division 1 of
the Regulations for each stage in the life of the facility; and r 2.26(c) requires the safety case to
comply with Subdivision D of Division 1 of the Regulations. The OPGGSS Regulations also provide
for NOPSEMA to request more information from an operator, for the rejection of a safety case
and for the submission of a revised safety case.
352 National Offshore Petroleum Safety and Environmental Management Authority, Safety case
353 UK Health and Safety Executive, Committee Briefing, Aberdeen, Scotland, 28 July 2014.
354 State Supervision of Mines, Ministry of Economic Affairs, The Hague, the Netherlands,
Committee Briefing, 21 July 2014.
4.120 Second, if NOPSEMA is to conduct technically competent assessments and make fair conclusions, it must have appropriately skilled staff. According to NOPSEMA’s Assessment policy, the assessment process is transparent and:

> each assessment will be conducted by an assessment team with the appropriate skills and competencies. The assessment team will have (or have access to) an appropriate combination of technical and operational expertise and experience to perform their allocated roles. In addition, all assessment team members will receive training to ensure that they are competent in the use of NOPSEMA core processes.\(^\text{356}\)

4.121 Mr Stuart Smith, NOPSEMA’s Chief Executive Officer, advised that:

> it is important that we [NOPSEMA] have deep expertise within the organisation, but that is not to say that we just rely on our own expertise; if we are seeking input from others we need to be able to understand what they are saying at a technical level as well as a more superficial level. We see it as critical that we have and maintain a great depth of expertise, and we believe we have that.\(^\text{357}\)

4.122 Mr Guyan confirmed that in the expert regulator model that Australia has in place, it is essential that the regulator ‘understand[s] the risks’ and what ALARP ‘looks like’.\(^\text{358}\) According to Mr Guyan, in line with NOPSEMA policy, the Authority has recruited industry practitioners and experts first and foremost.\(^\text{359}\) Mr Guyan described NOPSEMA’s expertise as follows:

> Typically we have people with 20-plus years’ experience in industry roles. They are almost without exception tertiary educated or with equivalent professional qualifications and then we go to an understanding of the legislation. So the technical expertise is paramount—it is primary. For example, we have 10 or 12 marine personnel who have experience as foreign-going masters, masters of FPSOs, chiefs of engineers of tankers and FPSOs, naval architects and so on across the board. Ex-marine surveyors from DNV and AMSA, for example, are in that group. When you consider that in terms of producing vessel facilities—vessel facilities producing hydrocarbons—


\(^{357}\) Mr Stuart Smith, Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 5.

\(^{358}\) Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 5.

\(^{359}\) ibid.
Chapter 4

right now there are roughly a dozen in the regime. We have a very high ratio of expert inspectors versus the number of facilities that they need to look after. Similarly with process, structural and pipe work, we have the same approach—industry experience first and foremost, often at very senior levels. Within drilling we typically have drilling superintendents with manager level people who again have 20-plus years’ experience and are tertiary educated. Absolutely that is the model.360

As the Committee noted in its May 2014 report on the economic impact of FLNG on the WA economy, as well as the three LNG plants currently operational in Australia (the North West Shelf, Pluto and Darwin LNG plants) a further seven are currently under construction.361 Not only has this created a high demand for skilled, technically expert workers, government authorities such as NOPSEMA need to compete with the private sector for experienced professionals.

4.124 Given the higher wages and salaries in the resources sector, this can make it difficult for government to employ and retain appropriately qualified and experienced staff. However, as Mr Smith explained, the Commonwealth government ‘has given exemptions in regard for recruitment so that we can pay the sort of money required to attract the right expertise’.362

4.125 This issue of recruiting and retaining appropriate staff is also found in other jurisdictions. The State Supervision of Mines in the Netherlands advised that it needs experienced staff with the right skills to assess project proponents’ safety cases. The State Supervision of Mines has found it difficult to get appropriate inspectorate staff as it also needs to compete with high salaries in the private sector.363 Similarly, the Norwegian Petroleum Directorate advised the Committee that because of the need to hire experts and to compete with the private sector, it has obtained Ministry permission to go beyond the normal public service salary.364

Finding 23

The National Offshore Petroleum Safety and Environmental Management Authority’s acceptance of a facility’s safety case does not certify the safety of the facility. Rather, it represents the Authority’s acceptance that the operator has measures in place that reduce risk to levels that are as low as reasonably practicable.

360 ibid.
362 Mr Stuart Smith, Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 5.
364 Norwegian Petroleum Directorate, Committee Briefing, Stavanger, Norway, 23 July 2014.
Finding 24

The National Offshore Petroleum Safety and Environmental Management Authority uses the expert regulator model, which makes it essential for the Authority to employ industry-trained experts with the appropriate skills and competencies to allow them to conduct technically competent assessments and draw fair conclusions.

Fee-for-service assessment

NOPSEMA, as Australia’s independent offshore petroleum regulator, is funded on a cost recovery basis through levies and fees paid by industry.\[365\] These levies and fees are provided for under s 685 of the OPGGS Act, r 60 of the Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Act 2003 (Cth) and the Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Regulations 2004 (Cth).\[366\]

The system of fees and levies covers regulatory activities, including the assessment of safety cases, well operations management plans and environment plans, and the conduct of investigations.

Mr Stuart Smith advised that NOPSEMA is ‘fully cost recovered’ and ‘does not receive funding from government, for instance’.\[367\] Using a levy model that is similar to that provided for in Western Australia’s state mining legislation, NOPSEMA has the capacity under the Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Act 2003 (Cth) to ‘apply a fee-for-service for some specific services, including if it happens to be from a government entity as well as from an industry entity, but they are for specific services’.\[368\] As Mr Guyan explained it, ‘levies are charged to an operator of a facility in relation to the facility itself and in relation to the safety management system... Effectively, there is a safety case levy and a facility levy amount.’\[369\] Mr Guyan also confirmed that levies are categorised according to activities, ‘so a different levy is charged to the operator of a drilling rig, for example compared to the operator of a production facility’.\[370\]

According to the Australian National Audit Office (ANAO) 2014 performance audit report on the establishment and administration of NOPSEMA, for the 2012–2013


\[367\] Mr Stuart Smith, Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 6.

\[368\] ibid.

\[369\] Mr Gavin Guyan, Acting Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 7 April 2015, p 12.

\[370\] ibid.
Chapter 4

financial year the Authority received $24.5 million in revenue,\textsuperscript{371} covering NOPSEMA’s ‘Regulatory oversight of Safety Cases, Well Operations Management Plans and Environmental Plans coupled with effective monitoring, investigation and enforcement’.\textsuperscript{372} For the 2013–2014 financial year, NOPSEMA’s fees and levy revenue was $29 million, with an operating expenditure of $31.8 million.\textsuperscript{373}

NOPSEMA received a total of 468 submissions in 2012–2013 and 389 in 2013–2014. These included the following:

- ‘area to be avoided’ (ATBA) access application
- application for approval to undertake well activity (AAUWA)
- diving safety management system (DSMS)
- environment plan (EP)
- petroleum safety zone (PSZ) access application
- PSZ application
- safety case
- scope of validation
- well operations management plan (WOMP)
- diving start-up notice.\textsuperscript{374}


\textsuperscript{373} ibid, p 30 and p 46.

4.131 Table 4.1 below provides the numbers of submissions received by NOPSEMA for new safety cases, revised safety cases and scope of validation assessments.

Table 4.1: Safety-case related submissions received by NOPSEMA

<table>
<thead>
<tr>
<th>Submission Type</th>
<th>2012–2013</th>
<th>2013–2014</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Safety case revised</td>
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</tr>
<tr>
<td>Scope of validation</td>
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<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>163</td>
<td>127</td>
</tr>
</tbody>
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Finding 25
The National Offshore Petroleum Safety and Environmental Management Authority operates on a cost recovery basis, with industry paying fees for the Authority’s services.

Finding 26
The National Offshore Petroleum Safety and Environmental Management Authority monitors an operator’s continued compliance with a facility’s safety case through a system of planned inspections and risk-based assessments.

Monitoring of ongoing implementation of safety case

4.132 Having demonstrated that risk levels have been reduced to ALARP, and having had the facility’s safety case accepted by NOPSEMA, an operator must continue to maintain those ALARP risk levels. As NOPSEMA advises, ‘the operator owns the safety case’ and, following the acceptance of a safety case, the Authority’s role is one of ‘inspecting/auditing the operator’s continued compliance with the safety case in force and the associated legislation’. 376

4.133 The OPGGS Act gives NOPSEMA inspectors the authority to ‘conduct inspections to ascertain whether the requirements of the Act and subordinate regulations are being complied with’. 377 While the OPGGS Act ‘does not differentiate between inspection and investigation’, NOPSEMA’s policy is to consider these as different, but related, functions.

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Chapter 4

4.134 A planned inspection is an inspection carried out to determine whether occupational health and safety law (OHS) is being complied with at a facility and ‘may include monitoring compliance with a facility Safety Case ... by inspecting the risk management commitments of the facility operator’.378

4.135 An investigation is an inspection in relation to ‘accidents, dangerous occurrences, a contravention or a possible contravention of a listed OHS law as a basis for enforcement action’.379

4.136 NOPSEMA inspectors do not physically examine every aspect of a facility; rather, inspections are based on a sample of controls and SMSs in place at the facility. The following activities may be included in a planned inspection:

- confirming that the hardware and procedural systems described in the safety case or DSMS [diving safety management system] are in place;
- obtaining evidence that such systems are functional in practice;
- gaining assurance that the implementation of the systems will be ongoing;
- verifying that risk control improvements have been implemented;
- verifying that actions arising from recommendations of previous inspections have been completed;
- testing personnel knowledge and understanding of selected aspects of the safety case or DSMS and supporting documentation as relevant; and
- Communication with OH&S Representatives and the workforce.380

4.137 In effect, a planned inspection asks:

- Are the controls implemented?
- Are the controls functional?
- Are the controls maintained?
- Are the controls audited?

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378 ibid.
379 ibid.
380 ibid, p 2.
4.138 NOPSEMA’s ‘starting point in compliance monitoring and how we [NOPSEMA] will conduct our inspections is based on the safety case that has been submitted and accepted’. Given the safety case assessment process, by the time a facility is on location, NOPSEMA ‘will be familiar in detail with that specific facility and the risks and controls at that facility’.

4.139 From that starting point, and prior to conducting a physical inspection of a facility, the NOPSEMA inspectors will have:

- will have thoroughly prepared what they are going to inspect, test and verify in relation to particular major accident events based on what has been defined in the safety case because the safety case is a legally binding commitment on the operator. So, they will have done that preparation, identified the controls they want to test. They will have done some of that testing verification office-based, then they will travel to the facility.

4.140 Then, once the inspectors are at the facility, they will:

- inspect the effectiveness of the risk controls in relation to the major accident events first and foremost in relation to that facility. We will do that on a sampled and systemic basis. We will look at the integrity of the structure; we will look at the maintenance system; we will look at the emergency shutdown and blowdown systems and general control systems relating to each of the major accident events.

4.141 In line with NOPSEMA’s OHS planned inspection policy, planned inspections of any facility that is continuously manned are carried out twice a year.

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382 Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 9.
383 ibid.
384 ibid.
385 ibid.
386 ibid; and National Offshore Petroleum Safety and Environmental Management Authority, OHS planned inspection policy, 24 July 2013, p 2.
In relation to investigations, Mr Guyan also advised that NOPSEMA not only investigates catastrophic events, it will investigate other incidents depending on the issue involved. According to Mr Guyan, NOPSEMA:

*may investigate on the basis of potential, so there has been no injury, however there might have been under other circumstances. We will conduct an investigation, which is essentially an inspection using similar powers and focusing on that particular event. I am actually talking about the category where it is unlikely that we are considering a prosecution case. We look to see what the deficiencies were and what the lessons can be with the view to disseminating that information.*

If an inspection reveals deficiencies in the implemented controls and systems, ‘a lack of systems available, or significant omissions or errors in the safety case’ and these constitute ‘regulatory non-compliance or opportunities for improvement’, NOPSEMA engages with the operator to promote compliance (through making recommendations) or takes enforcement action, as appropriate. NOPSEMA inspectors are able ‘to issue notices and directions to responsible parties to ensure compliance with a duty specified’ in the OPGGS Act or required in the Regulations.

It is through this system of planned, risk-based assessments that NOPSEMA will monitor and enforce an FLNG facility operator’s compliance with their obligations under the OPGGS Act and associated Regulations.

Finding 27
The National Offshore Petroleum Safety and Environmental Management Authority’s Planned Inspection policy requires planned inspections of continuously-manned facilities to be carried out twice a year.

Maintaining ALARP in a safety case regime

During the Inquiry concerns were raised in relation to the effectiveness of the safety case regime. In particular, there is a concern that a safety case submission and assessment is simply a form filling exercise, with no mechanism to review and amend the safety case other than after a major incident. This concern was increased by the fact that FLNG is new technology.

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For example, the Australian Manufacturing Workers’ Union (AMWU) expressed the following view:

The safety case is something that is produced before a venture commences. It is drawn up by the company’s safety experts, but once the venture starts, once the work starts and the commissioning and the processing starts and the guys get on the tools and maintain the equipment, there is no mechanism for review—none whatsoever—because the safety case is basically a tick and flick; it is approved and it is volumes of files in the safety manager’s office never to be reviewed again. The only trigger to review a safety case is after an incident—and I think by then it is a little bit too late. 390

In relation to FLNG facilities, the AMWU expressed confidence that the engineering design of FLNG ‘will stand up to rigorous scrutiny’; the concern is that an FLNG:

is still not operational. When it becomes operational and it is sitting off the coast and producing LNG, that is when the reviews should take place to determine whether we are doing best practice environmentally, industrially health and safety-wise. Are we operating in the best way? The safety case does not have that mechanism. Whilst they are developing a safety case, they are developing a safety case that “should” work like this, but we do not know that yet. 391

Again noting that FLNG is new technology, the AMWU argued that:

it will be a difficult ask to maintain a safe working environment when we have an organisation, NOPSEMA, to which you send in a safety case and your cheque—that is your payment you have to pay; I am not saying anything different than that—and that is the last you hear from it until there is an incident. There are no regular inspections and there are no committees inside NOPSEMA trying to work out ways to make the legislation safer and the jobs safer. 392

While accepting that the safety case regime for the offshore industry ‘is a good process’, albeit with ‘some shortcomings’, the Australian Workers’ Union (AWU) expressed concern that as safety cases were ‘prepared as part of an approval process’

391 ibid, p 8.
392 Mr Steven McCartney, State Secretary, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 2.
they were not always adequately assessed or audited. The AWU’s Branch Secretary, Mr Stephen Price, stated that:

there needs to be a regular review and updating of them, and I do not think there is a requirement at the moment for that to occur. Historically, what we have seen is that they are quite similar, so once a particular safety case is done for one type of vessel, the next one is very similar, and they all contain similar information and responses within them.

This is of particular concern to the AWU for FLNG facilities, which are based on ‘brand new’ technology:

there is no history there, as far as we [the AWU] are aware, that we can actually learn from. If we are going to allow—which the legislation does—the company to identify the issues they think are going to come up and their responses to it, then we are almost abrogating our responsibility to the company to put something in place, and should something go wrong, then of course we will be able to hold the company accountable for that, but, to me, we are missing a golden opportunity to ensure that that process is done with a little bit of a, I suppose, higher degree of inspection to ensure that we get the best possible outcome from the beginning.

The AMWU suggested that while a substantial safety case is submitted for an offshore facility, it was not clear whether the ‘management staff or anyone else will have their heads around their own safety case, because traditionally that does not happen’. Rather, according to the AMWU, once the safety case is accepted:

the skipper or the project manager has full responsibility, and then they run a collaborative-type approach on the job with safety reps, HSRs and others to try to build a safer environment on the job. They work outside of NOPSEMA to make it work.

As this chapter and Chapter 3 show, the legislation that applies to the offshore petroleum industry, particularly the OPGGS Act and the OPGGSS Regulations, requires operators to maintain risk levels to ALARP, and NOPSEMA is required to conduct

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393 Mr Stephen Price, Branch Secretary, Australian Workers’ Union, Transcript of Evidence, 10 November 2014, p 4.
394 ibid.
395 ibid.
396 Mr Steven McCartney, State Secretary, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 2.
397 ibid.
regular inspections and has the authority to take various enforcement actions to obtain compliance with the legislation.

4.153 It is important to recognise that ALARP is not a fixed level of risk; rather, it is a ‘moveable criterion’. As Mr Guyan explained, ‘what was ALARP 20 years ago, may no longer be ALARP. Simply new technology, new processes become available; what is now reasonably practicable has moved’.

4.154 Because of this, the safety case regime is an important mechanism in ensuring original risk levels are ALARP, that ALARP levels are maintained and that risks are reviewed and continual improvements are made. This is supported by NOPSEMA’s guidance note as follows:

> While the safety case may place emphasis on reducing the risk to a level that is ALARP, it should not detract from the need for continual improvement. Reducing risks to a level that is ALARP and continual improvement are both key objectives of the regulations, and relate both to what is done currently and to what is planned for the future.

4.155 According to NOPSEMA, safety cases drive continuous improvement in a number of areas, ‘including through a revision over a period of time or a revision being required by regulations over time or due to improvement in knowledge and information that is contained within the regulations’.

Finding 28

A safety case is not a static document. As operators are required to maintain risk levels to as low as reasonably practicable, the safety case must be changed to reflect any changes on the facility and any safety improvements deemed reasonable.

4.156 As well as driving continuous improvement through monitoring safety case implementation via inspections, NOPSEMA argues that it works to achieve improved standards through engaging with industry and other stakeholders in a non-prescriptive way. For example, NOPSEMA participates in public forums to ‘rais[e] awareness of different approaches ... that could be applied and maybe worth considering’.

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399 Ibid.
402 Mr Stuart Smith, Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 11.
Chapter 4

addition to this type of activity, there is also knowledge interchange within the industry itself.

4.157 Nevertheless, as Mr Guyan explained, NOPSEMA’s ‘primary approach’ to improving standards is:

"through our inspection process where upon recognising that operator A has not taken advantage of the process of technology or system that we are aware of or that we have seen in relation to operator B, that does not prevent us from making a recommendation."  403

4.158 It must be recognised that because there is a considerable amount of proprietary knowledge in the petroleum industry, NOPSEMA does not take a prescriptive approach to improving industry standards. Rather, part of the Authority’s:

"role in driving and promoting improvement is to facilitate that transfer of information, and our principal mechanism is by recommendations in inspections where we will recommend that, “Yes, what you have got is in line with what you have committed to in the safety case. However, you may wish to consider this” and we will provide an explanation that will allow—recognising of course that we are in a mature and professional industry in this context—provide enough information for the proponent to understand the issue."  404

4.159 NOPSEMA views this as part of their role in managing aging assets, and will raise an issue with an operator and ‘recommend and/or require an operator to consider a particular new risk that has been revealed, often tragically through accidents elsewhere in the world, that relate to that facility’.  405

4.160 The Committee understands the unions’ concerns in relation to operators maintaining risk levels to ALARP. Again, it was largely upon hearing about such issues during the Inquiry into the economic impact of FLNG on the WA economy that the Committee determined to undertake its current Inquiry.

4.161 Nevertheless, having reviewed the evidence presented to this Inquiry the Committee understands that a safety case is intended to be a ‘living’ document, one that can be refined and revised as a facility operates and is inspected by NOPSEMA. This is primarily driven by the legislated requirement for operators to maintain risks at an ALARP level throughout the life of the facility. In fact, if implemented effectively, the safety case regime should lead to continuous improvement.

403 Mr Gavin Guyan, General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 12 November 2014, p 11.
404 ibid.
405 ibid.
As the safety case regime is the mechanism by which Australia aims to ensure the safety of its petroleum industry, government also needs to ensure that NOPSEMA undertakes its role diligently and is appropriately resourced to allow it to effectively regulate the offshore petroleum industry. Only then will the safety of the oil and gas workforce and the environment be protected.

Consultation with the workforce

A further major concern raised in this Inquiry was what is seen as a lack of consultation with the workforce, particularly in relation to safety cases, by those companies undertaking or considering undertaking FLNG operations.

While the safety case is prepared by the operator, the legislation makes it clear that operators must consult with the workforce in relation to safety cases. OPGGSS r 2.11(1)(a) provides that the operator must demonstrate to the Authority that:

in the development or revision of the safety case for the facility, there has been effective consultation with, and participation of, members of the workforce.

Here, in accordance with r 2.11(3), members of the workforce include those who are:

(a) identifiable before the safety case is developed; and

(b) working, or likely to be working, on the relevant facility.

The notes to r 2.11 state that Part 3 of Schedule 3 to the OPGGS Act ‘sets out the broad consultative provisions that apply, including provisions for the establishment of designated workgroups, the election of health and safety representatives and the establishment of OHS committees’.

The requirement for workforce consultation in the development of a safety case is also set out in NOPSEMA’s policy and guidance notes. For example, NOPSEMA’s guidance note providing an overview of the safety case regime states that ‘the operator must ensure there has been effective consultation with, and participation by, members of the workforce in the development or revision of a safety case’.

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Chapter 4

4.168 NOPSEMA states that the process for effective workforce consultation in the ‘development, preparation and revision of the safety case’ as per r 2.11(1)(b) would generally need to cover:

- Preparing or revising the safety case;
- Identifying the hazards, including those that could lead to MAEs;
- Conducting and/or reviewing safety assessments;
- Identifying risk control measures and performance indicators for these measures, as well as setting performance standards;
- Establishing and/or implementing the Safety Management System; and
- Developing the emergency response plan under the umbrella of the broader-based plan discussed under Emergency Response Preparedness.

4.169 As this chapter has shown, the safety case regime requires a formal safety assessment to be included in the safety case to demonstrate that risks associated with MAEs are understood and that appropriate control measures, based on required performance standards, are in place. According to NOPSEMA, ‘the requirement to understand the risks extends to the workforce’; the workforce should be able to identify ‘the major contributing factors to the risk’ and ‘the critical activities or measures which can significantly influence risk levels’. It should be noted that there is no legal requirement of this consultation to include unions.

4.170 Consultation with, and participation by, the workforce in relation to new safety cases and the revision of existing safety cases is recognised as being important for two main reasons.

4.171 First, this process allows input from those with experience of working on facilities. This is recognised by GDF SUEZ Bonaparte, who advised that ‘the operations and maintenance workforce (the workforce) plays a critical role in the risk management and safety case process throughout the lifecycle of a development’. According to GDF SUEZ Bonaparte, ‘the workforce brings a diverse range of experiences and hands on knowledge that is instrumental in effectively identifying hazards, understanding risk

407 ibid, p 18.
408 ibid, p 12.
409 NOPSEMA’s, Safety case—Involving the workforce, Guidance note no. N04300–GN1054, July 2013, p 10 lists ten reasons why effective workforce involvement is important.
410 Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 3.
and addressing the range of potential operational demands on the Facility’.\textsuperscript{411} Similarly, ConocoPhillips stated that ‘the safety case does require a strong consultation with the workforce, because they are the guys who have got the experience of actually operating kit’:\textsuperscript{412}

Second, it allows the workforce to ‘understand the risks and hazards to which they may be exposed on the facility’.\textsuperscript{413} According to NOPSEMA, members of the workforce ‘must be knowledgeable and informed on the risk controls, the control effectiveness and their vulnerabilities, and the importance of monitoring risk control measure degradation’.\textsuperscript{414} For NOPSEMA, the best way of achieving this is ‘through appropriate participation in the formal safety assessment process’.\textsuperscript{415} This clearly reflects the provisions of OPGGSS r 2.11(1)(b) that requires a safety case to provide:

\textit{(b) … adequately for effective consultation with, and the effective participation of, the members of the workforce, so that they are able to arrive at informed opinions about the risks and hazards to which they may be exposed on the facility.}

**Finding 29**

The Australian regulatory regime for the offshore petroleum industry requires operators to undertake effective consultation with the workforce during the development of the safety case for a facility. There is no legal requirement for this to include unions or other representative bodies.

**Finding 30**

The National Offshore Petroleum Safety and Environmental Management Authority, in assessing the safety case, must be satisfied that there has been effective participation of the workforce in developing or revising a safety case for a facility.

Under OPGGSS r 2.11(1), NOPSEMA must be reasonably satisfied that there has been effective consultation with and participation by members of the workforce in the development or revision of a safety case.\textsuperscript{416} In effect, as NOPSEMA’s Safety Case Assessment Policy states, ‘the lead assessor will make judgements on the adequacy of the safety case based on the content of the safety case submission [including

\begin{itemize}
\item \textsuperscript{411} ibid.
\item \textsuperscript{412} Mr Mark Leigh, Team Leader, Asset Integrity and Process Safety, ConocoPhillips, Transcript of Evidence, 10 November 2014, p 2.
\item \textsuperscript{413} National Offshore Petroleum Safety and Environmental Management Authority, The safety case in context: An overview of the safety case regime, Guidance note N04300–GN0060, June 2013, p 1 and p 9.
\item \textsuperscript{414} ibid, p 1 and p 12.
\item \textsuperscript{415} ibid, p 12.
\item \textsuperscript{416} r 2.11(1) states ‘the operator of a facility must demonstrate [workforce consultation and participation] to the Safety Authority, to the reasonable satisfaction of the Safety Authority’.
\end{itemize}
Chapter 4

documentation required under OPGGSS r 2.11(b)] (workforce consultation). This is also clearly recognised in NOPSEMA’s guidance note, Safety case—Involving the workforce.

While demonstration of workforce involvement does not need to be included with the safety case, NOPSEMA states that ‘it may be the best place to document the demonstration required’. There are two main reasons for this. First, NOPSEMA requires supporting documents to be reasonably satisfied and, thus, accept a safety case, and, second, ‘the safety case is the key health and safety document for the facility’.

Workforce participation in safety case development in accordance with OPGGSS r 2.11(1)(a) and r 2.11(1)(b) is one of the legislative requirements that NOPSEMA must always assess in detail, and is one element in the Authority’s ‘detailed assessment of specific regulations’ assessment component.

NOPSEMA recognises that sometimes a safety case is developed prior to the recruitment of the entire workforce. NOPSEMA also points to data that ‘indicates workforce involvement is commonly centred on aspects of the Formal Safety Assessment (FSA)’ such as hazard identification, risk assessment and control measure identification. There appears to be lower levels of workforce involvement in the facility description and safety management system description components of a safety case, despite the fact that such involvement would provide ‘significant benefits’ to the operator.

Against the backdrop of this regulation and NOPSEMA policy, unions who provided evidence to the Inquiry expressed concern about the actual level of compliance with the requirement for engagement of the workforce, particularly in the preparation of the safety case.

For example, the AWU’s Mr Stephen Price, in discussing whether or not a safety case takes into consideration a company’s safety culture and ‘approach to safety on the job’, stated that ‘lot of the times they [safety cases] are also prepared as part of an approval

419 ibid.
420 ibid.
421 ibid, p 7.
422 ibid, pp 7–8.
process, so they are done without the involvement and engagement of their employees’.\textsuperscript{423}

4.179 However, as noted above, GDF SUEZ Bonaparte recognises the importance of workforce involvement. GDF SUEZ Bonaparte advised that as part of its consideration of using FLNG technology to develop its Bonaparte field it:

\textit{established an integrated Project team, including Operations and Maintenance personnel, who were involved from the early design studies in the pre-Front End Engineering and Design (pre-FEED) phase. The plan was to increase workforce involvement as the project progressed into FEED. The workforce was involved in the review of the design, in the formal hazard identification processes, formal design reviews and human factors reviews. This approach ensures the full integration and application of workforce experience throughout the development lifecycle.}\textsuperscript{424}

4.180 The Committee sought to better understand the level of engagement of the workforce in health and safety issues in relation to Prelude in particular as it will be the first FLNG facility to be moored off the WA coast.

4.181 During its site visit to the Samsung Shipyards in Korea to inspect the Prelude facility, members met a number of Australians who are at the facility to familiarise themselves with the vessel as it is being built. These workers gave the impression that they were being involved in setting up some of the safety systems around the operation of that vessel.

4.182 However, the AWU argued that while operators are involved early in the process, their input does not generally end up in the safety case. According to Mr Stephen Price:

\textit{it is the approach that all the organisations take when they are building a new kit or a new facility. They get the operators involved quite early. They will send them off and train them on simulators or equivalent pieces of equipment somewhere around the globe. They will take that experience they have and seek their input into putting in place the operational processes. But whether that then actually translates into the information that is captured within the safety case that they have to present, I am not convinced.}\textsuperscript{425}

\textsuperscript{423} Mr Stephen Price, Branch Secretary, Australian Workers’ Union, \textit{Transcript of Evidence}, 10 November 2014, p 4.

\textsuperscript{424} Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 3.

\textsuperscript{425} Mr Stephen Price, Branch Secretary, Australian Workers’ Union, \textit{Transcript of Evidence}, 10 November 2014, p 4.
Chapter 4

4.183 Given this, the Committee asked Shell about its consultation with Australian unions in relation to developing the Prelude safety case and whether the recruited operators were involved in working on some of the organisational/cultural aspects of the safety case. In response, Mr Andrew Doherty of Shell replied: ‘our engagements are widespread with many communities and stakeholders. We are and have been engaging with people in the development of the HSSE case’. 426

4.184 Mr Ian Grose also stated that Shell has:

> had some engagement with unions over the past few years and no doubt we will have more in the future. We work with our operators principally around making sure that they are competent and have all the necessary training to do their work and that they go to Geoje to learn how the facility will work.’ 427

4.185 Mr Dixon also commented on operators’ involvement in the early BOD stage:

> Shell operates many offshore assets around the globe and it has engaged with dedicated operators to come in and be part of the design process through all aspects of the build and the design concepts going forward. 428

4.186 When asked whether or not Shell saw union engagement as integral to safety discussions, Mr Doherty replied:

> recognising that right now we are still in the phase of construction and that there is much more development work to take place, there has, as Ian said already, been some engagement with unions and I am sure that that engagement will develop as the project develops. 429

4.187 Mr Grose also advised that Shell’s Prelude facility was:

> still in the construction phase. We would not normally consult third parties about our safety case. We work our safety up and submit it to the regulator. It is not something we necessarily discuss. 430

426 Mr Andrew Doherty, General Manager, HSSE, Shell, Transcript of Evidence, 12 November 2014, p 7.
427 Mr Ian Grose, Commercial Manager, Prelude, Shell, Transcript of Evidence, 12 November 2014, p 7.
428 Mr Gerald Dixon, HSSE Manager, Prelude, Shell, Transcript of Evidence, 12 November 2014, p 7.
429 Mr Andrew Doherty, General Manager, HSSE, Shell, Transcript of Evidence, 12 November 2014, p 7.
430 Mr Ian Grose, Commercial Manager, Prelude, Shell, Transcript of Evidence, 12 November 2014, p 7.
It is difficult to reconcile this statement with the regulatory requirement to ensure workforce consultation and participation during the development of the safety case. It is to be hoped that Shell will be able to demonstrate to NOPSEMA, as required, that there has been an appropriate level of workforce involvement in the development of the safety case.

Mr Ian Bray, Assistant National Secretary for the MUA, stated that:

it is very sad to say that there has been very little engagement in terms of discussions around the operations of an FLNG vessel. In fact, it would be nice to say that we have had minimum discussions but I would really put the discussion at zero. We do not know what Shell is anticipating in terms of intentions for training and job preparedness for a marine operation on an FLNG facility.\footnote{Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, \textit{Transcript of Evidence}, 7 November 2014, p 5.}

For Mr Bray, the problem seems to stem from a lack of consultation with the actual workforce because of the ‘top down approach’ of risk being ‘managed from officers and people employed specifically to look at those HSC officers et cetera. In fact, teams are employed in offices in Perth, for example, looking at mitigating risk.’\footnote{ibid.}

While not being critical of that per se, Mr Bray did see a lack of direct engagement with those who ‘participate in whatever those mitigations are, whether that be emergency response or just general safe systems of work’ as a failure of the system.\footnote{ibid.} Accepting that the Union needed to take some responsibility to develop a more inclusive culture, Mr Bray argued that a better consultative approach is needed, particularly in relation to how to engage the ‘employees who are at risk on these jobs to make sure that those places of work are getting world’s best practice in terms of safety.’\footnote{ibid, p 6.} Again, Mr Bray argued that:

learning from the workforce what they see and what they perceive to be the biggest issues in terms of safety—exposure to it, redress it, all these kinds of things. It is just not occurring. You go to a safety forum, ... it is all managers. Nobody is facilitated to come from the workplace because of the cost, again, of getting a safety rep off the job in a remote part of Western Australia down to Perth for a two-day conference and then how to get them back out. Also, the cost of who covers their job while they are not there et cetera. You go to these
forums and, sadly, there are no workers there; it is mostly managers.435

4.192 The AMWU advised that it had had no discussions with Shell in relation to Prelude’s safety case. According to Mr Steven McCartney, following a request to meet with Shell to discuss employment opportunities and safety on Prelude, Shell did not seem to ‘tak[ing] any consultation with our union seriously at all’.436 It is Mr McCartney’s view that Shell is going to develop its Prelude safety case ‘and then say take it or take it’.437

4.193 The AWU’s Mr Stephen Price advised that he had had one meeting with Shell’s Australian Country Chair, Mr Andrew Smith, who broadly outlined the facility and showed some video footage of the facility. Since that time, as Mr Price stated, he has made a number of approaches to Shell to meet with them and have a conversation about where they are going regarding their employees and development of the safety case and stuff, but they have not engaged back.438

435 ibid, p 5.
436 Mr Steven McCartney, State Secretary, Australian Metal Workers’ Union, Transcript of Evidence, 26 November 2014, p 8.
437 ibid. Note: this meeting was arranged through Hon Gary Gray, and while a Shell representative did meet with Mr McCartney he was not able to provide the information sought by the union.
438 Mr Stephen Price, Branch Secretary, Australian Workers’ Union, Transcript of Evidence, 10 November 2014, p 5.
Chapter 5

Prelude safety in design

5.1 In May 2011 Shell announced that it had made a positive final investment decision (FID) to develop the Prelude and Concerto gas fields in the Browse basin using floating liquefied natural gas (FLNG) technology. This was the world’s first FID based on FLNG technology. Woodside has announced that it is progressing FLNG as its preferred development concept to develop its Browse Basin fields.

5.2 While the concept of FLNG technology had been around for some time, challenges associated with producing, storing and transferring LNG at sea first needed to be overcome before FLNG could become a viable development option for offshore petroleum resources. Throughout its evidence to the Inquiry, Shell expressed its belief that the Prelude facility’s FLNG design is able to address and overcome these challenges.

5.3 As discussed in Chapters 3, 4 and 6, FLNG project proponents must demonstrate through their safety cases and environmental plans that they have considered the hazards associated with FLNG facilities and reduced risk to levels that are as low as reasonably practicable (ALARP). Shell advised that, based on their safety in design process, they have developed particular design solutions to reduce risk levels to ALARP, including, but not limited to, hull design, the turret mooring system and the facility layout.

5.4 In considering these safety features, it is useful to divide the Prelude facility into two broad components, the hull and the topsides. The hull, in combination with various supporting elements, has been designed to overcome the challenge of remaining permanently moored in the Browse basin. The topsides, designed to overcome the challenge of safely producing LNG at sea, should also limit the potential negative consequences in the event of an accident. That is, while Prelude is an integrated facility consisting of several important components, based on evidence provided by Shell, it is broadly the case that the facility as a whole has been designed to withstand the elements in which it will operate, with the liquefaction and cryogenic storage and handling infrastructure designed to overcome the challenge associated with limited available operational space.

439 Refer to: Economics and Industry Standing Committee, The economic impact of floating LNG on Western Australia, Volume 1, Legislative Assembly, Parliament of Western Australia, 2014.
440 Note that Woodside’s proposed Browse FLNG facilities will be using Shell’s Prelude FLNG design.
This chapter begins with a consideration of the facility’s hull design, including its size and mass, and mooring and storage systems, as well as the processes and knowledge that informed the design of each of these elements. The layout of the liquefaction infrastructure is then discussed, alongside concerns that have been raised by representatives of workers unions as to worker safety in relation to this new technology. Finally, the difficult process of transferring LNG and other petroleum products at sea from a dynamic facility to a cargo vessel is considered.

It is also important to recognise that Shell is required by NOPSEMA to provide a validation of its design. The Committee understands that this validator for the Prelude facility design is Lloyd’s Register.441

**Hull design**

The *Prelude* facility, which has been described as ‘the largest offshore floating facility ever built’, is immense.442 With a hull 488 metres long and 74 metres wide, when fully ballasted it will weigh in excess of 600,000 tonnes, which is ‘roughly six times as much as the largest aircraft carrier’.443 While its sheer size is, in part, a function of the task that it will perform, as Shell’s Engineering Manager, Mr Steven Kauffman, explained, this size is also ‘an important safety feature’444 as it is fundamental to the ability of the facility to ‘at all times, including during a cyclone, [remain] on-location, with personnel remaining on board’.445

To achieve this outcome, Shell has designed the Prelude facility to withstand ‘1 in 10,000 year weather events which means waves in excess of 28m and wind gusting at more than 300km/h’.446 The energy associated with such extreme metocean447 conditions is vast, but Shell submitted that the size and mass of Prelude ‘is a significant help’ in dealing with these forces.448

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441 Submission No. 9 from Shell Development (Australia) Pty Ltd, 11 August 2014, p 1.
444 Mr Steven Kauffman, Engineering Manager, Shell Australia, *Transcript of Briefing*, 26 June 2013, p 6.
445 Submission No. 15 from Shell in Australia, submission to Inquiry into the Economic Impact of Floating LNG on Western Australia, 30 August 2013, p 6.
446 ibid.
447 The term ‘metocean’ is an abbreviation of meteorological and oceanographic used within the offshore petroleum industry to describe the physical environment near an offshore facility.
448 Submission No. 15 from Shell in Australia, submission to Inquiry into the Economic Impact of Floating LNG on Western Australia, 30 August 2013, p 6.
The hull itself has also been designed for optimum stability during adverse weather conditions. Describing the hull as ‘a key element in the facility’s ability to withstand severe weather’, Shell explained that dynamic ballast tanks inside the hull will take on and expel sea water in accordance with how much product is being stored at any one time. This will allow the facility ‘to achieve the optimal draft at all times’.\textsuperscript{449} According to Shell, by achieving and maintaining optimal draft conditions, facility motion caused by severe weather conditions is reduced. In turn, this reduces workplace and equipment stress. Furthermore, the depth of the hull and its dynamic ballast system ‘reduces movement at the forward and aft ends of the facility due to swell’.\textsuperscript{450} Shell explained that this design will have the effect of ‘minimising “slam occurrences” which typically occur when a hull hits a wave and rises with it, then drops as the wave moves past’.\textsuperscript{451}

The \textit{Prelude} facility will operate with a high freeboard, which will ‘prevent large amounts of “green water” from reaching the deck’, thus protecting employees and limiting ‘the amount of sea water reaching the processing facilities’.\textsuperscript{452} The height of the freeboard also acts as a barrier against maritime piracy.\textsuperscript{453}

To ensure structural integrity, the facility consists of a complete double hull, ‘incorporating a double bottom, double side and double deck configuration’,\textsuperscript{454} with six metres between the inner and outer hulls. This design is to ‘provide[s] strength and in the unlikely event of a collision, [help ensure that] the hull’s integrity is unlikely to be compromised’.\textsuperscript{455} Shell also explained that the hull is:

\begin{quote}
 further reinforced by a centre line double plate bulkhead, forming a substantial centre girder which efficiently balances the topsides weight against hull buoyancy forces, creating further stability for the facility.\textsuperscript{456}
\end{quote}

\section*{Product storage at sea—overcoming the challenge of sloshing}

The \textit{Prelude} hull is also comprised of a number of other elements designed to help the facility combat extreme weather conditions, including its twin storage tanks for all stored petroleum products. This important element of the \textit{Prelude} hull design works to

\textsuperscript{449} Submission No. 9 from Shell in Australia, 11 August 2014, p 3.
\textsuperscript{450} Ibid.
\textsuperscript{451} Ibid.
\textsuperscript{452} Ibid. Freeboard is the distance from the waterline to the upper deck level. Green water is sea water that comes up over the deck.
\textsuperscript{453} This aspect of the \textit{Prelude} facility’s freeboard height was explained during a Committee tour of the \textit{Prelude} facility as it was under construction in the Samsung Heavy Industries shipyard in Geoje, Republic of Korea, in August 2014.
\textsuperscript{454} Submission No. 9 from Shell in Australia, 11 August 2014, p 3.
\textsuperscript{455} Ibid.
\textsuperscript{456} Ibid.
minimise the effects of a phenomenon known as ‘sloshing’. Sloshing refers to the dynamic, destabilising effect that occurs when large quantities of stored liquids begin to oscillate and gather momentum—with potentially disastrous consequences. Sloshing can occur during filling or as a consequence of environmental conditions.

5.13 According to Professor Murray Rudman of Monash University and Dr Paul Cleary of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), sloshing is a dangerous phenomenon that must be accounted for in the design of any LNG-carrying vessel. This is because it:

may resonate with structural frequencies and those of wave-induced ship motions. This can subsequently affect ship stability and, of particular importance here, can produce large loads on the internal tank membranes. In turn this can lead to structural damage to tank membranes and insulation, leakage and potentially to tank rupture.457

5.14 In that LNG is a technology that facilitates the maritime transport of natural gas, anti-sloshing technology is not new. According to Shell, however, ‘FLNG requires a different approach to containment of liquids on board of the facility compared to conventional LNG carriers’, and this requirement has produced a design in which pairs of side-by-side storage tanks are incorporated into the Prelude hull.458 The distinction between a conventional single storage tank on an LNG carrier and the dual storage tank layout within the Prelude hull is illustrated in Figure 5.1. Shell explained that this design ‘gives the [Prelude] facility much greater ability to withstand effects of liquid motion’ because by:

splitting the liquids into side-by-side tanks, the impact of the movement due to sloshing is reduced. The shifting of the weight due to sloshing is also distributed between the side-by-side tanks, providing balance (rather than the weight moving to one side of a larger tank).459

458 Submission No. 9 from Shell in Australia, 11 August 2014, p 3.
459 ibid, p 4.
The turret mooring system

Perhaps the most significant component of the Prelude design is the turret mooring system. As well as mooring Prelude at the field location, the turret mooring system adds to the immense size and mass of the facility. Figure 5.2 shows one section of the Prelude turret mooring system, which Shell describes as ‘an important safety feature which ensures that the FLNG facility remains securely on location in the field’.461

Shell further explained that Prelude:

will be moored near to the field location by four groups of mooring chains which connect at the turret. Each of these groups consists of four mooring chains, which will be held to the sea floor by driven steel piles each 65m long and 5.5m in diameter.462

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460 ibid, p 3.
461 ibid, p 2.
462 ibid.
The four groups of mooring chains will be fabricated from some 8,000 tonnes of steel, with each link being approximately 350 kilograms. The turret itself is a 12,000 tonne cylindrical structure some 30 metres in diameter and 93 metres tall, which is integrated into the Prelude hull at one end. A critical element of the facility, the turret is the point at which all gas flowlines and mooring chains are attached. In effect, the turret is fixed in place and the hull is able to ‘weathervane’ around it so that the facility as a whole will always assume the position of least resistance against the prevailing metocean conditions.

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463 ibid.
465 Submission No. 9 from Shell in Australia, 11 August 2014, p 2.
According to Shell:

*the turret’s swivel design enables the facility to ‘weather vane’ whilst the mooring lines remain fixed to the sea floor. This feature enables the facility to rotate according to weather and sea conditions. The ability to weather vane matched with the facility’s sheer size and weight creates stability and ensures safe and effective offloading can take place at sea.*

**Designed and tested to ride out a storm**

To ensure that the *Prelude* facility will be able to withstand extreme metocean conditions, Shell engaged the Maritime Research Institute Netherlands (MARIN) to assist in the process of design. MARIN, a global leader in hydrodynamic research and maritime technology, assists in maritime design by providing a suite of simulation, model testing, full-scale measurement and training services. At the MARIN testing facility in Wageningen the offshore department tested and helped refine the *Prelude* facility design by conducting scale model testing of the facility in its various testing basins. One such test, involving a model of an LNG carrier docked alongside a *Prelude* model, is illustrated at Figure 5.3.

*Figure 5.3: Prelude model testing at the MARIN testing facility.*

By using the MARIN testing basins, the hull design, turret mooring system, moorings and mooring chains were all able to be tested in wind and wave conditions of varying extremes. In particular, the basins were configured to simulate 1 in 100 year weather

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466 ibid.
468 Submission No. 15 from Shell in Australia, submission to Inquiry into the Economic Impact of Floating LNG on Western Australia, 30 August 2013, p 3.
conditions and 1 in 10,000 year weather conditions. The Prelude model was subjected to these conditions and the resulting data used by Shell to refine and enhance their design.469 According to Shell, in addition to the fact that the Prelude facility hull ‘complies with all international requirements for construction, strength and stability in offshore structures’, the MARIN analytical study and wave basin testing was:

*carried out to prove the suitability of the complete facility during a range of adverse weather events up to, and including, an equivalent one in 10,000 year storm at the Prelude location. This testing and assessment confirmed that it will be safe to inhabit the facility during severe weather, and that even in the most extreme event the facilities structural integrity will not be compromised.*470

5.21 The Prelude facility, that is, has been designed not only to withstand extreme metocean conditions, but to remain in place and staffed at all times. Rather than representing a risk to human safety, however, Shell submit that this design is itself a critical safety feature essentially because evacuation is an inherently high-risk activity. Outlining the design during a hearing, the Shell’s Commercial Manager, Prelude, Mr Ian Grose, explained that:

*the reason we [Shell] went that way was that it is far safer to make things completely able to withstand the weather and safe for all to stay on board than it is to design something that has to pick up and leave or has to be de‐manned and to have helicopters encroaching bad weather trying to get people off. This is intrinsically a much safer solution by going the other way and making the FLNG facility itself absolutely a safe haven in such an event.*471

5.22 Mr Grose’s evidence echoed earlier evidence given by Mr Mark Leigh, Team Leader for Asset Integrity and Process Safety at ConocoPhillips. ConocoPhillips have operated the Darwin LNG plant since June 2003, along with the associated Liberdade floating storage and offloading (FSO) facility, which is permanently moored above the Bayu Undan field in the Timor Sea, some 500 kilometres offshore from Darwin. Mr Leigh explained that, having ‘done the analysis on the moorings and the piles’, and the facility in general, the design for Liberdade ‘survived the 10,000 year test’.472 Mr Leigh also explained that while it is not ConocoPhillips policy to have workers on the Liberdade remain onboard through an extreme weather event, a decision as to whether to evacuate the facility

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469 The Committee was briefed on this testing process during a site tour of the MARIN testing facility in Wageningen in July 2014.
470 Submission No. 9 from Shell in Australia, 11 August 2014, p 7.
471 Mr Ian Grose, Commercial Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, p 5.
during cyclonic weather was never straightforward.\textsuperscript{473} This issue of de-manning is discussed further in Chapter 8.

**Designing for the metocean conditions**

5.23 With the *Liberdade* FSO in operation for more than 10 years, Mr Leigh’s evidence demonstrates that although FLNG technology is new and *Prelude* is a pioneering facility, in many ways—and particularly with respect to hull design—the *Prelude* risk profile appears to be very similar to that of many floating production storage and offloading (FPSO) facilities. There are currently thirteen FPSOs operating in waters off the Western Australian coastline.

5.24 The *Prelude* facility will be located within about 20 kilometres of a very similar floating facility also currently under construction—the INPEX Ichthys FPSO. A brief discussion of the Ichthys FPSO will help to illustrate how offshore petroleum facilities are designed for the conditions in which they operate.

5.25 Describing the Ichthys FPSO as ‘amongst the largest in the world’, Mr William Townsend, General Manager of External Affairs and Joint Venture at INPEX, explained that the facility’s ‘storage capacity is slightly under 1.2 million barrels; the length is ... 336 metres, and [it is 59] metres ... in breadth’.\textsuperscript{474} The Ichthys FPSO, while not as large as the *Prelude* facility, is an immense offshore floating facility in its own right. Like *Prelude*, the Ichthys FPSO (pictured under construction at Figure 5.4) will use an internal turret mooring system to remain permanently moored at sea. Also like *Prelude*, the Ichthys FPSO has been designed ‘to remain manned during cyclones’.\textsuperscript{475}

\textsuperscript{473} ibid, pp 3–4.
\textsuperscript{474} Mr William Townsend, General Manager, External Affairs and Joint Venture, INPEX, Transcript of Evidence, 7 November 2014, p 4.
\textsuperscript{475} ibid, p 3.
5.26 Mr Townsend explained that INPEX had designed all of the Ichthys project facilities ‘to withstand ... the one-in-10 000 year event’.\footnote{Mr William Townsend, General Manager, External Affairs and Joint Venture, INPEX, \textit{Transcript of Evidence}, 7 November 2014, p 3.} To put this design into context, Mr Townsend also explained that ‘the size of the facilities being as big as they are means that they are pretty robust against the weather conditions’.\footnote{ibid.} When questioned on the procedure that would be followed in the event of a cyclone, Mr Townsend indicated that the planned response will be ‘to reduce manning levels, but [for the FPSO] to remain manned’.\footnote{ibid.} In relation to how such a reduction would be coordinated if cyclonic activity were imminent, Mr Townsend indicated that the location of the Ichthys field (which is near the boundary between the Indian Ocean and the Timor Sea) meant that any such procedure would be complex:

\begin{quote}
One of the challenges of the Timor Sea as opposed to, say, North West Shelf is that cyclones tend to form closer to that area and we have less time to respond. That is the negative. The positive is that because they are still forming, they tend not to be as strong.\footnote{ibid, p 12.}
\end{quote}

5.27 This observation was subsequently confirmed by the Bureau of Meteorology’s Acting Regional Director for Western Australia, Mr Russell Stringer, who explained that tropical cyclones are:


478 ibid.

479 ibid.

480 ibid, p 12.
low pressure systems that form over warm tropical waters and have gale force winds near the centre—that is, sustained winds of 63 kilometres an hour or greater, and gusts in excess of 90 kilometres an hour.⁴⁸¹

Mr Stringer further explained that the system of categorising the intensity of cyclones, which in Australia is done on a scale of 1–5, is based upon maximum wind strength. The Bureau of Meteorology’s system of cyclone classification is outlined in Table 5.1.

<table>
<thead>
<tr>
<th>Cyclone category</th>
<th>Wind speed (gust, km/h)</th>
<th>Likely effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90-125</td>
<td>Negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings.</td>
</tr>
<tr>
<td>2</td>
<td>125-164</td>
<td>Minor house damage. Significant damage to signs, trees and caravans. Heavy damage to some crops. Risk of power failure. Small craft may break moorings.</td>
</tr>
<tr>
<td>3</td>
<td>165-224</td>
<td>Some roof and structural damage. Some caravans destroyed. Power failures likely.</td>
</tr>
<tr>
<td>4</td>
<td>225-279</td>
<td>Significant roofing loss and structural damage. Many caravans destroyed and blown away. Dangerous airborne debris. Widespread power failures.</td>
</tr>
<tr>
<td>5</td>
<td>280+</td>
<td>Extremely dangerous with widespread destruction.</td>
</tr>
</tbody>
</table>

After explaining that ‘when a tropical cyclone reaches category 3 intensity it is called a severe tropical cyclone’, Mr Stringer provided some insight into how cyclonic activity in waters off the Western Australian coast might impact upon petroleum industry activities in that region and, in particular, in the Browse Basin, where both the Prelude FLNG facility and the Ichthys FPSO will operate.⁴⁸³ According to Mr Stringer:

in other tropical parts of the world where there are extensive offshore oil and gas installations, such as the Gulf of Mexico or the South China

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⁴⁸¹ Mr Russell Stringer, Acting Regional Director for Western Australia, Bureau of Meteorology, Transcript of Evidence, 26 November 2014, p 2.
⁴⁸³ Mr Russell Stringer, Acting Regional Director for Western Australia, Bureau of Meteorology, Transcript of Evidence, 26 November 2014, p 2.
Chapter 5

Sea, cyclones typically form at a distance and then move into the area of interest.\textsuperscript{584}

5.30 By contrast, the Browse Basin is an area where cyclones often form in situ. While this ‘makes it more difficult to provide accurate forecasts at long lead times’, cyclones in this area ‘have typically not had as much time to intensify [because they] tend to intensify as they head further south toward the Pilbara’.\textsuperscript{485} Mr Stringer then provided some context for his evidence:

\begin{quote}
We can illustrate this by considering how many severe tropical cyclones passed through the Timor Sea, the Browse Basin and the North West Shelf over a forty year period from 1971–72 through to 2010–11. In each case, a circle of radius 220 kilometres was considered—that is, 120 nautical miles, or two degrees of latitude. The number of severe tropical cyclones experienced in each region was one, nine and 30 respectively—that is, one in the north west part of the Timor Sea, nine in the Browse Basin and thirty off the North West Shelf. I need to caution that that is just a quick and indicative inspection of cyclone occurrence, but it helps to illustrate the point.\textsuperscript{486}
\end{quote}

5.31 However many severe tropical cyclones may or may not impact upon the Prelude facility once it becomes operational, it is clear that the Browse Basin area is a challenging environment, periodically subject to extreme metocean conditions. As such, the design of the Prelude hull—and indeed that of any facility that will operate nearby—is undoubtedly a fundamental safety feature.

Producing LNG at sea—the importance of facility layout

5.32 FLNG technology necessarily involves the production of LNG at sea. This represents an added layer of complexity and, therefore, it is useful to consider what specific risks are associated with this process, and how Shell sees its Prelude design mitigating these LNG-specific risks.

5.33 FPSO technology enables the production, storage and offloading of liquid hydrocarbons at sea. FLNG technology is similar, but also adds the liquefaction of natural gas into the offshore equation—a process that involves refining, then chilling and ultimately storing and handling natural gas at -161°C Celsius. On Prelude, most of the complex and sophisticated equipment required in this process will be located on the facility’s deck; these modules are often referred to as the facility’s ‘topsides’. The starting point for

\textsuperscript{484} ibid.
\textsuperscript{485} ibid.
\textsuperscript{486} ibid, pp 2–3.
Shell in designing the topsides with safety as the paramount consideration was the layout of the process modules on the deck itself.

In providing an overview of the Prelude facility, Shell explained that topside module design was informed by careful consideration of what is referred to as ‘process safety’. According to Shell, ‘process safety management’ is concerned with the:

 prevention of incidents (such as fire or explosion), resulting from [the] unintentional release of energy or hazardous substances. Process safety has been the single most important guiding principle for developing the FLNG facility’s layout. This is primarily managed by adherence to the relevant international and industry process safety standards, and by the evaluation of the layout and process through multiple formal safety assessment and quantitative risk assessments, performed at relevant design phases of the project.487

Fundamentally, the layout of the Prelude topside modules is done according to risk profile, with the most hazardous elements—such as the flare—placed at the opposite end of the facility to the living quarters. Prelude has been specifically designed so that its operators have minimal need to work in close proximity to the more hazardous modules. Shell explained that the:

 living quarters, the helidecks, the control room and the workshop are located at the back of the FLNG facility. These areas, where people may be working or resting, are by design furthest away from the turret and processing facilities. These processing facilities are further separated by relatively low risk equipment and utilities.488

487 Submission No. 9 from Shell in Australia, 11 August 2014, p 7.
488 ibid, p 4.
Passive protection—design elements aimed at limiting the consequences of accidents—is fundamental in ameliorating the risks associated with LNG production and containment on the *Prelude* facility. The deck layout provides one example of passive protection which has been informed by an understanding of how a loss of integrity in one module can have catastrophic consequences if other modules are subsequently also compromised. This understanding was reflected in a submission by Woodside that ‘the layout of any hydrocarbon facility has a major effect on the consequences of major events and on the arrangements required for emergency response’.

It is also reflected in the fact that, as outlined in Chapter 4, a description of the facility layout is an essential element of its safety case.

Prelude HSSE Manager, Mr Gerald Dixon, explained that while on ‘some older first-generation assets, the modules tend to be stacked up on one another’, Shell approached the task of designing the layout of the topside modules on *Prelude* ‘to give maximum safety profile for the workers on the asset for living and work practices’.

The risk associated with handling cryogenic material in an offshore environment provides another example of how passive protection has been integrated into the *Prelude* design to limit the consequences of a loss of integrity within some particular module. Among the numerous hazards associated with the extremely cold temperature...
of LNG is that it will ‘embrittle’ any steel that it might come into contact with. This could quickly prove catastrophic if a loss of integrity were to occur within a Prelude LNG module. Therefore, in order to reduce the risk of embrittlement, the Prelude facility has been painted with a substance known as ‘Chartek 7’, which was originally designed as a fire protectant.\footnote{International Protective Coatings, Chartek 7. Available at: http://www.international-pc.com/products/info/Fire-Protection/Chartek-7.aspx. Accessed on 28 January 2015. According to its manufacturers, Chartek 7 is ‘a high performance epoxy intumescent fire protection coating system’.

492} Chartek 7’s high specific heat means that it is also excellent at withstanding extreme cold and its application on Prelude is to help the facility’s steel withstand cryogenic temperatures.

Another important example of passive protection in the Prelude design is the incorporation of ‘safety gaps’ between various topside components on the facility. A critical safety feature, the safety gaps—three of which are 20 metres in width and run perpendicular to the deck layout—are analogous to fire breaks. In the event of a loss of hydrocarbon containment, the safety gaps permit hydrocarbons to dissipate, diminishing the potential occurrence of an explosion—and a potential chain reaction—on the Prelude facility. According to Shell:

\textit{in the unlikely event of an incident, the safety gaps would reduce the risk of escalation by:}

- physically separating the equipment
- improving the dispersion of any leaked gas through free air circulation, reducing the size of any potential gas cloud caused by such an incident
- in the unlikely case of a gas cloud igniting, reducing flame acceleration along the entire length of the process area, hence decreasing the overpressure levels.\footnote{Submission No. 9 from Shell in Australia, 11 August 2014, p 4.

493}

As noted in the Committee’s 2014 report, concerns have been raised as to whether and how the layout of the facility will function to ensure the safety of those who will work on board. The WA Branch Secretary of the Australian Workers’ Union (AWU), Mr Stephen Price, explained that the AWU has:

\textit{concerns over [the facility’s] structural design, considering we have taken what normally would consume a fairly large footprint on terra firma and sort of compacted it into this extremely large floating facility; but where we normally have the benefit of space to provide...}
added protection within an onshore facility, that ability has been removed when we look at floating technology.\(^{494}\)

Similarly, the WA State Secretary of the Australian Manufacturing Workers’ Union (AMWU), Mr Steven McCartney explained to the Committee that his worry:

about this whole project is that when I go to Woodside, there is a clear defined area that is the bomb-proof zone and everyone knows that you have to evacuate to the bomb-proof zone if there is an explosion. Inside Woodside’s safety case there is a set up for tragedy and how people who can evacuate the area in time will evacuate before it goes bang. One concern is: where is that point on [Prelude]?

 [...] 

Our point is—it always has been and always will be—where are the safe zones on that boat?\(^{495}\)

Mr McCartney also expressed concern that because the Prelude facility will be ‘processing the gas and the gas is already on board ... every line on [the] vessel is full of gas and is a potential problem and a potential hazard’.\(^{496}\) Putting this concern into context, Mr McCartney further explained that even though the facility ‘is apparently designed to take the ebb and thrust’ of the conditions it will operate in, ‘there is nowhere to run and nowhere to evacuate to and no ability to evacuate’.\(^{497}\) Therefore, according to Mr McCartney:

our question is: will they shut down the facility and fly everyone off because of a cyclone? I do not think that they will. I think they will try to build a safety case that includes a skeleton staff et cetera. If they say that they will have a skeleton crew, those are the people, I think, who they are prepared to risk. I have not seen a safety case anywhere that has them anywhere else but on that vessel in a catastrophe and in trouble.\(^{498}\)

Issues relating to remaining manned or de-manning during cyclones are discussed further in Chapter 7.

\(^{494}\) Mr Stephen Price, Branch Secretary (Western Australia), Australian Workers’ Union, Transcript of Evidence, 10 November 2014, pp 1–2.

\(^{495}\) Mr Steven McCartney, State Secretary (Western Australia), Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 4 and p 10.

\(^{496}\) ibid.

\(^{497}\) ibid.

\(^{498}\) ibid.
Shell also submitted that all of the safety critical elements on the Prelude deck have been designed with multiple redundancies. As Shell explained, ‘full length escape routes that lead to temporary refuges’ run along each side of the vessel, while ‘the central alley on the process deck level between the port and starboard side modules provides another escape way’.\(^{499}\) As a result, multiple different routes for navigating the deck are possible so that in an emergency situation moving between areas should not be constrained by a particular hazard.

Finally, in the event of a hazardous incident, the living quarters ‘double up as the temporary refuge’.\(^{500}\) Furthermore, the living quarters, which are separated from all processing equipment by a fire- and blast-proof wall, have ‘direct access to all means of evacuation—via helicopter, freefall lifeboats (located aft) and integrated chute-based life rafts’.\(^ {501}\) Emergency planning and response procedures and infrastructure are also further considered in Chapter 7.

A further concern raised by the AMWU related to the remote location of the Browse basin, and the difficulties sometimes experienced by workers who spend weeks at a time working in such locations. Mr Glenn McLaren, an AMWU Official, explained to the Committee that one of the issues experienced by workers on existing offshore facilities ‘is communication or lack thereof’.\(^ {502}\) Mr McLaren noted the importance of telephones and the internet to offshore workers. Not only does it allow them to communicate with family and friends, it is relied upon for activities such as banking or paying bills.

Mr McLaren described the difficulties of operating outside of telecommunication range as follows:

\[
\text{There is a delay in the communication. Obviously, when you are doing internet banking, it times out because of the technological delay. The problem we also find is trying to ring the family, given that workers work a 12-hour shift; for example, the normal pattern is from 11.00 am to 11.00 pm and 11.00 pm to 11.00 am. We have peak times of communication when the workers are trying to get on to a computer or ring their loved ones and kids.}\(^ {503}\)
\]

The outcome of this is congestion, with some negative consequences for workers. Mr McLaren provided the following example of a situation that arises when workers are not able to communicate with home:

\(^{499}\) Submission No. 9 from Shell in Australia, 11 August 2014, p 4.
\(^{500}\) ibid.
\(^{501}\) ibid
\(^{503}\) ibid.
Chapter 5

‘The phone dropped out. I was halfway through a conversation with my wife and trying to resolve an issue that’s been brewing for a while and the phone drops out. I can’t resolve it until the following day.’ That causes anxiety for our members offshore. 504

In Mr McLaren’s view, ‘the companies are not investing heavily enough on the ability to communicate with home and that then causes its own inherent problems’. 505

The concerns expressed by Mr McLaren are undoubtedly significant. In May 2014 Shell and INPEX jointly announced plans to construct a $100 million, 2,000 kilometre subsea fibre optic communications cable linking the Ichthys and Prelude facilities to Port Hedland and Darwin. This infrastructure aims to ensure that projects located in the Browse Basin off North West Australia have ‘access to high-speed data and voice communication services for the life of their operations’. 506 Furthermore, the system’s bandwidth is vast: with ‘an initial design capacity of 80x40 Gbps’, it will also have ‘the potential to scale well beyond that as technology matures’. 507

Offloading at sea

A major challenge associated with FLNG technology is the need to transfer cryogenic material between two floating vessels. While LNG is ordinarily offloaded from a wharf to a ship, or vice versa, safely transferring cryogenic material between two floating vessels is a different matter entirely.

Transferring LNG at sea is a critical area of safety, particularly as LNG is not conventionally processed and transferred at sea, and this transfer occurs in a dynamic environment. This situation is recognised by both Shell and Woodside, as their discussion of the design of the loading arm for an FLNG facility demonstrates.

Acknowledging that weather is a critical concern for offloading safety, Mr Gerald Dixon, Woodside’s HSSE Manager Prelude, discussed the strict weather policies in place in relation to the use of ISVs to bring the LNG tanker to the FLNG facility. Mr Dixon stated:

we have strict marine adverse weather policies for operation, and there is also the additional guide wire, which ensures that when the

505 ibid.
507 ibid. Gbps refers to gigabits per second.
loading arms do go across to the manifold, which is an industry-proven technology, it will latch on to that loading point.  

Similarly, in relation to ‘offloading and bringing another vessel alongside [an FLNG facility] and in the planning and weather forecasting’ for this activity, Woodside’s Senior Vice President, Sustainability and Technology, Mr Shaun Gregory, stated ‘offloading is something we do almost every day, but side by side with a vessel is something we are spending a lot of time planning, both in design and in procedures and hazard management’.  

To address this challenge, Prelude has been designed to offload LNG (and LPG) into a carrier docked alongside the facility via a ‘double-counterweight loading arm that can extend down as far as 10m to reach the LNG or LPG carriers’. According to Shell:

this means the arm can adjust and cope with movement from both the facility and carrier during offloading. A new coupling design allows for the arms and carrier to connect safely despite the movement.

During loading, three 6,700-horsepower, azimuth thrusters will be used to help limit the motion of the Prelude facility and maintain a constant fixed position. Notwithstanding this aspect of the loading arm design, Shell submitted that the design is ‘an otherwise conventional loading arm design which has been proven on LNG operations for decades’.

During a hearing, Shell’s General Manager for Health, Safety, Security and Environment, Mr Andrew Doherty, reiterated that the loading arm technology on Prelude would be ‘similar technology to any loading arm’, but acknowledged that ‘the dynamic relationship’ between the facility and a loading LNG carrier had required careful design and testing. Mr Doherty explained that the loading arm had been:

designed and tested ... using liquid nitrogen [which, at -196° Celsius, is colder than LNG] to give us assurance that indeed that loading arm will operate safely.

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508 Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, pp 10–11.
509 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside, Transcript of Evidence, 7 November 2014, p 4.
510 Submission No. 9 from Shell in Australia, 11 August 2014, p 4.
511 ibid, p 4.
512 An azimuth thruster is a configuration of marine propellers placed in pods that can be rotated through 360 degrees horizontally, making a rudder unnecessary.
513 Submission No. 9 from Shell in Australia, 11 August 2014, p 4.
514 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 11.
Chapter 5

5.57 Mr Dixon added that the facility’s ‘adverse weather policy’ was a critical element in ensuring safe LNG transfer. According to Mr Dixon, the offloading operation will be subject to:

strict weather criteria and the use of the [infield support vessels] to bring in the LNG tanker and then it is fixed, obviously, with the mooring lines to the facility ... if the weather conditions are adverse—wind, tide, sea state—then that LNG tanker will not come alongside the facility.515

5.58 As with all of the facility’s various elements, the decision to configure Prelude for side-by-side LNG transfer was based upon the prevailing metocean conditions. This was emphasised by the Vice President of LNG at ExxonMobil, Mr Luke Musgrave, when he explained that plans for an FLNG facility to develop the Scarborough gas field in the Carnarvon Basin would require a different offloading procedure. According to Mr Musgrove, LNG carriers loading from a Scarborough FLNG would ‘not be taking a load from the side’, but would instead ‘tandem off-load’.516 As Mr Musgrove explained:

in a comparison between the systems that Shell are deploying at Prelude and what [ExxonMobil] would deploy in the outer Carnarvon basin for Scarborough, it is determined by the ocean conditions. Because the prevailing sea states are a little rougher in the outer Carnarvon [basin], the side-by-side loading and off-loading is not the most safe, so the tandem loading is by far a preferable configuration.517

5.59 Mr Musgrave’s evidence demonstrates that the design of any safety feature on an offshore petroleum facility is based not only upon the function it is to perform, but also upon the circumstances in which it is to operate. In Prelude, Shell has designed not only the world’s first ever FLNG facility, but also one of the first facilities to be installed in

515 Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, p 11.
516 Mr Luke Musgrave, Vice President, LNG, ExxonMobil, Transcript of Evidence, 10 November 2014, p 5. The transfer at sea of conventional liquid hydrocarbons such as crude oil and condensate is ordinarily done through a floating hose loading system, a method that allows considerable distance to be kept between an FPSO and a petroleum carrier during loading. Because LNG is a cryogenic substance, there is presently no suitable floating hose technology that could be used to offload LNG at a reasonable rate of transfer. As such the Prelude facility has been designed to offload LNG via a rigid arm, which is necessarily much shorter than a floating hose. Shell’s design for the Prelude facility will see LNG carriers dock immediately alongside for the purpose of loading. By contrast, tandem offloading, as envisaged by ExxonMobil, would see an LNG carrier docking to an FLNG facility in a bow-to-stern configuration.
517 Mr Luke Musgrave, Vice President, LNG, ExxonMobil, Transcript of Evidence, 10 November 2014, p 6.
the Browse basin. Furthermore, Woodside’s BOD for its Browse Basin fields is progressing on the basis of using Shell’s Prelude design.

5.60 Each of the various safety features on the Prelude facility will, of course, be described in significant detail in the safety case and environmental plan that Shell must prepare and submit for approval by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) before the facility can begin operations in Australia.

5.61 As previously stated, in their submissions to NOPSEMA, Shell will be required to provide evidence of the efforts they have taken, or will take, to reduce operational risk to the ALARP standard. These submissions will then be assessed and, if approval is granted and Prelude begins operations, NOPSEMA will subsequently begin monitoring and inspecting facility as per its policies. Under these circumstances, it is reasonable to expect that further improvements to safety will be made over time and the Prelude safety case will be amended accordingly.

Finding 31

FLNG project proponents have used a safety in design process to develop design solutions that reduce the risk levels to as low as reasonably practicable.

Finding 32

The design of any safety feature of an FLNG facility must consider both the facility’s function and its particular operating environment.
Chapter 6

Environmental management regulation

Ensuring environmental safety

6.1 Environmental management is a critical element of all Australian offshore petroleum industry activities. In an overview of offshore petroleum legislation, the Department of Industry explained that the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (OPGGS Act) and Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) function to ensure that petroleum companies operating in Australia are required ‘to conduct their activities in a manner that ensures a high standard of environmental protection’. 518

6.2 The OPGGS and EPBC Acts, in conjunction with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGSE Regulations), stipulate certain requirements for petroleum industry environmental management practices as well as the penalties that may apply if these requirements are breached. By and large, however, the environmental safety regulatory regime in Australia is objective-based, with industry being relied upon to set its own environmental objectives and then held to account against these commitments. In a broad sense, the aim of this regulatory regime is to ensure that offshore petroleum industry activities in Australia are carried out in an ecologically sustainable manner, and in a manner by which the associated environmental impacts and risks are reduced to a level that is as low as reasonably practicable (ALARP) and acceptable. 519

6.3 The regulation of environmental management practices in Australia’s offshore petroleum industry is therefore very similar to the regulation of safety standards. In both cases, proponents of offshore operations are required to convince and continually demonstrate to the regulator that the risks and impacts associated with their operations have been reduced to the ALARP standard. For the purposes of safety, this involves receiving regulator approval for a submitted ‘Safety Case’, a process that is described in Chapter 4. For the purposes of environmental safety, a proponent must receive regulator approval for their submitted ‘Offshore Project Proposal’ and associated ‘Environment Plans’ before they can commence any offshore activity. This

Chapter 6

Chapter provides an overview of the Offshore Project Proposal and Environment Plan requirements and outlines the assessment process that is followed for each. This overview is then given context via a detailed examination of a summary of Shell’s Environment Plan for the installation of subsea infrastructure for the Prelude FLNG project. This Environment Plan received regulator approval in November 2014.

6.4 As ‘the sole designated assessor for environmental management of offshore petroleum activities in Commonwealth waters’, it is the role of the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) to ensure that the petroleum industry operates in compliance with Australia’s statutory environmental requirements. NOPSEMA’s primary duty in this regard is to assess and ensure compliance by industry operators with their submitted Offshore Project Proposals and Environment Plans.

Finding 33

Offshore petroleum facilities, including FLNG facilities, cannot operate in Australian waters without an Offshore Project Proposal, together with all associated Environment Plans, first being accepted by the National Offshore Petroleum Safety and Environmental Management Authority.

Offshore Project Proposals

6.5 Producing petroleum resources from a discovered offshore reserve requires the construction and installation of various pieces of infrastructure such as subsea wells and pipelines, and offshore production and storage facilities. Though the specific infrastructure will vary according to field composition, for the purposes of the OPGGSE Regulations, a proponent’s activities to develop a specific resource are grouped together under the description of an ‘offshore project’. Specifically, the OPGGSE Regulations define an offshore project to mean:

one or more activities that are undertaken for the purpose of the recovery of petroleum, other than on an appraisal basis, including any conveyance of recovered petroleum by pipeline (whether or not the activity is undertaken for other purposes).

6.6 Before any such offshore project can commence, OPGGSE r 5A requires the proponent to submit an Offshore Project Proposal to NOPSEMA for ‘assessment on a “whole-of-lifecycle” basis’. An Offshore Project Proposal essentially provides an overview of all


522 National Offshore Petroleum Safety and Environmental Management Authority, Streamlining environmental regulation of petroleum activities in Commonwealth Waters, 28 February 2014,
of the various activities that will be undertaken in the development of a specific (discovered) petroleum resource, from drilling and establishing wells, to installing pipelines and commissioning production platforms. A proposal must include details of the project, describe the associated environmental impacts and risks, set out the environmental performance outcomes for the project, and include a description of ‘any feasible alternative’.  

6.7 Once it is in receipt of an Offshore Project Proposal, NOPSEMA must first determine whether the proposal appropriately identifies and evaluates the environmental impacts and risks of the project, while also setting out environmental performance outcomes that are relevant and consistent with the principles of ecologically sustainable development. If a received Offshore Project Proposal satisfies these criteria it will be deemed ‘suitable for publication’ and published on NOPSEMA’s website for a mandatory period of public comment.  

At the end of the period of public comment, the proponent is required to resubmit the Offshore Project Proposal, along with a summary of all comments received, an assessment of the merits of these comments, and a statement of response to each claim, ‘including a demonstration of any changes, if any, that have been made to the proposal as a result’. NOPSEMA will then ultimately determine whether to accept the Offshore Project Proposal, with acceptance granting the proponent permission to begin submitting Environment Plans for each of the individual activities it wishes to undertake in relation to the overall proposal.

Environment Plans

6.8 Before any proposed petroleum activity—including exploration—can commence in Commonwealth waters, NOPSEMA must have considered and accepted the associated Environment Plan. A ‘petroleum activity’ is defined in the OPGGSE Regulations as ‘operations or works carried out in an offshore area,’ either pursuant to a right that has been granted or in satisfaction of an obligation that has been imposed. An Environment Plan is a detailed submission that demonstrates how the environmental impacts and risks associated with some proposed petroleum activity will be reduced to an ALARP and acceptable level.

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Basic content requirements for any Environment Plan are detailed at Division 2.3 of the OPGGSE Regulations. These include detailed descriptions of the activity to be undertaken and the environment in which it will occur, an evaluation of the environmental risks and impacts associated with the proposed activity and a thorough environmental management implementation strategy. After ensuring that these details are in order, NOPSEMA begins the process of considering an Environment Plan by applying the criteria for acceptance, which are specified by OPGGSE r 10A. In order to be accepted by NOPSEMA, the OPGGSE Regulations require that an Environment Plan:

(a) *is appropriate for the nature and scale of the activity; and*

(b) *demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable; and*

(c) *demonstrates that the environmental impacts and risks of the activity will be of an acceptable level; and*

(d) *provides for appropriate environmental performance outcomes, environmental performance standards and measurement criteria; and*

(e) *includes an appropriate implementation strategy and monitoring, recording and reporting arrangements; and*

(f) *does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any part of a declared World Heritage property within the meaning of the EPBC Act.*

Regulation 10A also requires the proponent to undertake consultations with any stakeholders 'whose functions, interests or activities may be affected by the activities to be carried out'. To this end, an Environment Plan must include a report on all consultations undertaken, including an assessment of the merits of any objection or claim and the proponent’s responses, while also demonstrating that appropriate arrangements have been made for ongoing stakeholder consultation.

After completing this general assessment of the submitted Environment Plan, NOPSEMA will then closely examine the ‘key topic areas’ associated with the proposed

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529 ibid.
activity.\footnote{National Offshore Petroleum Safety and Environmental Management Authority, \textit{Environmental assessment}, December 2014, p 3. Available at: http://www.nopsema.gov.au/assets/Policies/N-04750-PL1347-Environment-Assessment-Policy.pdf. Accessed on 4 February 2015.} NOPSEMA explains that key topic areas are ‘components of the project or activity that pose the greatest levels of environmental impact or risk’, with the scope of this secondary assessment process taking into account various factors including ‘levels of risk, uncertainty, use of innovative technology, and the timing and geographical location of the activities proposed’.\footnote{Ibid.}

6.12 An important aspect of these key topic areas is the requirement that proponents specifically consider the impact on and risk to ‘matters of National Environmental Significance’, as defined within the EPBC Act.\footnote{Australian Government, Department of Industry, Geoscience Australia, \textit{Offshore Petroleum Exploration Acreage Release—Australia 2014—General and Special Notices}, p 4. Available at: http://www.petroleum-acreage.gov.au/2014. Accessed on 2 February 2015.} Specific information on matters of National Environmental Significance, which relate to such things of endangered and vulnerable species and World and National Heritage areas, is contained in a publicly accessible database maintained by the Department of Environment. The Commonwealth Government explains that proponents are ‘encouraged to consult this database [and] consider the range of impacts and risks to matters of National Environmental Significance’ associated with their proposed activities.\footnote{Ibid.} In providing general advice regarding the regulation of petroleum activities in Australia, the Department of Industry makes it clear that any activities proposed to occur in:

\begin{quote}
areas of important ecological and heritage value ... will be subject to a high level of environmental scrutiny, and further assessment and an EPBC ACT approval may be required.\footnote{Ibid, p 5.}
\end{quote}

6.13 Another important required component of every Environment Plan is an Oil Pollution Emergency Plan (OPEP). Where an Environment Plan is mostly preventative in scope, an OPEP is a contingency plan that describes what steps will be taken in the event of actual environmental damage occurring. In order to ensure that the proponent is adequately prepared to respond to an oil spill, an OPEP ‘must include adequate arrangements for responding to and monitoring oil pollution’, including:

\begin{quote}
\ \begin{enumerate}
\item \textit{(a) the control measures necessary for timely response to an emergency that results or may result in oil pollution;}
\item \textit{(b) the arrangements and capability that will be in place, for the duration of the activity, to ensure timely implementation of the control measures, including arrangements for ongoing maintenance of response capability;}
\end{enumerate}
\end{quote}
Chapter 6

(c) the arrangements and capability that will be in place for monitoring the effectiveness of the control measures and ensuring that the environmental performance standards for the control measures are met; [and]

(d) the arrangements and capability in place for monitoring oil pollution to inform response activities.\(^\text{535}\)

6.14 In addition, the OPGGS Act requires the proponent to demonstrate that has sufficient financial capacity to meet not only the costs but also the potential liabilities associated with undertaking the proposed activity.\(^\text{536}\)

Finding 34
An Environment Plan for a proposed offshore petroleum activity must include:

- a detailed description of the activity to be undertaken and the environment in which it will occur;
- an evaluation of the environmental risks and impacts associated with the activity;
- a thorough environmental management implementation strategy;
- an Oil Pollution Emergency Plan; and
- a demonstration of the proponent’s financial capacity to meet the costs and potential liabilities of the proposed activity.

Finding 35
An Oil Pollution Emergency Plan must describe the steps that will be taken in the event of an oil spill, including the control measures in place, response capacity and capability, and arrangement for monitoring the effectiveness of control measures.

Assessment

6.15 When it receives a proponent’s Environment Plan, NOPSEMA will assess and decide whether or not to ‘accept’ it.\(^\text{537}\) Under the provisions of OPGGSE r 10, NOPSEMA is duty bound to notify the proponent of its decision within 30 days, though the Environment Regulations also allow for an extension to this timeframe for various reasons (such as if the submission is unusually complex or if some details need to be clarified). In the


\(^{537}\) ibid.
event that NOPSEMA does not accept a submitted Environment Plan in the first instance, the proponent will be advised and given an opportunity to modify and resubmit the plan. If NOPSEMA remains unsatisfied with a resubmitted plan, it will ‘refuse to accept’ the plan.\(^{538}\) NOPSEMA advises that it will refuse to accept any Environment Plan:

*that does not contain appropriate environmental performance outcomes, environmental performance standards and measurement criteria to demonstrate that the environmental impacts and risks of the activity will be managed to as low as reasonably practicable and to acceptable levels.*\(^{539}\)

6.16 OPGGSE r 6 makes it an offence of ‘strict liability’ to commence a proposed petroleum activity without NOPSEMA first having accepted the associated Environment Plan.\(^{540}\) This means that should an operator commence an activity without an Environment Plan, there is no need to prove that this was done intentionally, knowingly, recklessly or even negligently.\(^{541}\)

6.17 NOPSEMA has also published a table of general advice for proponents, detailing matters that must be considered in the process of drafting an Environment Plan. NOPSEMA’s advice is summarised in Table 6.1 below.

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Table 6.1: NOPSEMA Environment Plan advice

<table>
<thead>
<tr>
<th>Matter protected</th>
<th>NOPSEMA prohibitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Heritage properties</td>
<td>NOPSEMA will not accept an Environment Plan that involves any activity, other than arrangements for environmental monitoring or emergency response, being conducted in any part of a declared World Heritage property (as defined by the EPBC Act). NOPSEMA will not accept an Environment Plan that proposes activities that would contravene a plan of management for a World Heritage property or proposes unacceptable impacts to the world heritage values of a World Heritage property.</td>
</tr>
<tr>
<td>National heritage values of declared National Heritage places</td>
<td>NOPSEMA will not accept an Environment Plan that proposes activities that will contravene a plan of management for a National Heritage place or proposes unacceptable impacts to the National heritage values of a National Heritage place.</td>
</tr>
<tr>
<td>Wetlands of international importance</td>
<td>NOPSEMA will not accept an Environment Plan that proposes activities that will contravene a plan of management for a Ramsar wetland or proposes unacceptable impacts to the ecological character of a Ramsar wetland.</td>
</tr>
<tr>
<td>Listed threatened species and ecological communities</td>
<td>NOPSEMA will not accept an Environment Plan that proposes activities that will result in unacceptable impacts to, or is inconsistent with a recovery plan or threat abatement plan for, a listed threatened species or ecological community.</td>
</tr>
<tr>
<td>Listed migratory species</td>
<td>NOPSEMA will not accept an Environment Plan that proposes activities that will result in unacceptable impacts to a migratory species or an area of important habitat for a migratory species.</td>
</tr>
<tr>
<td>Commonwealth marine environment</td>
<td>NOPSEMA will not accept an Environment Plan that proposes activities that will result in unacceptable impacts to the environment of a Commonwealth marine area.</td>
</tr>
</tbody>
</table>


543 The Convention on Wetlands of International Importance was signed in Ramsar, Iran in 1971.
A final important aspect of all Environment Plans is the requirement for the proponent to submit a summary of an accepted plan to NOPSEMA within 10 days after receiving notice of acceptance. NOPSEMA then publishes the summary on its website. The purpose of this requirement, made under OPGGSE r 11(3), is to:

*inform the public about petroleum activities being conducted in Commonwealth waters, to allow [proponents] to demonstrate that they are carrying out their activities in a manner consistent with the principles of ecologically sustainable development and to demonstrate that environmental impacts and risks are being managed to acceptable levels and [are] as low as reasonably practicable.*

Proponents are not required to disclose the full content of their Environment Plans as these contain technical (and often proprietary) information, which is ‘communicated to NOPSEMA through a legislative process under the expectation the information will be kept confidential’. Nevertheless, proponents must ensure that their Environment Plan summaries contain sufficient information to:

- *inform the public of the petroleum activity;*
- *demonstrate how the potential environmental impacts and risks of the proposed activity have been identified;*
- *demonstrate how the titleholder is managing those environmental impacts and risks;*
- *demonstrate how the titleholder has consulted with relevant persons and detail the titleholders plans for ongoing consultation;*
- *demonstrate how the titleholder has considered and addressed any objections or claims raised by relevant persons;*
- *demonstrate that the titleholder has sufficient arrangements in place to respond to potential oil spill emergencies; and*
- *demonstrate that the titleholder is able to effectively monitor their environmental performance for the life of the activity.*

Details of the 283 Environment Plan submissions made to NOPSEMA are available on the regulator’s website. Of these, 256 have been approved, eight were withdrawn, one

545 ibid, p 2.
546 ibid, p 3.
was refused and a further 18 are presently under assessment.\textsuperscript{547} On 4 February 2015, summaries were available for 247 of the 256 Environment Plans that had been approved—four of which pertained to Shell’s \textit{Prelude} FLNG project.\textsuperscript{548}

### The \textit{Prelude} Project Subsea Installation Environment Plan Summary

6.21 Shell’s \textit{Prelude} project is scheduled to begin production in 2017. To achieve this goal, various drilling campaigns—each of which was conducted subsequent to the acceptance of an associated Environment Plan—have been conducted in the field. Furthermore, in November 2014 NOPSEMA accepted Shell’s Environment Plan in relation to the construction and installation of subsea infrastructure associated with the \textit{Prelude} project. As such, of the four Environment Plan summaries that have been provided by Shell and published on NOPSEMA’s website, three relate to drilling and one provides details of the installation of the \textit{Prelude} subsea infrastructure.\textsuperscript{549} As the most recent published Environment Plan summary, the ‘Prelude Subsea Installation Environment Plan Summary’ (the Summary), provides a useful example of the information that is made publicly available as a result of the Environment Plan summary requirement.

6.22 The Summary begins by describing the \textit{Prelude} project location and outlining the specific subsea infrastructure that will be installed, which includes:

- \textit{two production manifolds};
- \textit{one riser base manifold};
- \textit{four production flowlines};
- \textit{one subsea umbilical and associated subsea distribution hardware};
- \textit{jumpers, steel flying leads, umbilical termination assemblies};
- \textit{16 mooring lines and 16 piles}; and
- \textit{associated temporary equipment (initiation anchors and parking frames) necessary for the installation activities}.\textsuperscript{550}

\textsuperscript{548} ibid.
\textsuperscript{549} ibid.
The Summary then describes the activities that will be undertaken to install this infrastructure, explaining that ‘the installation campaign will commence in mid-2015 to mid-2016’ and will involve between one and six vessels operating in the project field to perform the installation activities.\(^\text{551}\) According to the Summary:

> upon arriving in the field, the installation vessel will set up a seabed survey array to accurately position the structures. The vessel will then install the facilities on the seabed guided by Remotely Operated Vehicles (ROVs). A post-installation visual ROV survey will also be done to record as-built and as-laid conditions of the installed facilities.

Following offshore installation of the subsea facilities, there shall be pre-commissioning work conducted by a pre-commissioning vessel. The pre-commissioning activities include strengthtesting of the flowlines after installation, and leak testing of the flowlines and connectors. The subsea facilities will be installed filled with primarily [ethylene glycol]/water mixture.

Piles installation and mooring system pre-lay will be carried out by a DP Heavy Lift Installation Vessel. The piles will be hammer-driven.

The subsea facilities will have a significant duration (for some equipment around 18 months) between equipment installation at site and hook-up to and start-up of the Prelude FLNG facility. In order to ensure that equipment is able to perform safely as intended during future operations, preservation activities are planned such as surveillance inspections and assessment through measurements. These preservation activities will typically comprise of general visual nonintrusive inspections using ROVs.\(^\text{552}\)

The Summary next provides descriptions of both the physical and biological profile of the environment in which the subsea installation activities will occur. According to the Summary, ‘there are no significant topographical features in the region of the Prelude project area’, with ‘the most sensitive seabed features in the broader Browse Basin [being] the coral reefs and islands ... the closest of [which] is located some 40 km south-southeast of the Prelude location’.\(^\text{553}\) Owing to this distance, the planned activities ‘are not expected to impact any of these features’.\(^\text{554}\) Insight into the metocean conditions of the area is also provided within the Summary.

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\(^\text{551}\) ibid, p 4.
\(^\text{552}\) ibid, pp 4–5.
\(^\text{553}\) ibid, p 5.
\(^\text{554}\) ibid.
6.25 In considering the impact on, and risk to, the biological environment, the Summary explains that while ‘the Environment Protection Biodiversity Conservation (EPBC) Protected Matters Database does not list any Threatened Ecological Communities occurring in the marine environment’, there are nine listed ‘Threatened Species’ that could potentially transverse the area.555 These species are identified as Humpback and Blue Whales, Flatback, Green, Leatherback, Hawksbill, Olive Ridley and Loggerhead Turtles, and Whale Sharks. The Summary explains, however, that the area of proposed operations ‘does not contain any recognised feeding, breeding or aggregation areas’ for any of these species.556

6.26 Consideration is also given in the Summary to the impact of the proposed activities on the socio-economic environment, because ‘the project area overlaps with a variety of commercial fishing management areas’.557 According to the Summary, although ‘commercial fishing is concentrated mostly in coastal waters and minimum fishing occurs within the vicinity of the permit area … should there be a spill resulting from a wellhead release, some fisheries may fall within the zone of potential impact’.558

6.27 Similarly, though the area of proposed operations ‘is not located in any Marine Protected Areas’, in the event of wellhead hydrocarbon release:

\[\text{a number of Marine Reserves lie within the zone of potential impact.}
\text{These include: Ashmore Reef, Cartier Island, Argo-Rowley Terrace,}
\text{Oceanic Shoals, Mermaid Reef, Eighty Mile Beach, Roebuck,}
\text{Montebello, Kimberley Commonwealth Marine Reserve areas and}
\text{parts of the Southern coastline of the Indonesian Archipelago and}
\text{Timor Island.}559\]

6.28 In light of these potential consequences, the Summary then outlines the risks associated with each planned and each unplanned event, with ‘[t]he level of risk [having] been determined by assessing risk likelihood and consequence using the Shell Risk Assessment Matrix’.560 In providing an overview of all potential hazards, the Summary contains a table of ten planned events and six unplanned hazards, the potential environmental impact associated with each and the mitigation measures that Shell will take to reduce these hazards to the ALARP standard. Three of the ‘unplanned’ hazards provide useful insight; and are reproduced at Table 6.2 below.

555 ibid, p 6.
556 ibid.
557 ibid, p 7.
558 ibid.
559 ibid.
560 ibid, pp 8–9.
<table>
<thead>
<tr>
<th>Hazard/Event</th>
<th>Potential Environmental Impact</th>
<th>Controls – Mitigation Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel spill during refuelling at sea</td>
<td>Potential loss of diesel or fuel to the marine environment causing localised and temporary acute toxic effects and direct physical smothering of marine organisms.</td>
<td>At sea refuelling will occur with strict adherence to refuelling procedures, reinforced hoses with dry break couplings and fail-safe fittings; Operation will commence in daylight under normal conditions; Favourable wind and sea conditions as determined by the Vessel Master; Fuel hoses changed annually and refuelling constantly observed by crew member in radio contact with Vessel Master. Shipboard Oil Pollution Emergency Plans. Regulator accepted Oil Pollution Emergency Plan. Oil Spill Modelling indicates surface spilt hydrocarbons from a refuelling incident have no probability of reaching environmental sensitivities at levels above thresholds that may impact sensitivities in the area.</td>
</tr>
<tr>
<td>Diesel spill resulting from a collision with another vessel</td>
<td>Potential acute/chronic toxic effects and direct physical smothering of marine organisms.</td>
<td>A ‘Notice to Mariners’ advising of the presence of the installation vessels will be issued through AMSA prior to the commencement of the activity. Ongoing communication with [the Australian Fisheries Management Authority] and other commercial mariners such that that presence of vessels is widely communicated. All vessels routes are pre-determined and risk assessed. Vessels equipped with suitable navigation systems. A support vessel will monitor for approaching vessels during the installation activities. Regulator accepted Oil Pollution Emergency Plan.</td>
</tr>
<tr>
<td>Hydrocarbon Release from Formation due to dropped object</td>
<td>Potential loss of gas and condensate to the marine environment causing acute/chronic toxic and physical effect on marine organisms and habitats.</td>
<td>Regulator accepted Installation Safety Case and installation program meeting Shell’s requirements: • Training; • Global Standards for Well Design Integrity; • Risk identification and mitigation through Safety Cases; and • Robust barriers to protect against release prevention. Rigorous lifting procedure has been developed by Shell and Technip to prevent the risk of dropped objects. A worst case scenario of hydrocarbon release from the wellhead may result in entrained and dissolved concentrations that are above thresholds that may impact sensitivities in the area. Regulator accepted Oil Pollution Emergency Plan outlines response activities to reduce the environmental impact and links to the worst-case scenario contingency plan.</td>
</tr>
</tbody>
</table>
The Summary concludes by providing an outline of Shell’s corporate policies on Health, Safety, Security and Environment (HSSE) and Social Performance (SP), explaining that ‘Shell has a program of audits that take place at pre-mobilisation and during the activities’, and if any new or increased risks are identified during such an audit:

an assessment of the risk will be undertaken. It the risk is determined to be significant new or significantly increased risk, the associated activities will not continue until acceptance of the management approach to the new/changed risks has been provided and accepted by NOPSEMA and the Department of Environment.\(^{562}\)

The Summary also reveals that Shell consulted with various key stakeholders in the course of preparing the Prelude subsea installation Environment Plan, including:

- Commonwealth government departments (Department of Industry, Department of Foreign Affairs and Trade, NOPSEMA, NOPTA, AMOSC, AIMS, AMSA);
- Western Australia government departments (Department of Mines and Petroleum, Department of Transport, Department of Parks and Wildlife, Department of Environment Regulation);
- Northern Territory government departments (Darwin Port Corporation, Department of Mines and Energy, Department of Business, Department of the Chief Minister);
- Industry bodies (APPEA, CME);
- Broome community stakeholders (Broome Chamber of Commerce, Djarindjin Aboriginal Corporation, Lombadina Council, Kimberley Marine Tourism Associations);
- Broome local government agencies (Shire of Broome, Broome Port Authority);
- Fishing industry associations (WAFIC, CommFish, AusTuna, RecFish, NT Seafood Council, Kimberley Professional Fishermans Association, Pearl Producers Association);

\(^{562}\) ibid, p 14.
• Individual commercial fishing licence holders (Southern Bluefin Tuna Fishery, Western Skipjack Tuna Fishery, Western Tuna and Billfish Fishery, North West Slope Trawlery, Northern Prawn Fishery, Northern Demersal Scalefish Fishery, Mackeral Managed Fishery, North Coast Shark Fishery, West Coast Deep Sea Fishery); and

• Environmental NGOs (Environs Kimberley, Save the Kimberley, WWF, Conservation Council). 563

6.31 Shell’s ‘summary of response strategies in the oil pollution emergency plan’ is included in the Summary as an appendix. 564 This second summary explains that the ‘Prelude Subsea Installation Oil Pollution Emergency Plan’, which was submitted to and accepted by NOPSEMA as a component of the original subsea installation Environment Plan, ‘sets out Shell and Contractor responsibilities and response actions in the unlikely event of an oil spill during these operations’. 565 The OPEP identifies Shell as the ‘Combat Agency’ for any spills emanating from Prelude subsea installation activities, and explains that, ‘in the unlikely event of an oil spill’ during these activities:

Shell has a number of formal arrangements in place to access external assistance if required. These include:

• Australian Marine Oil Spill Centre (AMOSC) resources;

• Australian Maritime Safety Authority (AMSA) has access to resources under the National Plan;

• Shell’s AMOSC managed shared Broome Stockpile;

• Mutual Aid arrangements (industry support from other participating petroleum companies);

• Oil Spill Response Ltd (OSRL); and

• Shell Global Response Support Network (GRSN). 566

6.32 The Summary outlines the procedure that will be followed in the event of an oil spill, explaining that:

Shell will immediately follow the vessel’s procedures to protect human life, equipment and reduce the risk of fire or explosion. This may
Chapter 6

involve cutting off supply to the spillage, containing spill on deck if safe to do so and implementing vessel’s Shipboard Oil Pollution Emergency Plan (SOPEP). NOPSEMA and other relevant authorities such as AMSA, Department of Fisheries, Department of Transport and Department of the Environment will be notified, if required.567

6.33 The Summary also provides an overview of the strategies and procedures that will be followed to contain and reduce the impact of any such spill.

6.34 In satisfying the requirements of OPGGSE r 11(3), the Summary provides basic details of the measures that Shell will take to ensure that risk to, and impact upon, the environment as a consequence of installing the subsea infrastructure for the Prelude project will be reduced to the ALARP level.

6.35 Rather than being a document that is subjected to scrutiny, it must be remembered that the Summary is intended to simply demonstrate that the proponent—in this case Shell—understands the full range of risks to, and impacts upon, the environment that is associated with the subsea installation campaign. Ultimately for NOPSEMA to have accepted the Environment Plan from which the Summary originated, Shell must have demonstrated not only that they were aware of these risks and impacts, but that they have devised and will implement appropriate strategies and procedures in response.

6.36 Furthermore, it should also be recalled that after an Environment Plan has been assessed and accepted, NOPSEMA will continually monitor the proponent’s performance of their environmental commitments, through a regime of periodic inspections.

Finding 36

Under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth), the National Offshore Petroleum Safety and Environmental Management Authority is required to assess and, if appropriate, accept a project proponent’s Environment Plan. For an Environment Plan to be accepted the proponent must demonstrate both an awareness of risks and potential environmental impacts, and that appropriate strategies and procedures will be implemented in the event of a loss of containment.

567 ibid.
Chapter 7

Emergency response management

Introduction

7.1 According to proponents of FLNG technology, ‘FLNG facilities do not include any type or magnitude of hazards substantially different from those already in existence in Australia when considering: offshore subsea developments, offshore oil and gas treatment facilities, floating production and storage and offshore (sic) (FPSOs), floating storage offshore (FSOs) and LNG Carriers’. 568 ConocoPhillips’ Mr Mark Leigh stated that ‘there is no technical reason why you cannot make FLNG safer than any other hydrocarbon business. It is fundamentally no different. [...] I do not think there is anything specifically magic and different about it. It has to be addressed on its merits’. 569

7.2 History has shown, though, that not only do offshore platforms, drilling rigs and support infrastructure experience relatively minor incidents, there have been a number of major catastrophic events in the offshore petroleum industry. Some of these were outlined in Chapter 1 of this report. Furthermore, while some see FLNG technology as an evolution of existing technologies (such as FPSOs) and others see it as revolutionary, regardless of whether it is evolutionary or revolutionary, FLNG technology is different, and the largest FLNG facility in the world will soon be moored off the Western Australian coast.

7.3 While, as Mr Andrew Woodhams of the Australian Petroleum Production and Exploration Association (APPEA) stated, ‘major accident events are relatively rare’, 570 as Chapter 1 has shown, when major accidents or events do happen, they often have serious and, sometimes fatal, consequences for those who work on or near them, as well as major environmental impacts. As Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport advised, ‘these types of incidents occur rarely,
Chapter 7

but when they do they are really big.\textsuperscript{571} Whether FLNG facilities prove to have a better safety and environment record than other types of operations is yet to be proven.

7.4 This report, to this point, has summarised the federal regulatory regime for Australia’s offshore petroleum industry. Under this objective-based regime, the industry is responsible for the safety of its operations and workforce, and the environment in which it operates. As stated throughout this report, project proponents must demonstrate via their safety cases and environment plans that risks associated with FLNG facilities have been reduced to levels that are as low as reasonably practicable (ALARP). The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), as regulator, provides oversight in the form of assessing safety cases and environment plans, monitoring the implementation of controls and systems, and conducting inspections. This regime will apply to most, if not all, FLNG facilities off the Western Australian coast as they most likely will be anchored in Commonwealth waters.

7.5 Chapters 8, 9 and 10 outline industry approaches to a number of specific hazards that are particularly relevant to FLNG facilities. These particular hazards are a function of two main facts. First, Shell and Woodside have indicated that their FLNG facilities will not de-man during severe weather events such as tropical cyclones and, second, FLNG facilities will be producing and offloading LNG at sea, rather than piping gas to shore for processing.

Finding 37
The focus of the offshore petroleum industry’s emergency response management on major accident events reflects the reality that, while major accidents are relatively rare, their impact is often very serious, with the potential for fatalities to occur.

Finding 38
The offshore petroleum industry considers that there is no technical reason why FLNG technology cannot be made safer than other hydrocarbon operations. Whether FLNG facilities are safer and environmentally less risky than other offshore operations is yet to be proven.

Emergency management: No different from other operations?

7.6 As Chapters 4 and 6 explained, the operator is responsible for providing NOPSEMA with a safety case and an environment plan. Not only do these documents show how hazards are identified and major emergency events will be prevented, they must detail the operator’s planned response to any accident or emergency situation. That is, the

\textsuperscript{571} Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, \textit{Transcript of Evidence}, 19 November 2014, p 5.
safety case must contain an emergency response plan which also clearly shows that resources are available to implement that plan.

7.7 In particular, the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) (OPGGS Act) imposes duties on operators of FLNG facilities in relation to ‘Firefighting, helicopter, search and rescue, medical facilities, to the extent that they relate to the health and safety of personnel at a facility’.572 The Offshore Petroleum and Greenhouse Gas Storage (Safety ) Regulations 2009 (Cth) (OPGGSS Regulations) ‘require that the SC [safety case] for a facility must contain a detailed description of an “evacuation, escape and rescue analysis” [EE RA], and a “fire and explosion risk analysis” [FERA] both of which form part of the formal safety assessment for a facility’.573 Further detail on EERAs and FERAs is provided below.

7.8 Proponents of FLNG technology have advised that their incident response processes for FLNG facilities will be the same as for other facilities they operate. For example, Woodside has stated that in the event of an emergency, it ‘will adopt the same processes and systems to manage emergency response and incident management efforts as currently applied across all of our existing facilities and assets in Australia and across the globe’.574 According to Woodside’s Mr Shaun Gregory, the company has:

> a corporate-wide approach, so it actually scales and works no matter what, whether it is a kidnapping event, a lost traveller event, an oil spill event or a cyclone event. It triggers the exact same emergency structure. It saves the crisis management team having to learn different systems; it is the same.575

7.9 GDF SUEZ Bonaparte submitted that when considering FLNG technology to develop the Bonaparte fields it ‘identified the requirements for emergency response and the evacuation of personnel for the range of potential emergency scenarios, from small scale medical events, through to large scale evacuations due to major accident events’.576 From this it determined that ‘the management of personnel following evacuation from the facility and their recovery, and the subsequent medical response and treatment, would have been in a manner consistent with the arrangements currently in place for exploration and production activities in the Commonwealth waters of the north-west and north of Australia’.577

573 ibid.
574 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 20.
575 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 6.
576 Submission No. 5 from GDF SUEZ Bonaparte Pty Ltd, 30 July 2014, p 5.
577 ibid.
Chapter 7

7.10 Similarly, Shell advised that its Prelude FLNG responses to scenarios such as man overboard, fire or a leak of hazardous material ‘will be no different to that of any other offshore installation operating in the region’.578

**Finding 39**

Proponents of FLNG facilities in Australian waters will employ the same emergency management and progressive response processes for FLNG facilities as those adopted for their other offshore installations in the region.

7.11 The Committee has also heard a number of concerns in relation to the emergency capacity and preparedness of operators of FLNG facilities. These relate largely to the remoteness of FLNG facility locations, the safe evacuation of the facility, the compact environment in which people will be working and the limited amount of knowledge in the public realm.

7.12 For example, the Maritime Union of Australia (MUA) stated that it has:

> grave concerns about the ability of a FLNG facility to respond to an emergency, as well as the ability of onshore emergency services to respond to an emergency, given the remote areas where FLNGs are proposed to be located. The waters off the remote Kimberley region are a difficult maritime environment to say the least and an area susceptible to cyclones. This is a major concern given that the safety of the workforce and the safe evacuation of the workforce is the key consideration in the event of a significant incident that could pose a risk to workers.579

7.13 For the MUA, ‘in an event of abandonment of an FLNG vessel, there are unanswered questions regarding the operation of lifeboats and other life flotation devices’.580

7.14 In relation to the compact working environment on an FLNG facility, the Australian Manufacturing Workers’ Union (AMWU) compared an FLNG facility layout with that of an onshore LNG facility where the production infrastructure is more ‘spread out’ along the ground, with ‘a start, a middle and an end’.581 The AMWU’s concern is that:

> FLNG is going to grab that whole process and turn it that way [vertical] so that everybody will be working on top of everyone. There will be a lot more issues around working above and below people than you will ever find in any other facility anywhere. Because the whole process will

578 Submission No. 25 from Shell in Australia, 19 December 2014, p 6.
580 ibid.
581 Mr Steven McCartney, State Secretary, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 7.
be done offshore, it will be acting very differently to an FPSO, because the FPSO, of course, only does the first process offshore. This is doing the whole process from go to woe offshore, so that means the freezing facility, the storage facility—all those things—are all together in one big package. As I said before, the other tension behind that is: where do you go when it goes wrong?582

7.15 The compression of processing facilities is clearly demonstrated in Figure 7.1 which compares the deck area of the Prelude facility (highlighted in orange) to the footprint of Woodside’s Pluto LNG facility on the Burrup Peninsula (highlighted in yellow). Although it must be appreciated that gas field composition is a critical determinant of the size of any natural gas processing facility, the Pluto and Prelude facilities are both single-train LNG facilities with annual production capacity of 4.3 million tonnes and 3.6 million tonnes of LNG respectively.

Figure 7.1: The Prelude facility deck area in the context of the Pluto LNG plant footprint.

7.16 In discussing evacuation procedures and capabilities, the MUA’s Mr Ian Bray stated that ‘there are questions that we [the MUA] do not have answers to’.583 For Mr Bray, ‘as things come on and it [the Prelude FLNG facility] is getting closer and you are starting to pick up the picture of the operation, the remoteness of the operation and some of the

582 ibid.
583 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 8.
Chapter 7

contingencies that should be considered, I think we are probably coming up with more questions than we are answers.\(^{584}\)

7.17 Mr Stephen Price, Branch Secretary of the Australian Workers’ Union (AWU) expressed similar concern, questioning whether the capacity exists to manage ‘any major incident on any of our hydrocarbon processing facilities’, particularly in the event of multiple incidents.\(^{585}\) Mr Price stated that:

> if BP blew up, we would struggle, and if something went wrong at KGP [the Karratha Gas Plant] for Woodside, the same thing. If we are talking a very large quantity, multiple incident–type occurrence, which when these things explode is exactly what happens, I think we would struggle anywhere out of Perth to be able to deal with that. That is one thing: should something happen, for example, we will need to go and find someone. But the second part to that is: once you do find someone, what happens after it? What is the flow-on? If there is a major occurrence, what happens? What do we do when we are talking a significant number of casualties?\(^{586}\)

7.18 Mr Andrew Woodhams, APPEA’s Director, Safety and Environment, gave support to such concerns in relation to major accident events, in stating that ‘recent major accident events tell us that we have not got process safety right. We are tending to track that with things like loss-of-containment events in the offshore space; that is not down to zero so we are not happy’.\(^{587}\)

7.19 However, in response to questions relating to Shell’s responsibility and capacity to deal with major accident events with multiple casualties, Mr Andrew Doherty, General Manager, HSSE, stated:

> I can only stress again clearly that our focus is on prevention and a multiple scenario and we are focusing on ensuring that we are preventing the likelihood of those events happening. What we are doing is making sure that the emergency response procedures we have in place are then looking at the scenarios, what we would anticipate, and making sure that we have provision for that, and that we can reliably secure the safe recovery and treatment of anyone who would

\(^{584}\) ibid.

\(^{585}\) Mr Stephen Price, Branch Secretary, Australian Workers’ Union, Transcript of Evidence, 10 November 2014, p 9.

\(^{586}\) ibid.

\(^{587}\) Mr Andrew Woodhams, Director, Safety and Environment, Australian Petroleum Production and Exploration Association Limited, Transcript of Evidence, 7 November 2014, p 10.
be injured. That is the practice that is in place right now on the drilling rig.  

Emergency response plans

Shell submitted that it is ‘committed to an ongoing state of emergency preparedness’ and has an:

emergency response framework designed to comply with standards and regulatory requirements relevant to Australian operations, which are also aligned to Shell’s global standards and based on sound emergency management principles and good industry practice. Shell Australia has a dedicated emergency response team, which is on standby 24/7 to react to any incidents as a result of our operations.  

Woodside stated that its emergency management arrangements ‘are focused around prevention, preparedness, response and recovery philosophy based on an “all hazards” approach’. According to Woodside, its emergency and crisis management framework ‘allows escalation of response as required by the event’, with priority in a crisis given to:

- **People** – the safety and security of our people;
- **Environment** – the preservation of the environment;
- **Asset** – protection of our assets;
- **Reputation** – the preservation and where possible enhancement of our reputation;
- **Livelihood** – protection of our licence to operate; and
- **Services** – maintain critical business functions.

APPEA recognises that ‘operators or titleholders are required to not only demonstrate their own ability to respond to low and medium consequence events, but how they will respond to high consequence events (MAE’s) no matter how low the probability’.

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589 Submission No. 9 from Shell in Australia, 9 August 2014, p 8.
590 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 16.
591 ibid.
592 Submission No. 11 from Australian Petroleum Production and Exploration Association Limited, 20 August 2014, p 21. Under the OPGGSE Regulations, the titleholder is responsible for preparing the Environment Plan and Oil Pollution Emergency Plan, while under the OPGGSS Regulations, the operator is responsible for the safety case. This report concerns the use of FLNG technology
Emergency events are generally classified into a hierarchy of levels or tiers, ‘with most emergency response frameworks structured around these tiers, such that moving from one level up to another will trigger additional resourcing cascading into the response’.  

7.23 For example, Woodside has ‘a three tiered approach to emergency management’, as shown in Table 7.1 below.

<table>
<thead>
<tr>
<th>Emergency management structure</th>
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</thead>
<tbody>
<tr>
<td>Response level</td>
</tr>
<tr>
<td>Level 3</td>
</tr>
<tr>
<td>Level 2</td>
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<tr>
<td>Level 1</td>
</tr>
</tbody>
</table>

7.24 Woodside submitted that this three-tiered structure ‘is aligned and consistent with the Western Australian State and Commonwealth Governments’ emergency management protocols, including response levels, resourcing and common definitions to incident levels. Operating facilities and assets develop site-specific emergency response plans to prepare for all identified risks’.  

7.25 Woodside’s Mr Shaun Gregory advised that a level one emergency is handled on the facility; a level two means the facility would require ‘help, whether it be from a corporate, from us in Perth, or from Karratha or Broome, or a government agency’; and level three describes a situation where that help is ‘going to be sustained’.  

7.26 As noted above, an operator’s demonstration of emergency preparedness requires an EERA and a FERA. The EERA:

- **Identifi[es] ... the types of emergencies and fires and explosions that could arise at the facility;**

- **Consider[s] ... a range of: primary and alternate escape routes, procedures for managing the escape and rescue, means of and equipment for evacuation, escape and rescue, amenities and**

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593 ibid.

594 Based on figure provided in: Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 16.

595 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 16.

means of emergency communication to be provided in a temporary refuge, life-saving equipment; and

- Identif[i]es ..., as a result of such considerations, of technical and other control measures necessary to reduce the risks associated with emergencies to a level that is as low as reasonably practicable.

7.27 The FERA:

- Identif[i]es ... the types of fires and explosions that could arise at the facility;

- Consider[s] ... a range of measures: for detecting, eliminating or reducing the risk arising from fires and explosions, incorporation into the facility of automatic and manual systems to detect, control and extinguish fires and leaks or escapes of petroleum, isolation and storing hazardous substances;

- Consider[s] ... the EERA, in so far as it relates to fires and explosions; and

- Identif[i]es ..., as a result of such considerations of technical and other control measures necessary to reduce the risks associated with fires and explosions to a level that is as low as reasonably practicable.

Finding 40
The Offshore Petroleum Greenhouse Gas Storage (Safety) Regulations 2009 (Cth) require a project proponent’s safety case to include an evacuation, escape and rescue analysis, and a fire and explosion risk analysis.

7.28 Shell has advised the Department of Mines and Petroleum (DMP) that the Prelude FLNG emergency response plan will deal with at least the following:

- hydrocarbon spills;

- chemical spills;

- damage to wells, pipes, flow lines and other subsurface, surface or suspended structures;

Chapter 7

- fires and explosions;
- security issues or terrorism;
- medical evacuation;
- extreme weather conditions; and
- traffic or transport accidents.  

7.29 Based on information provided by Shell, DMP advise that the company’s emergency response plan will meet the following requirements:

- it receives the approval of the relevant authorities;
- staff are trained in its activation and implementation;
- it is backed-up by the necessary resources, equipment ‘and facilities;
- it is known to external agencies that may be called upon to respond; and
- drills are conducted and evaluated.  

7.30 The following chapters discuss particular emergency situations and arrangements that are in place to manage them. They include discussion on what happens in a severe weather event, an accident or explosion, a person overboard and an oil spill. These chapters also include discussion of the cooperation between oil and gas operators, and the involvement of federal and state agencies in the event of an offshore emergency.
Chapter 8
What happens during a cyclone?

Severe weather events

8.1 Generally speaking, there are three main options for offshore petroleum vessels, rigs, platforms etc when a cyclone occurs. They can:

- move position to avoid the cyclone;
- reduce manning levels, maintaining only a minimum crew; or
- de-man or evacuate the facility, leaving no personnel on board.

8.2 Given that FLNG facilities will be permanently moored in position, moving to avoid a cyclone is not an option. In relation to the remaining options, as noted previously, Shell and Woodside have indicated that their FLNG facilities will not de-man in the event of a cyclone; rather personnel will stay on board the facility.

8.3 Before discussing this in detail, it is useful to examine the cyclone warning system in place and the meteorological information available to operators that allow them to make decisions about what action to take to manage a severe weather event.

Cyclone warnings

8.4 As noted in Chapter 2, FLNG facilities—along with their support vessels—will be moored in storm and cyclone prone waters. It is therefore essential that operators receive reliable, accurate and timely meteorological information.

8.5 In Australia, the Bureau of Meteorology (BoM) provides ‘regular forecasts, warnings, monitoring and advice spanning the Australian region and Antarctic territory’. According to the BoM:

*the single most important source of observations in relation to tropical cyclones is weather satellites. These observations provide systematic coverage of the remote ocean areas where tropical cyclones develop and from where other types of data are very sparse. Satellite observations are the primary means for tracking cyclones and*

Chapter 8

determining their intensity and structure. Satellite observations also provide key data for numerical weather prediction models. 602

8.6 This information is supplemented by on-site information generated through surface observing systems. This ‘then helps to confirm features of the tropical cyclone more accurately, such as the intensity and size, and wave heights’. 603

8.7 In relation to its marine and ocean information, which is available to petroleum operators in Australian waters, the BoM provides:

- A Long Range Tropical Cyclone Outlook describing the risk of tropical cyclone formation for the next three weeks (received every Tuesday)

- A facility specific (area specific) seven-day TC [tropical cyclone] outlook and a short range three-day TC outlook

- A daily weather forecast for each facility. 604

8.8 ConocoPhillips submitted that:

in addition to this, once a cyclone develops we receive a TC track map every day depicting range, bearing, speed, intensity and ETA [estimated time of arrival] of gales to our facilities. As the cyclone intensifies, the daily map becomes a six-hourly forecast and then three-hourly forecast. 605

8.9 Evidence to the Inquiry shows that industry is satisfied with the quality of information provided by the BoM. For example, INPEX, in noting that they ‘are tied into the cyclone warning centre’ and receive ‘four reports a day’, stated that they were ‘comfortable’ with the information being received and had ‘not heard any complaints about it’. 606 While acknowledging that ‘you can never predict exactly’ because cyclone weather systems are ‘unpredictable’, ExxonMobil advised that ‘the weather management and alert systems are very sophisticated’, and that they ‘engage early with the relevant experts around very early predictions around what types of activity’ to expect. 607

602 Submission No. 22 from Bureau of Meteorology, 11 December 2014, p 2. Note: Australia does not operate any weather satellites, but ‘is a member of the United Nations World Meteorological Organisation, which coordinates arrangements amongst satellite operating countries and other countries for sharing this important data’.

603 Submission No. 22 from Bureau of Meteorology, 11 December 2014, p 2.


605 ibid.

606 Mr William Townsend, General Manager, External Affairs and Joint Venture; and Mr Richard Wilson, Senior Industry Adviser, INPEX, Transcript of Evidence, 7 November 2014, p 12.

ConocoPhillips submitted that ‘the quality and timing of the BoM service is sufficient for demobilisation of non-core personnel’.  

The Australian Petroleum Production and Exploration Association Limited (APPEA) advised that its ‘members are satisfied with the current adequacy of weather alerts from the Bureau of Meteorology (BoM). Industry regularly engages with the BoM, particularly in the lead up to “cyclone season”’. APPEA also noted that, ‘as with any risk mitigating activity, continuous improvement is paramount as new technology and innovations in forecasting methods become available’.

Finding 41

Reliable, accurate and timely meteorological information is essential to the safe operations of all offshore petroleum facilities. This is especially the case for FLNG facilities which are necessarily permanently moored in position and unable to move position to avoid an extreme weather event.

Finding 42

Offshore petroleum operations in Australian waters receive meteorological information from the Australian Bureau of Meteorology and from other private expert services.

Finding 43

The offshore petroleum industry is satisfied with the quality of meteorological information it receives from the Bureau of Meteorology.

Cyclone avoidance for vessels

The Committee understands that the safest procedure in relation to cyclones is to avoid them. Standard operating procedure is to stay at sea, find the safest water possible and ride it out. Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia (MUA), explained that:

> generally, if it can be anticipated, the normal procedure of navigation would be to go around; and there are set criteria in terms of operational procedures for vessels, not only off the Western Australian coast, but the Australian coast, in terms of how to get around a cyclone in the safest possible way.

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608 Submission No. 19 from ConocoPhillips, 9 December 2014, p 2.
610 ibid.
611 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2011, p 2.
Chapter 8

8.12 According to Captain Victor Justice, Chief Executive Officer of the Kimberley Ports Authority, ‘primarily, what the vessels need to do is to move off into the safe quadrant of the cyclone ... which is probably about the nine o’clock to 12 o’clock section of the circle, if you think of your watch face’.612 Here, because cyclones in the southern hemisphere ‘curve around in a counter-clockwise direction’, if vessels move to this safe quadrant ‘that is the best thing that they can do because they ride it out at sea’.613

8.13 Not only is this the safest procedure, it is also ‘an efficient procedure because it allows vessels to get back into position fairly shortly after the cyclone has passed and operations can continue’.614

8.14 For vessels to be able to ride out a cyclone they need to have sufficient fuel supplies. This means that vessels need to come into port to ‘top up with fuel so they have enough fuel on board’.615 Captain Justice provided the operations of the port of Broome as an example of what happens when a cyclone is occurring:

_What we do at the port of Broome is we shut down the port late, because what we do is we take into account the fact that the vessels that are offshore, when they are finally released they have about a 20-hour passage to get into Broome—it is a lot longer to get into Darwin. For them to be able to remain at sea they do not know how long they are going to have to ride out the cyclone for, so we accept them in and we top them up with fuel._616

8.15 For FLNG facilities, this means that their field vessels would not remain on standby during extreme weather events such as cyclones as it would be too hazardous.617 Woodside confirmed that, ‘as with other offshore facilities, ... during adverse weather conditions ... field vessels will depart at pre-determined weather conditions’.618 Shell also advised that its _Prelude_ infield support vessels will ride the storm out and go wherever is best at sea.619

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612 Captain Victor Justice, Chief Executive Officer, Kimberley Ports Authority, Transcript of Evidence, 27 November 2014, p 2. Captain Justice explained that a cyclone is a circular phenomenon, ‘split like a vertical and a horizontal area that divides it up into four quadrants’.

613 ibid. See also: Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2011, p 2.

614 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2011, p 2.

615 Captain Victor Justice, Chief Executive Officer, Kimberley Ports Authority, Transcript of Evidence, 27 November 2014, p 4.

616 ibid, p 3. Captain Justice also noted that vessels with pipes stacked on deck cannot ride out a cyclone for safety reasons.

617 ibid, p 6.

618 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 19.

619 Mr Gerald Dixon, HSSE Manager, Prelude, Woodside Energy Ltd, Committee Briefing, Shell Projects and Technology, Rijswijk, the Netherlands, 22 July 2014.
Finding 44
During a cyclone, the infield support vessels for an FLNG facility will not remain on standby; rather, as with all vessels, they will take standard maritime cyclone avoidance measures.

Maintain skeleton crew or evacuate?

8.16 It is difficult to generalise about what happens in a severe weather event in relation to decisions made to evacuate the facility to skeleton crew levels or to evacuate entirely. These decisions depend on a number of variables including, but not limited to, the location of the facility, the type of operation, the level of risk involved, and the resources and timeframe available to implement emergency procedures.

8.17 Clearly, though, for facilities such as fixed platforms and Floating, Production, Storage and Offloading (FPSO) vessels that are permanently moored and not able to move to a safer location to ride out the severe weather event, until recently there has been two options taken up by operators: either reduce manning levels, maintaining only a minimum crew, or evacuate the facility, leaving no personnel on board.

8.18 Mr Stephen Price of the Australian Workers’ Union (AWU) stated that:

containing people within a cyclone ... is a challenging environment. In pretty much every situation that we find ourselves exposed to cyclones we have very rigid cyclone procedures in place, 99 per cent of which are evacuates; they are evacuated early. It is very rare that we actually get caught where we have to keep people contained within some sort of shelter within a workplace at the moment.620

8.19 The third option, as adopted by Shell for its Prelude facility, is not to de-man. This option is discussed in a separate section of this chapter below.

8.20 The following outlines the position adopted by various project operators in relation to manning levels during severe weather events.

8.21 ConocoPhillips is the operator of the Bayu-Undan field in the Timor Sea approximately 500 km from Darwin, 250 km south of Timor-Leste.621 This facility includes a Floating, Storage and Offloading facility (FSO), the Liberdade, a permanently moored,

620 Mr Stephen Price, Branch Secretary, Australian Workers’ Union, Transcript of Evidence, 10 November 2014, pp 6–7.
Chapter 8

weathervaning facility, 248 metres long and 54 metres wide. While ConocoPhillips’ ‘base case’ in the situation of ‘a direct hit’ is to ‘shut down the platform and evacuate the platform’, the company would ‘proactively, preferentially down-man’ its FPSO.

INPEX will also have a permanently moored FPSO operating on its Ichthys field located approximately 220 km off the Western Australian coast and 820 km southwest of Darwin. Most of Ichthys’ condensate will be transported to the FPSO for offshore processing and storage before being periodically offloaded to carriers for export. The Ichthys FPSO will be 336 metres long and 59 metres wide, and will also be a permanently moored, weathervaning facility. INPEX advised that ‘in the event of a cyclone, our [INPEX’s] plan is to reduce manning levels but to remain manned, and our facilities are designed to remain manned during cyclones’.

Woodside’s Laminaria–Corallina oil fields facility is situated in the Bonaparte Basin, approximately 550 km north-west of Darwin. This facility also includes an FPSO, the Northern Endeavour, a 273 metres long, 50 metres wide vessel ‘permanently moored, on location, by an internal turret mooring system’. Unlike other Woodside FPSOs such as the Cossack Pioneer or the Okha, the Northern Endeavour remains on station during a cyclone. Woodside advised that the Northern Endeavour Basis of Design (BOD) was to maintain permanent manning on board during a cyclone. However, ‘due

627 Mr William Townsend, General Manager, External Affairs and Joint Venture, INPEX, Transcript of Evidence, 7 November 2014, p 3.
to changes in metocean data the facility design was reviewed and a subsequent cyclone response plan was developed. 630

8.24 Woodside also advised that:

\[ \text{the plan specifies triggers for staged reduction in manning based on tropical low/tropical cyclone location and forecast intensity. A final de-manning flight is planned for when a tropical cyclone track, including its cone of uncertainty, is forecast to pass within 100 nm [nautical miles] of the facility within a 24 hour period.} \] 631

8.25 It is clear from this statement that not only is reliable and accurate information essential, but the timing of this is also very important as it allows staged-evacuation processes to be triggered. As the Department of Fire and Emergency Services (DFES) explained, as part of their ‘proactive approach’, operators ‘have a lot of intelligence coming in—they are planning a pre-emptive evacuation and a timely evacuation’. 632 According to ExxonMobil’s Mr Luke Musgrave, ‘you usually have your response plans set up such that you are making decisions at the earliest opportunity, rather than at the latest opportunity’. 633

8.26 Generally speaking, industry discussed the possible shutdown and evacuation of a facility as a gradual or staged process.

8.27 ExxonMobil explained their process for dealing with a cyclone heading towards its proposed permanently-moored Scarborough FLNG as follows:

\[ \text{Way ahead of that [a cyclone heading directly toward the FLNG] we would do things like securing equipment, locking down crane booms and doing all of those types of things. We would begin precautionary down-manning of non-essential personnel. If we thought the risks were arising to a certain point, we would commence shutdown and depressurisation of topsides and processing equipment and, depending on the intensity, location and our assessment of the risk, we would even begin to shut down the wells subsea and de-pressure the risers and diverse equipment that connects the vessel to the ocean floor.} \] 634

630 Submission No. 15 from Woodside Energy Ltd, 1 December 2014, p 1.
631 ibid.
632 Mr Lloyd Bailey, Deputy Commissioner, Operations Command, Department of Fire and Emergency Services, Transcript of Evidence, 19 November 2014, p 6.
633 Mr Luke Musgrave, Vice President LNG, Exxon Mobil, Transcript of Evidence, 10 November 2014, p 8.
634 ibid, pp 7–8.
Chapter 8

8.28 ExxonMobil thought they ‘would probably maintain a small crew in a safe haven somewhere on that vessel during the storm. They would be responsible for the safety of that vessel during the storm’. 635

8.29 Again, timing is an important factor, with the ‘initiation point based on what we [ExxonMobil] thought was coming, how significant it was and the probabilities of that coming our way to give sufficient time to activate that’. 636

8.30 ConocoPhillips advised that ‘shutting things down for a day because you have had a warning might not be the safest option’. 637 This is because ‘machines are happier when they are spinning, levels are steady and temperatures have evened out; that is a safe place to be’. 638 Mr Mark Leigh advised that ‘the trick is to have a long enough lead time to balance that requirement [to possibly shut the plant down] to keep the plant in a safe condition’, with the time needed to ‘down-man the platform’. 639

8.31 Mr Leigh also explained that when they have a ‘few hundred workers offshore that may be doing projects and other things’, they need to determine how many are ‘actually critical to the operation’. 640 Because not all offshore workers would be critical, ConocoPhillips would then:

\[
\text{start to proactively down-man early in the cyclone warning horizon. So the OIMs and the folks onshore talk about it and say, ‘Yes, we are going to start down-manning now.’ You start sending helicopters in and out taking off all of your nonessentials.}.
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8.32 The concept of safety in design (as discussed in Chapter 4) was also raised in relation to designing FPSOs to meet particular conditions. For example, in discussing the fact that the Northern Endeavour stays on station, Woodside stated that, while its location meant that facility would not get the full impact of a category 5 cyclone, ‘it is integrated into design, so the engineers from day 1 will look at the options of a disconnect or a stay-on station and design accordingly for whatever is going to be the safest outcome’. 642 As noted above, part of the Northern Endeavour’s BOD was for permanent manning to be maintained on board during a cyclone. However, the design was reviewed following changes in the metocean data.

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635 ibid, p 9.
636 ibid, pp 7–8.
637 Mr Mark Leigh, Team Leader, Asset Integrity and Process Safety, ConocoPhillips, Transcript of Evidence, 10 November 2014, p 3.
638 ibid.
639 ibid.
640 ibid.
641 ibid.
642 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Transcript of Evidence, 7 November 2014, p 3.
Noting that helicopter flying is ‘one of the riskiest things’ in the oil and gas industry, ConocoPhillips advised that while its base case is to evacuate the platform, if that was not possible due to insufficient time or conditions not suitable for helicopters, they would ‘just shut-in production and essentially sit the storm out’. According to Mr Mark Leigh, because the FPSO weathervanes:

> it can adopt the optimum position for wind and tide and so on, and waves. It is the same thing; we would proactively, preferentially down-man it but, again, it also survived the 10 000-year test. We have done the analysis on the moorings and the piles and all that stuff. Certainly in the JPDA [Joint Petroleum Development Area], we have a system that we believe is robust.

ExxonMobil explained that its Scarborough FLNG ‘would be designed to remain at the Scarborough field essentially for the life of that field. It is designed to withstand the most severe storms and weather conditions that we would expect to see’. According to Mr Musgrave:

> the vessel is not built not to be damaged, but it is built not to be destructed, so on top there may be some damage to some equipment, but the integrity of the vessel is designed to be maintained.

**FLNG facilities in a severe weather event**

As previously noted, Shell is developing its Prelude field with its FLNG facility and Woodside is currently considering using Prelude FLNG technology to develop its Browse Basin fields. Also as noted previously, both Shell and Woodside have advised that personnel will remain on their FLNG facilities in the event of a cyclone. Shell submitted that ‘at all times, including during a cyclone, the [Prelude] facility remains on-location, with personnel remaining on board’. Woodside confirmed that ‘FLNG facilities that are permanently moored will remain on-station with personnel remaining onboard during cyclonic conditions’.

Concerns have been raised with the Committee in relation to an FLNG facility not being de-manned during severe weather events. For example, Mr Stephen Price, Branch Secretary of the AWU, citing the Montara incident as an example, noted that facilities

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644 ibid.
645 Mr Luke Musgrave, Vice President LNG, Exxon Mobil, Transcript of Evidence, 10 November 2014, p 7.
646 ibid, p 8.
647 Submission No. 15 from Shell in Australia, submission to Inquiry into the Economic Impact of Floating LNG on Western Australia, 30 August 2013, p 6.
648 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 19.
that are believed to be secure can fail in certain conditions.\textsuperscript{649} Mr Price stated that a Prelude-type FLNG facility ‘is absolutely enormous and it is very difficult to tell what a severe weather situation will actually do to it’.\textsuperscript{650} Similarly, Mr Glenn McLaren of the Australian Manufacturing Workers’ Union (AMWU) noted that ‘what is happening off the coast of Western Australia is unheard of in size and scale ... We are told that it will withstand the worst of the worst—the 99-year cyclone ... Call me cynical, but I would not want to be on there, regardless’.\textsuperscript{651}

\subsection{8.37}
The MUA described the situation that occurred when severe tropical cyclone \textit{Billy} developed in the Joseph Bonaparte Gulf on the Western Australian/Northern Territory border. According to the MUA’s Assistant National Secretary, Mr Ian Bray, the \textit{Castoro Otto}, a construction barge with 262 people on board, was working in the area.\textsuperscript{652} Mr Bray explained that ‘contingencies failed and there was a failure to evacuate. [...] It had 12 anchors out at the time. They failed to get the anchors up and hence the cyclone formed and ran over the top of them’.\textsuperscript{653} It was fortunate that amongst those on board were a marine crew who were able to maintain position, keep the engines going and make headway when the last anchor parted. Without the contingency of a marine crew on board, the \textit{Castoro Otto} may have run aground.\textsuperscript{654}

\subsection{8.38}
Mr Steven McCartney, State Secretary of the AMWU, also spoke of the situation on board the \textit{Castoro Otto} during Cyclone \textit{Billy}. In discussing the ship’s Captain’s misinterpretation of the cyclone procedure, Mr McCartney stated that the Captain ‘had 287 of our members bouncing around the deck on a ship for four days in the middle of a cyclone when they should have been sitting in a hotel watching it on the television’.\textsuperscript{655} According to Mr McCartney, due to delays in the government investigation of the incident, ‘the story was some months older, the evidence was cold

\textsuperscript{649} Mr Stephen Price, Branch Secretary, Australian Workers’ Union, Transcript of Evidence, 10 November 2014, p 3.
\textsuperscript{650} ibid.
\textsuperscript{651} Mr Glenn McLaren, Union Official, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 5.
\textsuperscript{652} Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 2. Tropical cyclone \textit{Billy} developed from a low pressure system that formed in the Timor Sea on 15 December 2014. The low moved into the Joseph Bonaparte Gulf on 18 December and intensified into cyclone \textit{Billy}.
\textsuperscript{653} Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 2.
\textsuperscript{655} Mr Steven McCartney, State Secretary, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 5.
and gone and some of the emotion around the incident had disappeared and with that some of the story and also some of the atmosphere of the incident’. 656

8.39 Mr Bray also raised the issue of a high level of distress on board the Castoro Otto, stating:

the vast, vast majority of those people [on board] were not trained in evacuation—so, jumping into lifeboats, life rafts or whatever other lifesaving devices there were—and it was leading to a major amount of stress and fear on board the vessel. 657

8.40 Captain Justice of the Kimberley Ports Authority expressed concerns in relation to the possibility of vessels or facilities experiencing demobilisation problems due to timing issues and hesitancy between the Australian Maritime Safety Authority (AMSA) and NOPSEMA. Captain Justice advised that he ‘had heard a number of cases of this type of thing happening, and in many cases it has several causes’. 658 For Captain Justice:

the first one is commerciality versus safety, which is always a problem with vessels and cyclones. The second one is the lack of clear information flow, where the people who are in a position in, say, Canberra to make a decision or NOPSEMA or whoever, they do not know that the cyclone is developing and where it is going and so forth. They may not necessarily be getting the information fed to them. In a lot of cases it becomes almost a local call. I have not heard of that specific incident [with the Castoro Otto] but I have certainly heard of many of them where the demobilisation and the evacuation at the start has been left a bit long. 659

Finding 45
There is significant concern in relation to FLNG facilities not de-manning during extreme weather events.

8.41 Woodside recognises that ‘adverse weather conditions have the potential to impact the health and safety of the employees and the potential to compromise facility integrity’. 660 Given this, the balance of this chapter outlines the main reasons why Shell and Woodside are confident that it is safe not to de-man FLNG facilities during a severe

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656 ibid, p 2.
657 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 2.
658 Captain Victor Justice, Chief Executive Officer, Kimberley Ports Authority, Transcript of Evidence, 27 November 2014, p 2.
659 ibid.
660 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 19.
Chapter 8

weather event. These relate to the safety in design features of the facility and company policies relating to using FLNG facilities’ accommodation areas as temporary refuges.

8.42 As noted previously, Prelude has been designed to withstand a 1 in 10,000 year weather event. In fact, as Shell’s Mr Andrew Doherty explained ‘the philosophy that staff would always remain on board, and the turret assembly, the hull and storage assembly’ are part of ‘the design premises that were put in place at the outset’ to ensure Prelude can withstand those conditions.661

8.43 Similarly, Woodside explained that the design of its Browse Basin facility ‘will be based on resisting environmental conditions, up to and including the 10,000 year return period event’.662 In the event of a cyclone, Woodside’s FLNG facility will also remain manned. Woodside further stated that ‘FLNG facility design has evolved with due consideration to cyclone survivability and maintaining a safe environment for the workforce’.663

8.44 The safety in design features of Prelude were discussed in detail in Chapter 5. In brief, the size and mass of the hull, along with a number of other hull design features, are designed to help the facility remain stable in severe weather conditions. These include the turret mooring system which will allow the facility to weathervane to adopt the optimum position to suit prevailing weather conditions. According to Shell, part of its testing at the Maritime Research Institute Netherlands (MARIN) included comparing the FLNG facility results with that of FPSOs. This testing showed that the surge motion, sway motion, heave motion, and pitch and roll for the FLNG facility were less than that for FPSOs.664

8.45 Captain Justice, in discussing the strength of the mooring systems of Shell’s FLNG facility, stated:

\[
I \text{ know that companies like Shell in particular, because it also has vast shipping interests, is very conservative in what it does and in its engineering design, so I would hope that it has gone through that in some detail.}665
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8.46 As Chapter 5 also noted, Shell sees its Prelude accommodation module as a critical element of the facility’s design safety. The accommodation module is the facility’s temporary refuge during emergency events, including extreme weather, and forms part

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661 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 5.
662 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 19.
663 ibid.
664 Winthrop Professor Mike Efthymiou, Shell EMI Chair of Offshore Structures, UWA, presentation to Committee at MARIN, the Netherlands, 22 July 2014.
665 Captain Victor Justice, Chief Executive Officer, Kimberley Ports Authority, Transcript of Evidence, 27 November 2014, p 7.
of the facility’s topsides. The topside load is taken by the hull—the hull is the foundation of the facility and is designed for these loads using the ALARP principle.666

While the accommodation unit’s structure is designed to withstand emergency events, the Committee was concerned about what would happen inside the living quarters. For example, Captain Justice described a situation on a 240,000 tonne ship that was caught in a cyclone off the coast near Dampier. The ship was rolling ‘so violently’ that ‘all of the fittings inside the ship, everything that was not welded, broke free. All of the bunks, the galley fittings, the tables—everything that was not welded—broke free’.667

Given Shell’s advice that the accommodation unit, as part of the topsides, was designed ‘to withstand the survival event without damage and be operable after a 10,000 year event’, and in light of Captain Justice’s experience, the Committee sought further assurance from Shell that its accommodation module would remain safe for workers.

According to Shell, the modelling conducted at MARIN confirmed that Prelude’s temporary refuge facilities would remain ‘comfortable’ and ‘habitable’, and preserve the ‘health, safety and welfare’ of those on board during an adverse weather event.668 Furthermore, the living quarters, which can accommodate up to 340 people, ‘have direct access to all means of evacuation—via helicopter, freefall lifeboats (located aft) and integrated chute-based life rafts. The wall facing the processing equipment is blast rated and has passive fire protection’.669

In addition to the facility design, an FLNG facility cannot operate without a safety case which has been assessed by NOPSEMA as being sufficient to reduce risks to ALARP levels. An FLNG facility’s safety case is supported by a number of procedures and policies that demonstrate how various hazards are dealt with. Both Shell and Woodside have advised they have policies and systems in place for their operations in cyclone prone areas.

Woodside submitted that it has:

sophisticated arrangements in place to monitor and assess storm/cyclone development, which may impact operations. Early warning systems drive well practised preparedness activities across our onshore and offshore assets. This capability is underpinned by a regime of specific emergency exercises preparing our infrastructure and people for a cyclone or severe storm. Comprehensive Emergency

666 Winthrop Professor Mike Efthymiou, Shell EMI Chair of Offshore Structures, UWA, presentation to Committee at MARIN, the Netherlands, 22 July 2014.
667 Captain Victor Justice, Chief Executive Officer, Kimberley Ports Authority, Transcript of Evidence, 27 November 2014, p 2.
668 Submission No. 25 from Shell in Australia, 19 December 2014, p 4.
669 Submission No. 9 from Shell in Australia, 11 August 2014, p 4.
Response Plans are in place for all of Woodside facilities that may be impacted.  

8.52 According to Shell, its weather policy sets out the:

controls which are documented disciplined controls to be acted on by the offshore installation manager who has the duty and responsibility to keep members of the community out there safe and the facility safe.  

8.53 Mr Andres Doherty, General Manager, HSSE for Shell advised that this documented set of controls:

will guide the offshore installation manager very clearly in the actions that he needs to take progressively in advance of an impending adverse weather situation and also based on the escalation that that event may incur as it develops and as its path is predicted.

8.54 This includes a ‘progressive turning down of the facility, a reduction of activities, bringing staff inside to the safe location of the accommodation, which is designed to adverse weather scenarios and to ultimately stop production’.  

8.55 The Committee asked Shell to clarify the procedure that would be followed to ensure the safety of those working on board in the event of an extreme weather event and to explain what made the Prelude living quarters significantly different from any other facility in operation in other parts of the world and in the North West.

8.56 Shell explained that its ‘shutdown philosophy is expected to be for categories 4 and 5 cyclones’ and:

[i]n the event of an extreme adverse weather condition ... the topsides process ... will be turned-down or shut-down and de-pressurised to mitigate the threat of pressurised hydrocarbons. This reduces the potential escalation for fire and explosion events. In the event of adverse weather all personnel will muster in the main accommodation module (temporary refuge) and be accounted for. They will remain inside the accommodation for the duration of the adverse weather event.  

670 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 19.
671 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 5.
672 ibid.
673 ibid 5.
674 Submission No. 25 from Shell in Australia, 19 December 2014, pp 3–4.
Shell also submitted that:

> when comparing Prelude FLNG facility motions with motions of a typical North Sea operated FPSO (per unit wave height) the motions of the Prelude FLNG facility are lower for all wave periods of equivalent interest. Extreme FLNG facility motions at the Prelude location are lower than most extreme FPSO motions operated in the North Sea at the 100 and 10,000 year conditions. Note, the North Sea operated FPSOs considered here are permanently moored, manned and have been operating satisfactorily over the last 15 years under the UK offshore oil and gas safety regime.675

Shell submitted that having personnel remain on board to manage the day-to-day operations of the FLNG facility during a severe weather event will ‘avoid exposure to risks associated with helicopter and boat transfer operations’ during those conditions.676 According to Shell, personnel will take refuge in the living quarters when the wind speed exceeds an average level of 130 kilometres per hour (70 knots) over a 10 minute period, which is the threshold of a category 3 cyclone.677

Furthermore, Shell confirmed that production on Prelude ‘will not be re-started until the process safety integrity of the entire FLNG facility is functionally assured’.678 Shell also confirmed that the accommodation module ‘is a safety critical element’ of Prelude as it is there that those working on the facility will seek ‘temporary refuge’ during an extreme weather event.679 According to Shell, the accommodation module:

> shall provide protection for people in case of a hazardous event and have the necessary command and control to organise emergency response. The temporary refuge (accommodation module) shall be designed to withstand the survival event without damage and be operable after a 10,000 year event.

> Life support requirements include leak tightness to prevent smoke and gas ingress into the temporary refuge, while structural support includes consideration of extreme and survival wind loads and extreme and survival vessel motions.680

The Committee, while acknowledging Shell’s evidence that safety is its primary focus, also asked the company to advise what differences there are between the ALARP levels

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675 ibid.
676 ibid, p 2.
677 ibid p 2.
678 ibid, p 4.
679 ibid.
680 ibid. Emphasis in original.
for onshore processing facilities such as those in Karratha and the ALARP levels for FLNG facilities.

8.61 Shell noted that the ‘ALARP outcomes will be different for every project’.\textsuperscript{681} In relation to differences between onshore and FLNG facility ALARP levels, Shell submitted that:

for an onshore LNG plant, the ALARP assessment will not include the risk of travelling in a helicopter. However, most onshore plants receive gas from an offshore platform that processes and compresses the gas to shore. This means that those offshore workers will have exposure to helicopter travel risks. The overall offshore/onshore ALARP needs to be considered when comparing to FLNG.\textsuperscript{682}

8.62 Shell further advised that its ALARP studies for the Prelude facility:

determined that the levels of risk for each worker group are comparable to other offshore oil and gas facilities. In addition, the temporary refuges impairment frequency (a measure of the safety of the temporary refuge facility) benchmarks favourably (i.e. is an order of magnitude lower) against other current offshore oil and gas facilities.\textsuperscript{683}

8.63 A further issue raised in evidence was the psychological safety of those on board an FLNG facility during a cyclone. This concern was expressed by Mr Glenn McLaren of the Australian Manufacturing Workers’ Union as follows:

It is very hard to envisage putting myself in the position of one of our members of sitting in an offshore facility that is a number of hundreds of kilometres away from anywhere that is remotely safe and secure and away from the eye of potentially a very catastrophic event and putting my faith in, ‘I hope they got it right’. I cannot put up my hand and say that I want off, because the moment the cyclone approaches within a certain radius—and that is dependent on the safety case produced—they will not fly you off. It is not a case of ‘Barleys, I’m out!’ It is ‘You’re out there, good or bad; you’re riding it out champ, and we hope we get through the other side’.\textsuperscript{684}

\textsuperscript{681} ibid, p 5.
\textsuperscript{682} ibid.
\textsuperscript{683} ibid.
\textsuperscript{684} Mr Glenn McLaren, Union Official, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 10.
The Committee sought clarification from Shell in relation to what, if any, consultation it had undertaken with oil and gas workers to determine that workers would be prepared to stay on the facility during extreme weather events. Shell submitted:

Prelude FLNG personnel are engaged on cyclone manning arrangements from the earliest point of their recruitment, throughout their on-boarding to the project and in their regular mandatory offshore training. Video footage of the simulator motions in cyclonic weather is a key communication component of the induction material for all on-boarding sessions.

Through these engagements, our personnel understand that it is safe to stay on the FLNG during all weather conditions and that the decision to not de-man during a cyclone is based on results from an extensive 15 year research and development program, real model testing and advanced 4D simulation by the MARIN institute, supported by subject matter experts in Shell.

In addition, Shell Prelude FLNG operations personnel with offshore experience have witnessed first-hand the motions and support the policy of remaining on the facility in the most severe of weather conditions. 685

While Shell may have designed its FLNG facility to structurally withstand a 1 in 10,000 year severe weather event, it is essential that those working on the facility are sufficiently trained in all emergency procedures; it is important that Shell does not overlook the human factor and the fact that accidents happen. The confidence that can be placed in Shell’s capacity to get its safety systems right is contingent on those who work on and around the facility. People’s actions must be consistent with company safety plans. Captain Justice, in agreeing with this position, stated that ‘in terms of risk management, I think that there is a higher likelihood of an idiot at loose rather than a cyclone’. 686

Ultimately, as with all issues relating to occupational health and safety, the operator must demonstrate to NOPSEMA that it has reduced the risks to workers’ mental health to a level that is ALARP, and NOPSEMA’s acceptance of an operator’s safety case signals that it is satisfied that this is the case.

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685 Submission No. 25 from Shell in Australia, 19 December 2014, p 5.
686 Captain Victor Justice, Chief Executive Officer, Kimberley Ports Authority, Transcript of Evidence, 27 November 2014, p 7.
Finding 46
The accommodation unit of the proposed FLNG facility has been designed to provide a fully self-contained life support environment for personnel during emergency events.

Finding 47
Proponents of FLNG facilities are confident that the facility design makes not de-manning during extreme weather events the safest course of action.

Finding 48
It is essential that all personnel on an FLNG facility and its infield support vessels receive the necessary training to ensure they are prepared to respond appropriately during an extreme weather event.

Finding 49
All aspects of health and safety, including the mental health of workers during extreme weather events, must be included in the safety case and assessed by the National Offshore Petroleum Safety and Environmental Management Authority.
Chapter 9

What happens if there’s an accident or other emergency?

9.1 As noted, Shell argues that ‘the design of the Prelude FLNG facility has focused on the containment of hazards and incorporates extensive mitigation and recovery measures, should they be required’. 687 These include strategies for managing fires and explosions, medical emergencies, safe escape from a hazardous situation and for the evacuation and rescue of personnel from or about the facility in the event of an emergency event.

9.2 This chapter outlines industry strategies developed for handling emergencies, such as fires and explosions, emergency and medical evacuation from FLNG facilities, search and rescue, and training required to ensure the emergency preparedness of those who work on or near an FLNG facility. It also outlines the operator and government responsibilities in responding to an emergency on or near an FLNG facility.

Fires and explosions

9.3 As noted in Chapter 7, an operator’s safety case is required to have a fire and explosion risk analysis (FERA) which identifies the types of fires and explosions that could occur at a facility, and details the consideration given to the control measures to be in place, the facility’s response plan and the medical and pharmaceutical supplies kept of the facility for such an emergency situation.

9.4 Prelude’s safety in design elements, including passive protection aimed at limiting the consequences of accidents associated with producing LNG at sea, were outlined in Chapter 5. However, should a fire or a leak of hazardous material occur, Shell’s Prelude FLNG response to a fire or a leak of hazardous material will be the same as for any of its other offshore installations in the region. In the case of a fire, the ‘standard response’ is to ‘fight the fire if safe to do so, i.e. if there is a small fire in its incipient stage then all personnel are trained in using portable fire extinguishers/hydrants etc’. 688 However, if it is not safe for personnel, they must all ‘muster in the temporary refuge [the accommodation quarters] and let the platform automated systems manage the fire

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687 Submission No. 4 from Department of Mines and Petroleum, 14 July 2014, p 6. See also: Submission No. 9 from Shell in Australia, 11 August 2014, p 4.
688 Submission No. 25 from Shell in Australia, 19 December 2014, p 6.
scenario’. Shell also advised that ‘there are sufficient detectors and active fire protection systems designed to contain foreseeable fire scenarios’.  

9.5 Prelude’s fire, explosion and cold spill strategy manages emergency situations through the following measures:

i. Fire and gas detection

ii. Automatic emergency shutdown and emergency depressurisation (primary means of hazard and escalation control)

iii. In the case of large cryogenic releases, overboard drainage ensures any liquids are removed overboard

iv. The process piping design for rundown and loading lines ensures removal of any collection of hydrocarbon inventory in the process system when a shutdown occurs

v. Passive fire protection and cold spill protection (as an assured secondary means of escalation prevention) on structures and equipment which can generate escalation outside the associated fire zone

vi. Designing critical structures and equipment to withstand residual consequences

vii. Active fire protection will cool equipment and manage sources of specific pool fires/smaller fires

viii. Use of fire water monitors to create water curtains to separate port and starboard to control heat radiation, and for dedicated areas such as flammable chemical storage.

9.6 Shell’s Mr Gerald Dixon advised that in the case of fire, the priority is to contain the fuel source, and the air gaps in the design are critical. Prelude will also be equipped with deluge and fire hydrant equipment. The three Infield Support Vessels (ISVs) will also have fire fighting facilities, with two ISVs being in operation at any one time.

9.7 The Committee heard concerns in relation to the Prelude FLNG facility’s capacity to manage a fire situation. For example, the Maritime Union of Australia (MUA)

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689 ibid.
690 ibid.
691 ibid
692 Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, Committee Briefing, the Netherlands, 22 July 2014.
questioned the capability of the ISVs to assist in all fire situations, depending on where the fire was located and whether water was the best suppressant in that situation.693

9.8 Again, Mr Bray stated that:

\[\text{this is not where you just step out of a building on fire, walk into the street and wait for the fire brigade; this is a case of people working remotely and needing their own resources to be able to save the equipment in the first instance, and if that cannot be done, save themselves. You do not have all the things you take for granted in a shore-based operation. Everything is reliant on what you do at that time in that situation, and if you cannot deal with it you need to be able to get out of there.} \]

9.9 Nevertheless, as Hon Ken Baston, MLC, Acting Minister for Emergency Services advised, ‘incidents occurring offshore are dynamic in nature’ and the expectation is:

\[\text{that the on-site industry employee crews are the first and most qualified to respond due to their specialist knowledge of the working environment coupled with their ability to quickly isolate pipelines and supplies, either remotely from an offshore location or on board.}\]

Evacuation, escape, and rescue and recovery strategy

9.10 The Prelude facility has an Evacuation, Escape and Rescue (EER) strategy which includes two elements relating to escaping from hazardous situations on the facility. The first of these is:

\[\text{to allow personnel on Prelude to escape safely from an area where there is a hazardous event. Accessible means of escape are located throughout via a range of forward and aft escape routes.}\]

9.11 Shell provided the following details in relation to the escape routes available on Prelude:

\[\text{On the facility’s deck and the main process deck, full length escape routes that lead to temporary refuges are provided at both the starboard and port side. The central alley on the process deck level between the port and starboard side modules provides another escape}\]

693 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 6.
694 ibid, p 9.
695 Submission No. 16 from Hon Ken Baston, MLC, Acting Minister for Emergency Services, 1 December 2014, p 2.
696 Submission No. 9 from Shell in Australia, 11 August 2014, p 8. Emphasis in original.
way. There is also an alternative escape route on the starboard mooring deck, which connects the secondary refuge (forward) with the temporary refuge (aft).  

9.12 The second element in the escape strategy is:

   to provide temporary refuges in different locations (main temporary refuge aft and secondary refuge forward) on Prelude with adequate sizing for maximum anticipated personnel and protection for as long as required to control an incident and/or effect a controlled evacuation (if necessary). Duration is one hour (which is standard for offshore facilities).

9.13 Shell also advised that ‘there are two helidecks located at the aft, nearby the accommodation and temporary refuge. They are also located well away from the process areas’.

9.14 Shell’s EER strategy for Prelude includes the following elements in relation to evacuation, and rescue and recovery:

   To ensure a controlled safe evacuation from the installation with different means of evacuation at strategic low risk locations. There are primary, secondary and tertiary means of evacuation via helicopter, freefall lifeboats (located aft) and integrated chute-based life rafts respectively.

   To facilitate the rescue and recovery of personnel, once evacuation has been carried out, by external means. For example facility based infield support vessels, acting as standby vessels, and the dedicated search and rescue helicopter service located in Broome.

Emergency evacuation

9.15 This section discusses the means of evacuation from an FLNG facility based on Shell’s Prelude design. It deals with evacuation due to a major accident or explosion type of event. The issue of medical evacuation is discussed in a separate section below.

9.16 Shell’s Prelude HSSE Manager, Mr Gerald Dixon, reiterated that the FLNG facility had been designed ‘in accordance with all the safety assessments, shutdown and

697 ibid, p 4.
698 ibid, p 8. Emphasis in original.
699 ibid, p 4.
700 ibid, p 8. Emphasis in original.
blowdown criteria with the aspect of people safety.\textsuperscript{701} If there is an extreme emergency situation, the facility’s Offshore Installation Manager (OIM) ‘decides whether to abandon and evacuate the asset’, making that decision ‘on the basis that people’s safety is paramount’.\textsuperscript{702} In such circumstances, the ‘facility will blowdown naturally’ and those on board will be evacuated by helicopter, totally enclosed motorised propelled survival craft (TEMPSC) and ISVs.\textsuperscript{703}

9.17 According to Shell:

\textit{evacuation by helicopter (primary arrangement) or by life boats (secondary arrangement) or by life rafts (tertiary arrangement) and use of the ISVs would occur if there was an emergency incident that occurred resulting in a potential threat to personnel safety}.\textsuperscript{704}

9.18 Which combination of these evacuation arrangements would be used would depend on the circumstances surrounding the emergency incident, and details of particular scenarios should be included in the operator’s emergency plans and systems.

**Finding 50**

There are three main means of evacuation from an FLNG facility—by helicopter, by life raft and by using infield support vessels. The particular method(s) used during an emergency event will depend upon the prevailing circumstances.

9.19 The Australian Manufacturing Workers’ Union (AMWU) expressed concern in relation to the evacuation of personnel from an FLNG facility. In particular, the union raised the issue of evacuating between 150 and 300 people on board the facility.\textsuperscript{705} According to Mr McLaren, while there could be between 150 and 300 people on board the FLNG facility, helicopters, depending on their size, generally only carry up to 22 people.\textsuperscript{706} The use of helicopters as the primary means of evacuation also raises issues of time, which is crucial in an emergency. Given the distance of the Prelude facility from shore, for Mr McLaren, this raised the possibility of the need to ‘hot fuel’ (refuelling while the engines are running) the helicopters on the facility, a dangerous activity in itself, one that requires people trained in helideck landing and refuelling.\textsuperscript{707}

\begin{thebibliography}{9}
\bibitem{701} Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, \textit{Transcript of Evidence}, 12 November 2014, p 7; Submission No. 25 from Shell in Australia, 19 December 2014, p 4.
\bibitem{702} Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, \textit{Transcript of Evidence}, 12 November 2014, p 7.
\bibitem{703} Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, \textit{Transcript of Evidence}, 12 November 2014, p 7; Submission No. 25 from Shell in Australia, 19 December 2014, p 4.
\bibitem{704} Submission No. 25 from Shell in Australia, 19 December 2014, p 4.
\bibitem{705} Mr Glenn McLaren, Union Official, Australian Manufacturing Workers’ Union, \textit{Transcript of Evidence}, 26 November 2014, p 11.
\bibitem{706} Ibid.
\bibitem{707} Ibid, p 11.
\end{thebibliography}
Chapter 9

9.20 Based on evidence provided by INPEX in relation to the Ichthys project, ‘heavy carrier’ helicopters carry 19 passengers, with ‘inbound available seats from offshore during damanng operations’ calculated to be 17.708

9.21 Shell advised that its helicopters were able to accommodate 20 persons including pilots. Shell also advised that the ‘operational capacity can vary subject to weather and fuel loads’, which can reduce the number of persons on board to ‘14, 16-18’.709 As the Prelude facility will have refuelling capability on board, the helicopters will ‘have the range and flying air time necessary’.710

9.22 This operational limitation was acknowledged by Shell’s Mr Ian Jewitt, FLNG HSSE Team Leader, in the Netherlands. Mr Jewitt advised that while the two helidecks used to bring people to the facility would be used as the primary means of evacuation, the number of people that could be evacuated quickly was a limitation.711

9.23 However, as Shell advised, in addition to helicopters:

there are five freefall lifeboats each with capacity of 70 people and therefore total capacity of 350 personnel. There are integrated chute based life rafts located both aft and forward and located on both port and starboard sides. The aft life rafts have a total capacity of 170 people on each side. The forward life rafts have a total capacity of 70 people on each side.712

9.24 The Prelude facility will operate with three ISVs, two of which will be on site at a time.713 These ISVs, with a capacity of 85 persons, would assist in any evacuation from the facility. According to Shell, while ‘in a worse case scenario and life threatening situation the ISV’s can accommodate more’, this has not formed part of its evacuation, escape and rescue analysis (EERA) arrangement.714

9.25 The method for transferring people from the FLNG facility to the ISVs was a concern for the AMWU. According to Mr McLaren:

In the worst-case scenario, they can get people off, but the transfer will be via Billy Pugh. There is no stairwell down the side that they can

708 Submission No. 10 from INPEX Operations Australia Pty Ltd, 18 August 2014, p 11.
709 Submission No. 27 from Shell Australia, 4 March 2015, p 2.
710 ibid. The use of Shell’s search and rescue (SAR) helicopter for medevac is discussed below.
711 Mr Ian Jewitt, FLNG HSSE Team Leader, Shell, The Hague, Committee Briefing, 22 July 2014.
712 Submission No. 25 from Shell in Australia, 19 December 2014, p 6.
713 Mr Glenn McLaren, Union Official, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 11.
714 Submission No. 27 from Shell Australia, 4 March 2015, p 2.
9.26 The AMWU’s Mr Steven McCartney described Billy Pugh as ‘probably the highest-risk method of moving anyone anywhere’ and as something that ‘is used as a last resort’. Of major concern was the time it would take to evacuate people using this method, particularly as it ‘can pick up only two or three people at a time’ and is so dependent on the ‘sea-state, weather patterns and all those other things’. According to Mr McLaren, this may result in workers being ‘left out there during an adverse event’.

9.27 In light of these concerns, the Committee asked Shell if there were any circumstances in which personnel would be evacuated from the Prelude facility using Billy Pugh equipment. Shell advised that it does not use a Billy Pugh for ‘Facility to Vessel evacuation’. Shell acknowledged that the ‘Billy Pugh has very limited use for transfer of an injured or medically sick person’.

9.28 A further issue raised was that of the skill set of people on the FLNG facility and whether they would receive appropriate training in emergency evacuation methods. The MUA’s concern was that, given the number of people on the facility, there could be confusion which, in turn, could lead to events such as ‘failure to get the lifeboat into the water safely with zero injury’. According to the MUA’s Assistant National Secretary, Mr Ian Bray:

as people get stressed and time moves and you are working very, very fast, you need to be able to work as a team, you need to be well drilled

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715 Mr Glenn McLaren, Union Official, Australian Manufacturing Workers’ Union, Transcript of Evidence, 26 November 2014, p 11
716 ibid.
717 ibid.
718 ibid.
719 ibid.
720 Submission No. 27 from Shell Australia, 4 March 2015, p 2.
721 ibid.
722 ibid.
723 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 9.
724 ibid.
in those procedures to get a lifeboat or a life raft away. It is dangerous in itself putting a lifeboat into the water, and add to that the stress of an emergency response and throw in a bit of confusion, and that could be catastrophic in itself in terms of an event when people failed to simply get away because they did not know what to do.725

Finding 51
Concern has been raised in relation to the capacity and safety of evacuation methods for FLNG facilities.

Finding 52
Emergency evacuation plans will not be accepted by the National Offshore Petroleum Safety and Environmental Management Authority unless they adequately ensure the safety of all those at risk, regardless of their location on the facility and the numbers on board.

Finding 53
All personnel working on or around an FLNG facility must receive appropriate training to ensure they are adequately prepared to respond during an emergency evacuation.

Medical emergencies and evacuation

9.29 Shell described their emergency response procedure as a ‘tiered process’.726 Similarly Woodside submitted that its proposed Browse development medical planning is a tiered medical response system based on its Medical external support guidelines, which, in turn, are based on the Oil and Gas Producers—Managing health for field operations in oil and gas activities (the OGP/PIECA Guidelines).727 Woodside’s Mr Shaun Gregory stated that Woodside’s principle is to deliver ‘high quality health care’.728 He further stated that the company is ‘fully committed to the health and welfare of all employees that [... are] out there. That is one of our core values’.729

9.30 The OGP/PIECA guidelines state that medical emergency response plans (MERPs) should be site-specific and require the following resources necessary for them to be successfully implemented:

- effective means of communications;

725 ibid.
726 Mr Andrew Doherty, General Manager, Shell in Australia, Transcript of Evidence, 12 November 2014, p 8.
727 Submission No. 15 from Woodside Energy Ltd, 1 December 2014, p 2.
728 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 10.
729 ibid, pp 10–11.
In relation to first responders and medical staff on board an FLNG facility, the OGP/IPIECA guidelines describe required health care personnel as ranging from first aid officers through to medical specialists required for complex medical conditions. The OGP/IPIECA guidelines divide first responders and medical personnel into five levels, as outlined in Table 9.1 below. Table 9.1 also provides the recommended response times for primary treatment and for getting casualties to secondary and tertiary health care units (HCUs).

<table>
<thead>
<tr>
<th>Level</th>
<th>Treatment provided</th>
<th>Response time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Basic</td>
<td>First line first-aid treatment provided by basic first-aiders.</td>
<td>&lt; 4 minutes</td>
</tr>
<tr>
<td>Level 2: Advanced</td>
<td>First line first-aid treatment provided by advanced first-aiders.</td>
<td>&lt; 20 minutes</td>
</tr>
<tr>
<td>Level 3: Health-care professionals</td>
<td>Treatment provided by professionals with specialised training in emergency care. Level 3 staff usually work in the field to manage medical emergencies with remote support from other higher level health-care professionals.</td>
<td>&lt; 20 minutes</td>
</tr>
<tr>
<td>Level 4: Health-care professionals</td>
<td>Emergency and primary care provided in the facility’s primary HCU by registered and licensed health care professionals such as doctors and nurses.</td>
<td>&lt; 1 hour</td>
</tr>
<tr>
<td>Level 5: Health-care professionals</td>
<td>Diagnosis and treatment of complex medical conditions at a secondary HCU (hospital) or tertiary health-care unit (critical care centre) by medical specialists.</td>
<td>&lt; 6 hours</td>
</tr>
</tbody>
</table>


731 ibid, pp 6–7.
Working in conjunction with the first responders and health-care professionals that form part of a facility’s MERP, facilities must also provide adequate transportation for the evacuation of personnel, including the use of specialist providers where necessary.732

Operators must also have adequate medical structures in place, including appropriate primary, secondary and tertiary HCUs. These three tiers, as they would apply to offshore operations, are described in Table 9.2 below:

<table>
<thead>
<tr>
<th>Tier</th>
<th>Facility</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary HCU</td>
<td>On-site</td>
<td>Provide primary care for the entire workforce on board, including:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Emergency response and resuscitation; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Assist in patient transfer to secondary HCU if required.</td>
</tr>
<tr>
<td>Secondary HCU</td>
<td>Hospital</td>
<td>• Manage inpatient medical and surgical cases;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Emergency resuscitation and stabilisation of patients to prepare them for transfer to tertiary HCU; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Assist in patient transfer to Tertiary HCU.</td>
</tr>
<tr>
<td>Tertiary HCU</td>
<td>Major hospital or critical care unit</td>
<td>Provide treatment for critical conditions that cannot be met by first and second tier HCUs. Such conditions include, for example, cardiac arrest, severe burns, oncology, organ failure, high-risk pregnancy, major psychoses and complex tropical diseases.</td>
</tr>
</tbody>
</table>

These guidelines seem to generally align with the handling of casualty patients outlined by the Western Australian Department of Health (DoH). The Department submitted that:

typically, critical and multiple casualty patients are stabilised to the nearest available health facility, and then transferred to the most appropriate facility, usually the Regional Resource Centre or a major Perth hospital if required, depending on the level of care provided.734

732 ibid, p 7.
733 ibid.
734 Submission No. 24 from Department of Health, 19 December 2014, p 1.
Furthermore, the DoH stated that ‘considerations, such as the availability of surgical intervention, high dependency or Intensive Care requirements, and the nature of ongoing patient care are taken into account when making these decisions’.735

Finding 54
Offshore petroleum operators’ medical response and medical evacuation procedures are generally a tiered process, from basic first-aid provision on site through to evacuation for diagnosis and treatment of complex medical conditions.

With the above information as background material, the balance of this section of the report discusses the medical response provisions of Shell and Woodside for their FLNG facilities.

According to Shell, the company ensures it has ‘the capability to treat potentially injured people both on the facility itself, [...] with paramedics and clinical facilities on board’.736 Furthermore, escalation would require a casualty to be medevaced from the facility, first to Broome hospital, then to either Darwin or Perth if further escalation occurs.737 Mr Andrew Doherty explained that ‘it is a medically-governed decision as to where those facilities can best treat the case, both the facilities and our own medical practitioners’.738

Woodside also stated its ‘principle is delivery of high quality health care’.739 Woodside’s Mr Rory O’Connor explained that the medical treatment at a Woodside facility is ‘just the first part of the medical care’, with Woodside having the capacity to escalate medical care as needed.740 Mr O’Connor advised that Woodside looks:

at the whole integration from a point of injury or point of significant serious illness to how we get the individual to that definitive care. We look at each of the locations with the timings and the infrastructure and the support which is needed, so it would be dependent on that outcome.741

In relation to on-board medical resourcing, Shell advised that it anticipated ‘having paramedic capability combined with the medical facilities that have already be[en] built into the accommodation. In addition is paramedic capability on the infield support

735 ibid.
736 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 8.
737 ibid.
738 ibid.
739 Mr Rory O’Connor, Senior Manager, Health, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 10.
740 ibid, p 11.
741 ibid.
Chapter 9

vessels’. The decision to have paramedic capability on-board is based on Shell’s own experience and that demonstrated elsewhere in the world—such as the Gulf of Mexico and the North Sea—to be ‘a good practice for managing emergency response cases’ in remote locations. In relation to Prelude, Shell advised that ‘there is the capability, in combination with the paramedics, to stabilise patients in such a way that they can then be appropriately medivaced’.

Mr O’Connor also advised that Woodside would apply its current philosophy to its FLNG facilities, but it would be understood ‘in the context of the proposed Browse development’. At the time of this Inquiry Woodside was not able to ‘categorically say what the manning would look like’, but assured the Committee that it takes ‘all the considerations of the particular development with the experience that we have now from the existing offshore assets’.

While Woodside was not able to advise what level of medical staffing would be on its Browse FLNG facilities, it did say that is was looking at the requirements in accordance with the number of staff on the facility at a particular time. According to Mr O’Connor:

If you are looking out for 300 individuals or more on a facility and the intensity of the campaign, you might look at more medical staff. You may look at day shifts, night shifts, for instance. In the actual planning stage, those are the considerations that we put forward.

Woodside also advised that it was used to looking after large numbers of people on its facilities. Citing its Goodwin A offshore platform as an example, Mr Gregory stated that the numbers that would be on an FLNG facility ‘is not something that we are unfamiliar with; it is the same things, we scale up the medical support as part of that planning’.

Shell stated that in addition to on-board paramedic capability and a supervisor ‘trained up to first-aid level’, Prelude will have:

The facility through the medic-air, to call up a doctor or that level to go out on the search and rescue helicopter so that way you actually take additional medical support out with you, so should a casualty of

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742 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 8.
743 ibid, p 9.
744 ibid, p 9.
745 Mr Rory O’Connor, Senior Manager, Health, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 11.
746 ibid.
747 ibid.
748 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 11.
medivac have to come off the asset, you are not leaving the asset without any medical cover.”749

Finding 55
The number and capability of medical staff on board an FLNG facility must be appropriate to that particular facility.

9.44 Mr Doherty advised that once patients were stabilised they could be medevaced to Broome for treatment at the local hospital. If Broome Hospital was not able to assist, Shell ‘is making provision for further transfer to either Darwin or the Perth hospitals’.750

9.45 Shell’s Prelude facility has two helidecks, with the helicopters based in Broome.751 Shell also has a search and rescue helicopter based in Broome and, at their November 2014 hearing, advised that the helicopter had been operational for nearly two months.752

9.46 According to the Kimberley Ports Authority, Shell’s helicopter, an EC225 SAR, provides safety and emergency response support to the FLNG facility, ‘along with pilots, paramedics, engineers and crew’.753 The Kimberley Ports Authority further advised that Shell’s helicopter service is ‘on standby 24-hours a day and able to respond within 15 minutes during daylight hours and 30 minutes at night. The aircraft has a range of 300 nautical miles from the Broome airport’.754

9.47 According to the Australian Petroleum Production and Exploration Association (APPEA), for oil and gas facilities in Western Australia, the ‘difficult and hazardous environments’ in which the industry’s personnel are exposed ‘is further complicated by the distances both offshore and onshore from primary health care facilities’.755

9.48 Clearly, as Mr Woodhams, APPEA’s Director, Safety and Environment, stated, ‘the earlier the warning you get, the better. It is true that the further you go offshore, of course, the longer it takes the helicopters to get there, which is what tends to drive

749 Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, p 8. See also: Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 8.
750 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, pp 9–10.
751 Submission No. 25 from Shell in Australia, 19 December 2014, p 6.
752 Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, p 12.
753 Submission No. 3 from Kimberley Ports Authority, 11 July 2014, p 4.
754 ibid.
neighbouring activities to cooperate. The issue of cooperation between operators is discussed further below, and in Chapter 10.

According to APPEA, to facilitate ‘rapid access from these [remote Western Australian] locations to Port Hedland, Perth or Darwin hospitals’, some oil and gas companies have formed an aero-medical evacuation service called the West Australia Resources Aero Medical Evacuation (WARAME). Apache, BHP Billiton, Chevron, Santos, Shell, Vermilion and Woodside are the current WARAME members.

The tender documentation for this service stated that WARAME services include:

- **Clinical Co-ordination of ill and/or injured personnel from various WARAME Member operating sites within Western Australia and Timor Sea to designated medical facilities within Western Australia, Darwin or Adelaide;**

- **The Clinical Co-ordination to include the Aero Medical Evacuation of ill and/or injured personnel from approved aerodromes utilized by WARAME Members operating within and near Australian territory to designated medical facilities;**

- **Clinical Services at various WARAME Member operating sites; and**

- **Clinical Care of sick and/or injured personnel (including the supply of appropriate clinical equipment);**
  (a) **During Aero Medical Evacuation; and**
  (b) **At various WARAME Member operating sites.**

Woodside confirmed that the additional aviation support necessary for remote medical emergencies is provided by WARAME and that this is ‘well established practice for the North West Shelf’. Woodside also advised that ‘planning for the proposed Browse FLNG Development assumes Woodside will continue WARAME service and will be used to transfer injured personnel to Perth or Darwin hospital’.

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756 Mr Andrew Woodhams, Director, Safety and Environment, Australian Petroleum Production and Exploration Association Limited, Transcript of Evidence, 7 November 2014, p 11.


759 Submission No. 15 from Woodside Energy Ltd, 1 December 2014, p 2.

760 ibid.
Chapter 9

**Finding 56**
To help overcome the difficulties associated with medical evacuations in remote and hazardous regions in Western Australia, some oil and gas companies have formed an aero-medical service named the Western Australia Resources Aero Medical Evacuation.

**Finding 57**
Emergency medical evacuations from oil and gas facilities in the north west, including FLNG facilities, will be to the nearest capable facility, most likely Perth or Darwin.

**Rescue and recovery—international responsibilities**

9.52 Australia’s *National Search & Rescue Manual* (the *Manual*), published and maintained by the Australian Maritime Safety Authority (AMSA), defines search and rescue (SAR) as being ‘the search for and provision of lifesaving assistance to people in distress and imminent danger of loss of life’.\(^{761}\) The *Manual* further explains that:

> Australian SAR arrangements are intended to complement other emergency services (police, fire, ambulance) in circumstances where those services are unable to operate effectively. Such circumstances could include, for example, remote area operations, rescues at sea, and the need for specialist SAR facilities not normally available to emergency services.\(^{762}\)

9.53 As signatory to the Chicago Convention on International Civil Aviation (1944), the International Convention for the Safety of Life at Sea (1975), the International Convention on Maritime Search and Rescue (1979) and the United Nations Convention on the Law of the Sea (1982), Australia is responsible for SAR over an area that is comprised of the Australian continent and the East Indian, South-west Pacific and Southern oceans, as well as the Australian Antarctic territories. In total, this is a region of approximately 52.8 million square kilometres—or about one-tenth of the Earth’s surface.\(^{763}\)

9.54 Specifically, as a signatory of the Chicago Convention on International Civil Aviation, Australia is required to ‘provide such measures of assistance to aircraft in distress, in the SAR areas under their jurisdiction, as is practicable’.\(^{764}\) In addition, the *International

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762 ibid.


764 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 23.
Chapter 9

*Convention for the Safety of Life at Sea* requires Australia to ensure that ‘arrangements are made for coast watching and for the rescue of persons in distress at sea around its coasts’.\(^{765}\) In particular, these arrangements must include:

> the establishment, operation and maintenance of such maritime safety facilities as are deemed practicable and necessary having regard to the density of the seagoing traffic and the navigational dangers, and should, so far as possible, afford adequate means of locating and rescuing such persons.\(^{766}\)

9.55 *The International Convention on Maritime Search and Rescue* further requires Australia to ‘participate in the development of search and rescue services to ensure that assistance is rendered to any person in distress at sea’.\(^{767}\) Finally, the *United Nations Convention on the Law of the Sea* states that every coastal state:

> shall promote the establishment, operation and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements cooperate with neighbouring States for this purpose.\(^{768}\)

9.56 None of these requirements prescribe exactly what is required of signatory countries because search and rescue in response to a distress situation can take many different forms depending on the extent and complexity of the incident, as well as the resources that are available. In practice, the *Manual* notes that ‘dedicated SAR assets are limited in Australia and other government, private and commercial assets may be diverted from their primary function by charter, arrangement and request’.\(^{769}\) As a consequence of this divergence strategy:

> many SAR operations are conducted jointly by Commonwealth and State/Territory authorities. It is, therefore, essential that the available resources and operational techniques are standardised and coordinated across the Australian region.\(^{770}\)

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765 ibid.
766 ibid.
767 ibid.
768 ibid.
770 ibid.
AMSAs is Australia’s national SAR authority, with the police service of each state and territory being responsible for the area within their jurisdiction.\footnote{771} This means that AMSA is the responsible SAR authority for the vast majority of Australia’s offshore petroleum industry activities as they occur mainly in Commonwealth waters.

APPEA explained that ‘the oil and gas industry, as one of many industries operating in the marine environment, assists AMSA when requested to perform SAR activities’.\footnote{772} Furthermore, as one of the primary industries operating within Australia’s maritime territories, AMSA has itself implemented a number of its own SAR initiatives. According to APPEA, ‘while these initiatives are primarily focused on supporting industry personnel, the industry takes seriously its support for assisting other maritime personnel who require assistance’\footnote{773}

\section*{Search and rescue by the Australian petroleum industry}

Regulatory approval for any proposed offshore petroleum activity is contingent upon the acceptance of an associated safety case and, because these activities involve workers transiting between and working on offshore facilities, the availability of adequate SAR capability must form part of any safety case. This was explained by the General Manager of Safety and Integrity at the National Offshore Petroleum Safety and Environmental Authority (NOPSEMA), Mr Gavin Guyan, who made it clear that:

\begin{quote}
the regulations define safety case content and they specifically include a requirement to address emergency evacuation. They address emergency preparedness and they also address medical facilities. The safety case must address all the things.\footnote{774}
\end{quote}

In meeting this requirement, Australia’s offshore petroleum industry has implemented a number of formal and informal SAR collaborative arrangements, a good example of which is the recent provision by Shell Australia of a ‘dedicated search and rescue helicopter service to support the offshore oil and gas industry in the Browse basin.’\footnote{775}

\begin{footnotes}
\item[771] The Department of Defence also serves as a search and rescue authority at a national level, and is available to support the efforts of any authority by formal request.
\item[772] Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 23.
\item[773] ibid.
\item[775] Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 29.
\end{footnotes}
Chapter 9

9.61 When Shell’s SAR helicopter:

is not required for oil and gas activities, Shell advises that it may be tasked by authorities such as WAPOL to assist with medevac and search and rescue needs in the region.776

9.62 There is a paucity of available SAR infrastructure along the Kimberley coastline. This was highlighted by the MUA’s Mr Bray, who explained that the Union:

have long held a view that Western Australia, through the resource boom, grew exponentially in [some remote] areas [such as the Kimberley]. One of the concerns we always had was the emergency response capabilities were not keeping up with the pace. [...] WA grew up very quickly in remote areas and I do not think that we responded.777

9.63 This situation makes Shell’s SAR helicopter a necessary component of the Prelude project. Equally, the availability of this helicopter enhances the SAR capabilities in and around Broome, and along the Kimberley coastline in general. As such, this helicopter stands as a clear example of how a local community can benefit from the development of nearby petroleum resources.

9.64 In essence the safety case requirement for SAR places the onus on industry to ensure that adequate emergency response capability exists in remote locations prior to petroleum activities being undertaken. Thus, when asked to provide further details of the investment in its Prelude helicopter service, Shell made it clear that there would be capacity for its helicopter facilities to serve the needs of industry as a whole. According to Shell’s Mr Gerald Dixon, although the helicopter is currently ‘Shell-dedicated’, Shell ‘are looking at other operators to come in and, obviously, share that facility’.778 This was confirmed by Prelude Commercial Manager, Mr Ian Grose, who explained that Shell’s policy is to ‘welcome wherever we can synergies between oil and gas operators and others in the region because it makes more sense’.779

9.65 Mr Nigel Wilson, Senior Industry Adviser at INPEX, also confirmed that the Ichthys project would rely upon this helicopter service, explaining that INPEX is ‘discussing a

776 Submission No. 3 from Kimberley Ports Authority, 11 July 2014, p 4.
777 Mr Ian Bray, Assistant National Secretary, Maritime Union of Australia, Transcript of Evidence, 7 November 2014, p 7.
778 Mr Gerald Dixon, HSSE Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, p 12.
779 Mr Ian Grose, Commercial Manager, Prelude, Shell in Australia, Transcript of Evidence, 12 November 2014, p 12.
formal agreement with Shell’, and that ‘Shell, the industry and ourselves are involved in the search and rescue helicopter’. 780

Furthermore, Shell’s General Manager of Health, Safety, Security and Environment, Mr Andrew Dohery, also made it clear that the capability of the helicopter service would be complemented by:

infield support vessels supplied out of Broome and an all-weather dedicated search and rescue helicopter located in Broome. In Perth, to back up the emergency response services, we have a 24/7 emergency response management team that is equipped to support the offshore facility and engage with agencies onshore where required. 781

The practical reality of shared SAR services was outlined by Mr Mark Leigh of ConocoPhillips, who explained that ‘the first response to man overboard, for example, would be your stand-by vessels and things you have in the field’. 782 On this point, Mr Leigh provided context to the benefit of shared emergency response capacity, stating that:

the more operations there are in an area, in this context the safer it gets. You have got more assets you could mobilise; more stand-by vessels, more supply vessels going in and out. There are actually more helicopters in the area and so on. The first response to somebody getting in the water is essentially local help. Ideally, your stand-by vessel and then potentially other assets as well. 783

Shared SAR capability was one of the key reasons why there were no significant human consequences associated with the 2009 Montara oil spill. Despite being an environmental disaster, workers on the Montara platform were safely rescued in the immediate aftermath of that incident by vessels involved in other petroleum industry activities in the area at the time. This was explained by the WA Branch Secretary of the AWU, Mr Stephen Price, as follows:

Montara [was] probably the closest thing we have had to a catastrophic failure of any of these facilities, and that in itself being a fixed platform, I suppose it was fortunate that there was some construction work going on, because the only thing that saved [the

780 Mr Nigel Wilson, Senior Industry Adviser, INPEX, Transcript of Evidence, 7 November 2014, pp 8-9.
781 Mr Andrew Doherty, General Manager, HSSE, Shell in Australia, Transcript of Evidence, 12 November 2014, p 3.
782 Mr Mark Leigh, Team Leader, Asset Integrity and Process Safety, ConocoPhillips, Transcript of Evidence, 10 November 2014, p 8.
783 Ibid.
workers on] Montara was that there was construction work going on not too far away, and there were vessels in the area—pipe-laying vessels and everything associated with it—and they were able to get a quick response to it. It may have been a completely different story if the circumstances were different there.\(^{784}\)

**Finding 58**

An adequate and available search and rescue capability is a regulatory requirement for all offshore petroleum facilities, including FLNG facilities. The search and rescue capability requirements for an FLNG facility are necessarily dictated by international best practice and the facility’s particular location and risk characteristics.

**Finding 59**

Resource companies have invested in search and rescue equipment and services, which has helped address the paucity of search and rescue infrastructure along the Kimberley coastline.

**Finding 60**

One way in which offshore oil and gas operators have discharged the regulatory requirements for search and rescue capability is to collaborate in providing their search and rescue facilities and, thus, enhance each individual operation’s capability.

**The need for coordination**

9.69 With industry and government both making resources available to SAR authorities at both national and state levels, it is critically important that the specific roles and contributions of both industry and government are clearly defined. The Manual characterises Australia’s SAR arrangements as being comprised of ‘two levels’ of response and notes that:

> it is common for a number of SAR Authorities to contribute to one SAR operation. Therefore it is vital that one SAR Authority is responsible for the overall coordination of the SAR operation and the other Authorities involved will cooperate to produce the best response possible within available resources.\(^{785}\)

9.70 In the first instance, however, it must be appreciated that the safety of workers at any offshore petroleum facility is the responsibility of the operator. This fact is emphasised

\(^{784}\) Mr Stephen Price, Branch Secretary, Australian Workers’ Union, *Transcript of Evidence*, 10 November 2014, p 9.

beyond the WA Police, who submitted that ‘in most instances’, the operator of an FLNG facility would effectively:

*assume the role of Controlling Agency for an emergency, having immediate responsibility for the response, supported by the relevant Port Authority. This is where emergency response planning, including emergency evacuation and man overboard procedures that they have in place are critical. If these local arrangements are well thought out ... the demands for external assistance are likely to be limited to where a significant emergency has occurred, for example where this has impacted on these resources to the extent that they are inoperable.*

It is indeed likely that many ‘emergency’ situations involving offshore petroleum facilities—for example, in a man overboard situation—can and should be immediately addressed by the operator without having to call upon external assistance. For more severe emergency situations, however, government assistance may be of paramount importance. In areas of state jurisdiction, the *Emergency Management Act 2005 (WA)*, in conjunction with the *Emergency Management Regulations 2006 (WA)*, establishes the Commissioner of the WA Police as the Hazard Management Agency responsible for SAR. In confirming this responsibility, the WA Police explain that, ‘with regard to emergency management in the maritime environment’, their duties only extend to a distance of three nautical miles seaward of the Territorial Sea Boundary (TSB). Beyond that—which is to say for the vast majority of the maritime environment for which Australia has international SAR responsibility—the responsible SAR authority is AMSA.

According to the WA Police, ‘AMSA undertakes its coordinating function for maritime SAR through the Joint Rescue Coordination Centre (JRCC) Australia’. Furthermore, the WA Police advised that an ‘Inter-Governmental Agreement on National SAR Response Arrangements’ stipulates that all SAR authorities should ‘provide such assistance or facilities as may reasonably be requested by the SAR Authority with overall coordination of a SAR operation’.

Turning to the issue of FLNG operations, the WA Police explained that ‘the scale of any response to an emergency in relation to a FLNG facility from WA Police as a response agency/SAR Authority, as with any police operation, will be determined by the specific incident and location’. For an SAR operation involving a facility ‘located beyond

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786 Submission No. 26 from WA Police, 5 February 2015, p 5.
787 Submission No. 8 from Woodside, 8 August 2014, p 19.
788 Submission No. 26 from WA Police, 5 February 2015, p 2.
789 *ibid*, p 4.
790 *ibid*.
791 *ibid*, p 5.
Chapter 9

costal waters’, the WA Police advised that ‘the State [emergency management] arrangements set out in Westplans do not apply’.792 As it is unlikely that an FLNG facility will operate in state waters, if SAR was required in respect of an FLNG facility it would be ‘coordinated at a national level ... with WA Police and/or other response agencies, such as DoT and/or DFES, providing assistance’.793 WA Police further clarified that this arrangement would ‘not preclude State agencies undertaking the initial response to a call for assistance prior to a more appropriate structure being implemented’.794

9.74 The ‘likely role’ for the WA Police under a nationally-coordinated SAR effort in waters off the WA coast would be ‘to coordinate surface assets’ such as ocean vessels through the Water Police Coordination Centre based ‘in North Fremantle, [and] staffed 24/7 by civilian radio/call takers and police officers who are nationally trained SAR Mission Controllers’.795 The WA Police also advised that four Water Police vessels and five aircraft are available for SAR duties.796 These are outlined in Table 9.3 below.

Finding 61
As safety is the responsibility of an offshore facility’s operator, in the event of an emergency the operator is the Control Agency.

Finding 62
In severe emergency situations on offshore petroleum facilities, including FLNG facilities, government assistance would be required. In Commonwealth waters, this assistance would be coordinated by the Australian Maritime Safety Authority; in state waters it would be coordinated by Western Australia Police.

792 ibid.
793 ibid.
794 ibid.
795 ibid, p 8.
796 ibid, p 8.
### Table 9.3: WA Police vehicles available for SAR duties

<table>
<thead>
<tr>
<th>Water vessels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delphinus:</strong> 22 metres, based in Dampier, accommodates skipper, engineer and 6 crew, 12000 litre fuel tank, maximum speed 26 knots, safe range of operation 760 nautical miles.</td>
</tr>
<tr>
<td><strong>Cygnet V:</strong> 18 metres, based in North Fremantle, accommodates 4 crew, 6000 litre tank, maximum speed 30 knots, safe range of operation 480 nautical miles.</td>
</tr>
<tr>
<td><strong>TW152:</strong> 10 metres, based in North Fremantle, accommodates 8 crew, 700 litre fuel tank, maximum speed 46 knots, safe range of operation within 20 nautical miles of a coast radio station.</td>
</tr>
<tr>
<td><strong>TW154:</strong> 8.5 metres, based in North Fremantle, accommodates 8 crew, 500 litre fuel tank, maximum speed 46 knots, safe range of operation within 20 nautical miles of a coast radio station.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Polair 61:</strong> Rotary Air Wing Helicopter VH-WAH, 7 seat, with facilities including 250kg winch, night vision goggles, thermal imaging (FUR), range of 230nm (425km) and speed 120 knots (222km/hr).</td>
</tr>
<tr>
<td><strong>Polair 62:</strong> Rotary Air Wing Helicopter VH-WPX, 9 seats, facilities including 250kg winch, night vision goggles, FUR, range of 350nm (648km) and speed of 120 knots (222km/hr).</td>
</tr>
<tr>
<td><strong>Pilatus PC-12 (x2):</strong> Fixed Wing Aircraft VH-WPE (at Jandakot hangar, 8 passengers) &amp; WH-WPY (at Karratha hangar, 9 passengers), can fly up to 35,000ft so avoiding all weather activity, range 2000nm (3704km), speed 250knots (463km/hr). Estimated travel time Jandakot to Karratha 3 hrs.</td>
</tr>
<tr>
<td><strong>Gippsland Aeronautics GAS Airvan:</strong> Fixed Air Wing Aircraft (VH-WPF), range 575nm (1064km), speed 115 knots (212km/hr).</td>
</tr>
</tbody>
</table>

Other government agencies can be, and often are, also tasked to assist in SAR activities. In outlining assets that may be of use in an SAR context, the Kimberley Ports Authority submitted that with its ‘regional ship Automated Identification System’, which is able to ‘locate and track vessels well offshore’, it could provide ‘AMSA and WAPOL incident commanders with the position of a ship casualty and a suggested initial course heading for the emergency response helicopter to take’. Furthermore, the Broome port:

*is also capable of operating as a local maritime emergency response centre with the usual command centre accessories inclusive of whiteboards, tabards, forms, plans and communication systems.*

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797 ibid.
798 Submission No. 3 from Kimberley Ports Authority, 11 July 2014, p 4.
799 ibid.
Similarly, the Assistant Commissioner of DFES, Mr Gary Gifford, advised that, if needed, the WA Police would be able to:

use DFES volunteer marine rescue and they can also use a cray boat out in Dongara. If they use the volunteer marine rescuers, they are using a trained capable asset, which they have visibility and awareness of. Our volunteer marine rescuers also have legislation through the FESA act to perform rescues at sea. They also have to a certain extent their own autonomy to respond, but basically with a notification to the police that there is a search and rescue going on.800

Industry assets would also be made available to the coordinating authority during an SAR event. Woodside submitted that collaborative endeavours between industry and government, such as ‘local committee representation, joint exercises and the linkages through incident management systems all enable an integrated approach to search and rescue events’.801 In order to ensure that this collaboration is efficient, Woodside explained that its personnel:

directly engage with the Western Australian State Government emergency management framework including Local Emergency Management Committees, District Emergency Management Committees and the State Emergency Management Committee. Woodside values the ongoing engagement with law enforcement, fire and emergency services, Border Protection Command and the Australian Defence Force who are regular participants in all levels of exercising and drills.802

Woodside also advised that industry working groups regularly meet ‘to discuss emerging issues and potential synergies in the Broome region’, and that Australia’s petroleum industry ‘assesses search and rescue capability for each operating area to ensure that there is a high prospect of recovering personnel from the water within sea survival times’.803 Indeed, the historic development of the North West Shelf project, and the way in which industry has developed SAR capability that is appropriate for supporting petroleum activities in the Carnarvon Basin, provides some insight into the way that industry is preparing for the inevitable expansion of petroleum activities within the Browse Basin.

800 Mr Gary Gifford, Assistant Commissioner, Operations Capability, Department of Fire and Emergency Services, Transcript of Evidence, 19 November 2014, pp 4–5.
801 Submission No. 8 from Woodside, 8 August 2014, p 19.
802 ibid, p 18.
803 ibid, p 19.
Woodside explained that, to ensure that emergency response capabilities in an area are appropriate:

*a range of control measures is assessed in each location and for the North West Shelf this has resulted in a number of sharing arrangements with other operators within the area, for example the Western Australian Resources Aero Medical Evacuation (WARAME) service. This service provides a medically equipped jet with the aim of providing a 24-hour on-call service to the oil and gas industry in the region.*

APPEA explained that the Western Australian Resources Aero Medical Evacuation (WARAME) service exists ‘to provide a 24 hour on call aero medical evacuation service to the oil and gas industry in WA’.

The service, which is based in Karratha and operates a fully medically equipped aircraft, is currently being expanded to eventually also cover the activities that will occur in the Browse Basin. According to APPEA, WARAME was established so that the petroleum industry could ‘avoid drawing on government resources by limiting the potential impact on emergency services should medical evacuation be required’.

Similar to the way in which petroleum industry assets are able to be used to assist AMSA or the WA Police during an SAR event, ‘in the event of an emergency medical case in the community, the Royal Flying Doctor Service or local medical agencies can request use of the WARAME service based on clinical need’.

**Training for emergency preparedness**

**Emergency response exercises**

One method that oil and gas companies use to enhance their emergency preparedness is to conduct regular emergency response exercises. According to Woodside, their regional response teams include personnel trained in ‘incident management, oil spill, fire fighting, communications, aviation, marine and logistics’, and ‘regular exercises are conducted to ensure competencies are adequate for a broad range of scenarios that may affect one facility, several facilities or require multiple points of industry and government coordination’.

For Mr Shaun Gregory, Woodside’s Senior Vice President, Sustainability and Technology, exercising emergency response is the best means of continuous

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804 ibid, p 19.
805 Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 30.
806 ibid.
807 ibid.
808 ibid.
809 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 17.
improvement. To demonstrate, Mr Gregory gave the example of a recent oil spill exercise which:

included the Department of Transport in our level 3 arrangements both in Perth and in Exmouth, and there were some improvements in terms of their understanding of what we were doing and our understanding of what they were doing. That, to me, when we get to FLNG, is the way forward—we will exercise and we will find those gaps and we will close them.  

Similarly, Shell submitted that exercises are conducted to allow those who will respond to an emergency ‘to practice their roles and responsibilities and remain familiar with specific response plans’.811 According to Shell:

major exercises and regular stakeholder engagement with government, regulators, contractors and other key service providers ensure integration between organisations, familiarisation and communication requirements. Further Shell global and regional exercises test and refine Shell’s ability to respond to incidents across multiple regions and business units.812

While government involvement in emergency response exercises is discussed in Chapter 2, it is useful here to acknowledge that government agencies are involved in Major Accident Event (MAE) exercises. For example, because of its proximity to the oil and gas supply chain in the north west of the state, the Kimberley Ports Authority is ‘invited to participate in offshore operators’ safety training, drills and exercises’.813 The Kimberley Ports Authority submitted that:

major safety incident exercises are generally conducted from individual company crisis management centres, and KPA has contributed to several of these exercises by both physically deploying equipment on platform supply vessels, and participating by telephone with the crisis management centre.814

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810 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside Energy Ltd, Transcript of Evidence, 7 November 2014, p 7.
811 Submission No. 9 from Shell in Australia, 11 August 2014, p 8.
812 ibid.
813 Submission No. 3 from Kimberley Ports Authority, 11 July 2014, p 4.
814 ibid.
9.85 The Department of Transport (DoT) advised that it was hosting the June 2015 National Plan exercise which will involve an offshore petroleum incident off the coast of Exmouth, ‘most likely involving a fictional FLNG facility with a coastal impact’. 815

9.86 WA Police also advised that its Critical Infrastructure Unit ‘has witnessed and participated in a number of EM exercises with oil and gas owner/operators and have found these exercises to be of a uniform high quality’. 816 Furthermore, according to WA Police:

\[
\text{while outcomes varied, even those with outcomes which were substandard, were used as a basis to improve in the future, with lessons identified communicated to those who needed to know to ensure better outcomes in the future.} \text{817}
\]

9.87 WA Police see ‘safety culture and a need to very regularly exercise emergency management are “business as usual” to oil and gas operators’. 818

Finding 63
Regular collaborative exercises which allow personnel to practise their roles are a critical component of an FLNG facility’s search and rescue preparedness.

9.88 As the chapters on emergency responses to severe weather events, loss of containment, accidents and oil spills demonstrate, it is essential that those who will be working on or near an FLNG facility receive appropriate training to the necessary level of proficiency. While good policies and procedures, together with a company-wide robust safety culture, are extremely important, without appropriately trained staff those policies and procedures will be ineffective at best. Not only must staff be trained in particular emergency situation responses, they must also be fully aware of how a facility’s safety system operates and what their particular role is.

9.89 Woodside submitted that its emergency and crisis management personnel undertake ‘ongoing competency based training and a crisis management capability development program’. 819 This ‘weekly onshore and offshore facility training and regular team training culminates in quarterly pan-Woodside exercises to test preparedness, performance and identify opportunities for improvement’. 820

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815 Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, pp 3–4.
816 Submission No. 26 from Western Australia Police, 2 February 2015, p 5
817 ibid.
818 ibid.
819 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 17.
820 ibid.
Shell acknowledges the need to ensure that all staff working on its FLNG facilities ‘understand how the safety systems work, what their role is and how we work together to make it a safe operation’. In relation to Prelude, Shell advised that some of the recruited operators are undertaking:

*core FLNG training so that when they join us, they come up to the same level of understanding of the hazards and how to manage and then going on to Geoje and helping with pre-commissioning so they become intimately involved with the FLNG facility and how it works.*

This FLNG operator training is taking place at the Australian Centre for Energy and Process Training (ACEPT) in Henderson. ACEPT advised that the Foundation Training Program is an eight week course that includes Prelude FLNG ‘fundamental design and operating principles’, together with Shell’s HSSE requirements. According to ACEPT, ‘the program is designed to ensure technicians can move beyond routine operation and maintenance and deal with the novel situations that operate during commissioning in a safe and efficient way’.

ACEPT’s FLNG training program consists of three main streams, each with several topics, as set out in Table 9.4 below.

<table>
<thead>
<tr>
<th>Stream</th>
<th>Units/Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nationally Recognised Units of Competency</td>
<td>• Working Safely at Heights</td>
</tr>
<tr>
<td></td>
<td>• First Aid</td>
</tr>
<tr>
<td>2. Awareness and Introduction to FLNG and the Prelude Facility</td>
<td>• Pre-treatment</td>
</tr>
<tr>
<td></td>
<td>• LNG Simulator exercises</td>
</tr>
<tr>
<td></td>
<td>• Fire Water Systems</td>
</tr>
<tr>
<td>3. Shell Standard Front Line Barrier Management (FLBM) Competencies</td>
<td>• Chemical Handling and Hazard Communication</td>
</tr>
<tr>
<td>(Shell’s Global HSSE Standards)</td>
<td>Controlling Static Electricity</td>
</tr>
<tr>
<td></td>
<td>• Gas Testing</td>
</tr>
<tr>
<td></td>
<td>• Gas Freeing or Purging</td>
</tr>
<tr>
<td></td>
<td>• Simple Lifting/Rigging and Slinging</td>
</tr>
</tbody>
</table>

822 ibid.
823 Submission No. 18 from Australian Centre for Energy and Process Training, Challenger Institute of Technology, 8 December 2014, p 1.
824 ibid.
825 ibid, pp 1–2.
Eighty-nine technicians, including production, instrument electrical and mechanical technicians, have been trained to date and a further 27 are to be trained by the end of March 2015. 826

**Knowledge sharing**

The oil and gas industry also argues that sharing information is part of its emergency prevention and management strategies. For Woodside, this information sharing occurs within the organisation and with other groups. According to Woodside, its internal Emergency Management Steering Group ‘shares emergency management risk trends and learning’s, provides advice on improvement opportunities and promotes standardisation and consistency across the company’. 827 Woodside further submitted that it ‘participates in a number of formal and informal groups established at local, state and national levels in Australia which provide platforms for communication and sharing of strategic emergency advice and learnings’. 828

APPEA advised that its members involved in FLNG projects ‘share safety lessons and environmental lessons with their peers’. 829 APPEA also advised that it has a committee of health and safety officers that meets quarterly and provides a means by which members:

> share high-potential events, lessons learnt, and then they will talk about them with the Chatham House rules. That forms a link of better understanding about those specific events, but it also joins mutual interests together that say, “I’ve got a problem like that”, and those guys then speak to each other directly out of that committee process. 830

According to Mr Andrew Woodhams, Director, Safety and Environment, APPEA, ‘the industry is good at benchmarking with each other and learning off each other when they see good practice, thus making the practice of the whole industry better’. 831

APPEA also advised that it had introduced in 2009 a requirement for members to report high potential incidents. From this information APPEA distributes anonymised high potential incident alerts to the oil and gas industry so that lessons can be learned from these incidents. APPEA submit that this reporting and alert program ‘is now well established with wide dissemination of information, root causes and lessons learned. It

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826 ibid, p 1.
827 Submission No. 8 from Woodside Energy Ltd, 8 August 2014, p 17.
828 ibid.
830 ibid, p 5.
831 ibid, P 9.
Chapter 9

covers incidents capable of causing fatalities or a major accident event’. 832
Furthermore, in conjunction with the International Association of Oil and Gas
Producers, APPEA’s alerts are also included on the international database, allowing
sharing of information on an international basis.

As at 19 February 2015, a total of 166 incident alerts had been published on APPEA’s
HiPo Alerts data base. An example of an APPEA HiPo Alert is provided at Appendix
Eight.

While acknowledging that it is apparently true to say that ‘there are no new incidents’,
Mr Woodhams stated that:

the important thing is to keep it prevalent in people’s minds so that
they take the nuggets away and then go and check their operations
and make sure that those similar items are being well managed. It is a
good sharing process. 833

Finding 64
It is essential that the petroleum industry continues to share information on safety
lessons learned and on safety incidents.

Finding 65
While safety cases and environmental plans necessarily contain proprietary
information, the high-potential event summaries published on the Australian
Petroleum Product and Exploration Association’s website need not contain proprietary
information.

Finding 66
High-potential event summaries could usefully be made available to regulators and to
government agencies. For example, it would assist the Western Australian Government
in the preparation of Westplans.

Operators as control authorities

There are two main reasons why the development and sharing of emergency
management resources by operators is appropriate. First, arrangements of this nature
simply reflect the broad regulatory requirements that the entity responsible for
creating a risk is also responsible for guarding against it. This has been discussed in
detail in Chapters 4 and 6.

832 Submission No. 11 from the Australian Petroleum Production and Exploration Association,
833 Mr Andrew Woodhams, Director, Safety and Environment, Australian Petroleum Product and
Exploration Association Limited, Transcript of Evidence, 7 November 2014, p 11.
9.101 Mr Guyan of NOPSEMA further explained that an operator would need to demonstrate that resources were available to implement an emergency response plan, and that as such the plan became a ‘control’ for any NOPSEMA inspection. On this point, Mr Guyan confirmed that NOPSEMA:

> can, and often do, inspect against that control. We view that as being a mitigation measure. It is after the fact of whatever the event is to mitigate any further harm to people, so we can test against that control, and often do. I am not sure if you are going to onshore resources in terms of hospital capability, but the safety case in general and in this area in particular, requires that there be performance standards in relation to safety controls. For example, a performance standard might specify a particular time to get a casualty to an appropriate level of medical care. It might specify time to recover a man overboard, so once a fast rescue craft has recovered them and has them in the medical facilities. The performance standards are key to the effectiveness of all of the controls. Those are specified, so on a facility-by-facility basis, of course, that changes.  

9.102 Given the onus on the operator to be prepared for emergency situations, industry collaboration in making emergency resources commonly available represents an efficient way for petroleum companies in Australia to discharge this duty. Industry has developed a cooperative approach such that ‘if one company has a problem, another company will actually assist them, not only because it is in the interests of everyone to do a good job, but it is actually a good way to get experience as well’.  

9.103 This means that if a resource slated for development is so remote as to render any existing SAR capability inadequate, the proposed operator will have to rectify this situation (generally through installing appropriate SAR infrastructure) before any development is able to proceed. It is for this reason that, as Woodside submitted, while ‘it is important for Government and industry to continue to work together to consider necessary response requirements and possible gaps and areas that can be improved’, the present situation is such that:

> there has not been an immediate need for additional Federal or State government emergency response resources or infrastructure to support FLNG projects.  

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835 Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, p 5.
836 Submission No. 15 from Woodside, 1 December 2014, p 3.
The second reason why it is appropriate for operators to develop and share emergency response resources is that, largely because they are in the best position to provide the initial response, operators are the designated control agencies for emergency situations. As the DoT’s General Manager of Marine Safety, Mr Raymond Buchholz, explained, while the DoT has ‘jurisdictional authority responsibility’, it is very important:

the control agency is in place, because they are the people who are best placed to actually provide an initial response and then the resources to continue that response. That is why, for example, Shell or Woodside are pinned with being the control agency. It is expected as part of these plans that they have adequate training, equipment and procedures in place. They are the first on the scene; they deal with it.837

The DoT’s role is to oversight that response in state waters and ensure that ‘an adequate response is provided’, and providing as much assistance as is possible.838 Mr Buchholz further explained that while ‘it is really important that the Department of Transport is the lead agency’ for responding to oil spill pollution in state waters, that does not mean that there exists ‘an army of people waiting to be deployed to any spot in the state’.839

Mr Buchholz also advised that in the case of very large incidents, particularly as neither government nor industry has ‘sufficient resources to manage it by themselves’ a collaborative approach to emergency response has developed.840 According to Mr Buchholz:

whilst NOPSEMA would be the jurisdictional authority, they are very much getting support instantly from the national response team, from AMSA, from ourselves. There is a whole collegial approach to that arrangement.841

Finding 67
As neither industry nor government has the capacity to manage high consequence offshore incidents alone, a collaborative approach to emergency response has developed.

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837 Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, p 6.
838 ibid.
839 ibid.
840 ibid, p 5. See also Mr Gavin Guyan, Acting Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 7 April 2015, pp 3-6.
841 ibid.
For this reason, whenever it can, the DoT takes the opportunity to send its staff to other jurisdictions to learn from their experiences with petroleum industry emergencies. For example, and reflecting the community spirit of emergency response, DoT staff were sent ‘to New Zealand in the Rena incident’ of October 2011.  

NOPSEMA noted that ‘it is not an emergency or pollution response agency’; rather, in the event of an offshore incident, NOPSEMA’s role ‘includes monitoring the duty holder's response to the emergency, investigating the causes of the incident and taking appropriate enforcement action to secure compliance as necessary’.  

NOPSEMA advised that ‘the principal formal arrangement for government coordination of a significant offshore petroleum incident is the Australian Government Crisis Management Framework, which identifies the Federal Department of Industry-led Offshore Petroleum Incident Coordination Committee (OPICC)’.  

According to the Department of Industry, the OPICC’s roles and responsibilities are:

- providing leadership and strategic coordination in response to an incident;
- developing and communicating a common operating picture on behalf of the Australian Government;
- reporting to relevant Ministers and governments on the conduct and associated risks of emergency and response operations;
- developing and implementing a whole-of-government approach to media management in response to the incident;
- developing and implementing a whole-of-government approach to community engagement in response to the incident; and

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842 ibid. On 5 October 2011, the MV Rena ran aground on the Astrolabe Reef located off the north east coast of New Zealand. Of its load of 1,368 containers, eight contained hazardous materials. It was also carrying 1,700 tonnes of heavy fuel oil and 200 tonnes of marine diesel oil. This was described as New Zealand’s worst maritime environmental disaster. See: http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=10758195. Accessed on 20 February 2015.


844 ibid. The OPICC was established in response to the Report of the Montara Commission of Inquiry.
Chapter 9

- providing support to the Control Agency as required.\(^{845}\)

9.111 The Department of Industry notes that the OPICC is not a mechanism through which to ‘deploy Commonwealth resources for the operational response’ as that is, ‘in the first instance, the offshore petroleum titleholder’s responsibility’ which is ‘coordinated in accordance with their Oil Pollution Emergency Plan and other regulatory instruments’.\(^{846}\) OPICC is also not responsible for ‘incident control or implementing operational response arrangements’ as these are also the responsibility of the control agency.\(^{847}\)

Finding 68

Neither the National Offshore Petroleum Safety and Environmental Management Authority nor the Offshore Petroleum Incident Coordination Committee are emergency or pollution response agencies. The responsibility for emergency and pollution response lies with the facility’s operator.

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\(^{846}\) ibid.

\(^{847}\) ibid.
Chapter 10

What happens if there’s a loss of containment?

Oil pollution

10.1 Environmental damage caused by an unplanned release of petroleum at sea is an inherent risk of any offshore petroleum activity. While the magnitude of the damage depends on a range of different factors, if petroleum is spilled in a marine environment the potential consequences for fish, birds and other fauna in the area can be devastating. The impact on marine vegetation is also often severe. Furthermore, the volatility of petroleum can create a safety hazard. Put simply, petroleum pollution can have catastrophic consequences if it is not immediately and adequately addressed.

10.2 It is for this reason that the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGSE Regulations) stipulate, at r 14(8), that every Environment Plan must include an Oil Pollution Emergency Plan that specifies the proponent’s capacity and strategy for dealing with an oil pollution event.848 This means that no offshore petroleum activity can occur in Australia without the proponent satisfying the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) that they are properly prepared to respond quickly and limit damage to the environment if oil pollution occurs.

10.3 This requirement thus places the onus for responding to, and dealing with, oil pollution on the company that caused it. According to the Australian Petroleum Production and Exploration Association (APPEA), this arrangement—in which ‘the petroleum titleholder is responsible to act as the Combat Agency’ in the event of a petroleum spill—represents a ‘major regulatory change’ implemented in the aftermath of the Montara and Macondo disasters in 2009 and 2010.849 In submitting that these disasters (both of which are described in Chapter 1) ‘provided many valuable lessons and led to a significant collective response by the Australian upstream petroleum industry’, APPEA explained that as a result of both Montara and Macondo, ‘industry has focussed its collective leadership on expanding and strengthening its capacity and preparedness to respond to … major incidents’.850

850 ibid.
Chapter 10

Finding 69

As the risk of oil pollution is inherent to any petroleum facility, robust regulation and management practices are critical. It is essential that industry and government have a strong focus on the regulation and management of oil pollution risk and occurrences.

10.4 Oil pollution caused by offshore petroleum activity represents what is often referred to within the petroleum industry as a ‘low probability, high consequence’ event. In order to ensure that individual petroleum companies in Australia are able to respond to such an event, the industry as a whole maintains a suite of resources for common use when necessary. APPEA explained that because ‘no one titleholder or operator can possibly continuously hold the emergency response capacity’ for such an event:

the petroleum industry, regionally, nationally and internationally, has developed a series of mutual aid arrangements (both between companies, and between industry and governments) that allow for the cascading of additional resources into an emergency response.\(^{851}\)

10.5 APPEA cited ‘initiatives such as the Subsea First Response Toolkit, mutual aid arrangements for drilling of relief wells, and international collaboration in developing advanced well capping solutions’ as examples of such arrangements.\(^{852}\) To appreciate how these arrangements would aid the response to an offshore oil spill pollution event, it is useful to consider the strategies that exist for responding to an unplanned release of petroleum at the wellhead, before turning to consider how oil spill pollution on the ocean’s surface is treated.

Subsea First Response

10.6 One of the great challenges faced by petroleum producers is the fact that reservoir characteristics can vary markedly from field to field—while some fields can be under immense pressure, for example, others may require pressurisation in the production process. Sophisticated well infrastructure is thus used in order to regulate the flow of raw petroleum from a reservoir. This infrastructure can also be used to stem the flow of petroleum entirely if required.

10.7 From time to time, however, this infrastructure can suffer a loss of integrity, leading to what is referred to as a ‘loss of containment’.\(^{853}\) When this occurs on a subsea well,

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851 ibid. Under the OPGGSE Regulations, the titleholder is responsible for preparing the Environment Plan and Oil Pollution Emergency Plan, while under the OPGGSS Regulations, the operator is responsible for the safety case. This report concerns the use of FLNG technology to produce a discovered petroleum resource, rather than exploration activities undertaken by titleholders. Therefore, for ease of discussion, the Committee generally uses the term operator in discussing the workplace and environmental safety responsibilities of FLNG project proponents. See: Submission No. 28 from Department of Industry and Science, 16 April 2015, p 1.

852 ibid.

853 ibid, p 25.
petroleum is released into the ocean, causing oil pollution—and demanding a rapid response from the operator. APPEA explained that:

_in the event of any loss of well containment incident, one of the first steps involved in any response is to survey the well site, attempt intervention on the existing well integrity systems, such as the Blow-Out Preventer (BOP) or Xmas tree, and if necessary, prepare the site for the possible deployment of a capping stack._

While the equipment required for this intervention is complex and expensive, stemming the flow of petroleum into the ocean demands that this equipment be readily available for rapid deployment. Intervention at a compromised wellhead is often referred to as ‘source control’ and is an extremely important component of any oil spill response strategy. Clearly, ‘the elimination of a hydrocarbon spill at source will always result in lower impact than an attempt to recover the hydrocarbon once it has been released to the environment’.

In Australia, APPEA members have jointly invested in a suite of ‘first response’ intervention equipment known as the Subsea First Response Toolkit (SFRT). APPEA submitted that the investment of ‘many millions of dollars’ by the Australian petroleum industry into procuring and maintaining the SFRT ensures that:

_incident response times in Australian waters are minimised by locating this equipment in Australia and ensuring it is kept in a state of operational readiness at all times through the Australian Marine Oil Spill Centre._

**Finding 70**

_In the event of a loss of containment at the wellhead, the response needs to include targeted subsea source control._

The SFRT consists broadly of ‘the tools required to prepare the well for the source control’. Source control can involve both ‘capping’, wherein a sophisticated capping structure is fitted over a damaged subsea well to seal off the well and stop any petroleum flow, and/or ‘containment’ which involves the capture and collection of petroleum from a damaged well. APPEA explained that ‘it is important to differentiate between capping and containment’, because where ‘[c]aping stops flow, containment captures [it]’, and as a result ‘[t]he equipment requirements for a

854 ibid, p 26.
855 ibid, p 25.
856 ibid, p 26.
857 ibid.
858 ibid, p 25.
containment system may be considerably more complex than those for capping the well.\textsuperscript{859} In both cases, the aim is to prevent oil spill pollution from occurring.

\textbf{Figure 10.1: A capping stack.}\textsuperscript{860}

\begin{figure}[h]
\centering
\includegraphics[width=0.5\textwidth]{capping_stack.png}
\caption{A capping stack.}
\end{figure}

\begin{quote}
\textbf{10.11} In explaining the present situation in Australia, APPEA highlights the fact that ‘each titleholder proposing to drill an offshore well in Australian waters is responsible for developing source control strategies.’\textsuperscript{861} Should a capping stack contingency be required, titleholders:

\textit{will lay out the requirement for a capping stack contingency [and] explain the mechanism it has in place for securing the use of a capping stack in a timely manner should a loss of containment occur.}\textsuperscript{862}
\end{quote}

\begin{quote}
\textbf{10.12} APPEA cited arrangements in place for access to capping stack infrastructure as another example of industry collaboration because, although some maintain an in-house capping stack and others have negotiated a commercial arrangement for
\end{quote}

\begin{thebibliography}{9}
\bibitem{859} ibid.
\bibitem{861} Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 25.
\bibitem{862} ibid.
\end{thebibliography}
capping stack access, many of Australia’s petroleum producers have instead ‘joined the
global Oil Spill Response Limited/Subsea Well Response Project’. Describing it as a
joint initiative between several major oil and gas companies’, APPEA explained that the
Oil Spill Response Limited/Subsea Well Response Project has:

\[
developed four capping stack systems, with one system delivered to
Singapore, enabling the industry to cap most subsea oil wells in water
depths up to 3000m around the world, as well as providing flexibility
for various contingencies.\]

**Finding 71**
The offshore petroleum industry’s Subsea First Response Toolkit is designed to address
a petroleum spill at its source.

10.13 This intervention system is stored and maintained by the industry-owned global
cooperative Oil Spill Response Limited and is ‘available to operators through
subscription and a supplementary agreement’. Similarly, equipment that is needed in
mounting an emergency response, such as vessels, remote operated vehicles and
drilling units, are made available ‘with minimal response time if an emergency [is]
declared’. As APPEA explained, ‘whilst this equipment remains the responsibility of
individual titleholders, the availability of this equipment is assured through an industry
mutual aid agreement facilitated by APPEA and signed by Australian offshore
operators’.

10.14 Further practical details of the subsea response and source control arrangements in
Australia was also provided by Woodside’s Senior Vice President, Sustainability and
Technology, Mr Shaun Gregory, who explained that ‘there are three layers’ of oil spill
response protocols, with the first being:

\[
the immediate, or what is on board [which] would be definitely in stock locally [with each specific operator]. The next step … would be the
subsea first respond toolkit. For that, we are a part of an industry
body, but that is an Australian industry body. Currently that is pre‐
staged, ready to go in Fremantle, and that is a kit that is needed to
clear the subsea infrastructure and the damage that is there. The next
tier is a capping stack facility, and we are part of a global community,
where currently that for us is based in Aberdeen, and that would be
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863 ibid.
864 ibid.
865 ibid.
866 ibid, p 26.
867 ibid.
Chapter 10

mobilised once the sea floor was ready for that to be installed. So they are the three tiers. 868

It is important to note that the design of various pieces of source control infrastructure has been heavily informed by the logistical challenges associated with remote offshore operations. When asked about the difficulty of transporting large pieces of equipment to an emergency site, Mr Gregory explained that ‘the kit is made modular for air transport and regional infrastructure, so it is able to get to Exmouth, for example’. 869 Mr Gregory also explained, however, that the need for the multi-tiered response model was a function of the difficulty of transporting some of the more complex pieces of intervention equipment, noting that ‘the capping stack facility is sort of a seven-day time frame; the first few days is the subsea first response toolkit, which is why that is pre-staged in Fremantle’. 870

Dealing with oil spill pollution

Depending on its composition, petroleum that is spilled at sea has the potential to become a very harmful pollutant. With the OPGGSE Regulations establishing each petroleum company as the Combat Agency responsible for cleaning up any oil spill pollution caused through their activities, an important facet of any Oil Pollution Emergency Plan is a detailed strategy for cleaning up any oil spill pollution that does occur.

There are four broad methods of treating oil spill pollution, with factors such as location, petroleum composition, accessibility and metocean conditions bearing upon any decision as to which method is most appropriate for a given set of circumstances.

- **Natural biodegradation**: the most basic method for treating spilled petroleum is to let nature take its course. If petroleum is spilled in a location where damage is unlikely to occur, and particularly if the petroleum in question is ‘light’, it is said that ‘the best method is to leave it to disperse by natural means [because the] combination of wind, sun, current and wave action will rapidly disperse and evaporate most oils’. 871

- **Containment and collection**: in some circumstances, it may be possible to contain spilled petroleum ‘with booms and collect it from the water surface using skimmer equipment’. 872 These booms, which ‘vary from inflatable neoprene tubes to solid,
but buoyant material’, can also be used to prevent a slick of spilled petroleum from reaching an ecologically sensitive area.\textsuperscript{873} This method, however, is ‘less effective when deployed in high winds and high seas’.\textsuperscript{874}

\textbf{Figure 10.2:} Floating booms in various configurations at the AMOSC warehouse in Fremantle.

\textbf{Figure 10.3:} Oil spill skimming devices at the AMOSC warehouse in Fremantle.

- The use of chemical dispersants: perhaps the most commonly used method is to break up a slick of spilled petroleum and thereby speed its natural biodegradation using chemical dispersants. Ordinarily, oil and water molecules will not mix, which

\textsuperscript{873} ibid.
\textsuperscript{874} ibid.
Chapter 10

means that spilled petroleum has a tendency to form large ‘slicks’ on water and break down very slowly. Dispersant acts to separate these slicks by allowing petroleum molecules to emulsify with sea water. When petroleum is broken down into smaller droplets, the process of natural degradation is much more rapid. Though ‘most effective when used within an hour or two of the initial spill’, dispersants are not always an appropriate for treating oil spill pollution, because dispersing oil ‘through the water column can affect marine organisms like deep-water corals and sea grass’. 875

• The use of biological agents: the biodegradation process can also be enhanced by the introduction of certain biological agents (such as certain types of bacteria and other microorganisms), which can break down spilled petroleum into less harmful substances like fatty acids and carbon dioxide. 876

Finding 72

In the event of oil pollution, the deployment of the appropriate resources is as important as the speed of response. It is important that the right method of treatment for a particular spill is applied in the most efficient manner.

10.18 Just as a loss of containment from a subsea well requires a rapid response, the speed with which a Combat Agency responds to a petroleum spill is critical in limiting environmental damage. This is particularly true when chemical dispersants are to be used. It is, therefore, important that dispersants are available for rapid deployment in the event of a petroleum spill. In providing details of Woodside’s petroleum spill response model, Mr Gregory explained that the arrangements that are in place for dealing with spilled petroleum are similar to those in place for source control: individual petroleum companies will typically maintain an in-house inventory of equipment suitable for immediate response, only seeking assistance from local and ultimately global partners if a situation escalates. 877 According to Mr Gregory, in the event of an petroleum spill:

if you were to use dispersant, the same early dispersant is pre-staged.
The next tier is part of an Australian community engagement, which is what we work with, and OSRL [Oil Spill Response Limited] is our international body for if we need long-term supply of dispersant. So we tier it according to the demand and requirement. 878

875 ibid.
876 ibid.
877 Mr Shaun Gregory, Senior Vice President, Sustainability and Technology, Woodside, Transcript of Evidence, 7 November 2014, pp 5–6.
878 ibid.
Mr Gregory’s explanation of these arrangements reflects the fact that adequately dealing with a petroleum spill can very easily require a response effort that is beyond the capacity of any one company. APPEA made it clear that, in recognition of this fact, ‘oil and gas companies have over a number of years developed cooperative arrangements providing for mutual aid, both in Australia and globally’.\(^{879}\) According to APPEA, within Australia:

> these mutual aid arrangements are brought together under the Australian Marine Oil Spill Plan (AMOSPlan). The AMOSPlan embraces the:

- response and training activities of AMOSC [Australian Marine Oil Spill Centre]; and

- company to company mutual assistance arrangements administered by AMOSC.

Under the AMOSPlan, designated oil spill response resources of individual companies are made available to other companies and to the National Plan under service contract agreements administered by AMOSC. The AMOSPlan is activated by a company when the response to an oil spill incident is regarded by the company as requiring resources beyond those of the company itself.\(^{880}\)

The Australian Marine Oil Spill Centre (AMOSC) was established in 1991 and ‘is a not-for-profit company, financed by nine participating oil companies and other subscriber companies, and operates the Australian oil industry’s major oil spill response facilities’.\(^{881}\) AMOSC has 14 permanent staff members and is also able to draw upon the skills of a further 84 employees of various member companies. AMOSC works to ensure that rapid petroleum spill response capacity exists in Australia by providing ‘a 24 hour a day spill response capability’.\(^{882}\) To do this it maintains a ‘stockpile of oil response equipment [including] oil spill dispersant and containment, recovery, cleaning, absorbent and communications equipment’.\(^{883}\) A primary stockpile of this equipment is maintained in Geelong, Victoria; two secondary stockpiles are maintained in Fremantle and Exmouth, and a supplementary stockpile is maintained in Broome. Among the various resources maintained by the AMOSC is a stockpile of 500 cubic metres of

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\(^{879}\) Submission No. 11 from the Australian Petroleum Production and Exploration Association, 18 August 2014, p 27.

\(^{880}\) ibid, pp 27–28.

\(^{881}\) ibid, p 27.

\(^{882}\) ibid.

\(^{883}\) ibid.
Chapter 10

dispersant that is ‘suitable for use as part of the source control system’, and was
procured as part of the SFRT initiative. According to APPEA:

the substantial equipment stockpile located in Fremantle supports Western Australian based training and operations. In addition, selected AMOSC equipment is also available under short term hire arrangements to required locations, to cover temporary requirements for equipment.

Figure 10.4: A stockpile of dispersant at the AMOSC warehouse in Fremantle.

10.21 During a Committee visit to AMOSC’s Hamilton Hill facility, which forms part of its
Fremantle stockpile, AMOSC stressed the importance of drills and exercises to oil spill
response preparedness. According to AMOSC, exercising is crucial as it helps to test not
only the competencies of staff, but also the resilience and operational status of
equipment. For example, AMOSC has recently run a drill for a North West Shelf
operator which involved mobilising an aircraft from Perth to a light airstrip in the
Pilbara within the time requirements for response and also coordinating the exercise
for the four participating companies. AMOSC also described an exercise that revealed
that some of the equipment was past its certification date and needed to be

884 ibid, p 26.
885 ibid, p 27.
Clearly, during an emergency AMOSC would work with the equipment it has to hand. However, exercises provide a valuable means of ensuring equipment is operational when it is most needed.

10.22 While it is clearly the proponents’ decision as to how often they exercise, the Committee sees great value in these types of drills. Furthermore, given that the Prelude facility will be the first FLNG facility to operate off the Australian coast, an FLNG-based exercise would be of significant benefit as a learning exercise. The Committee’s view is that a Prelude-based exercise would involve operators, Commonwealth and Western Australian Government agencies, AMOSC and other stakeholders.

10.23 AMOSC also offers various national and international training packages to staff within Australia’s petroleum industry, and its response capabilities are constantly reviewed and upgraded—APPEA cited the recent acquisition of an ‘Oiled Wildlife Response Mobile Facility’ as an example of an equipment upgrade, and the recruitment of an ‘Oiled Wildlife Response Expert’ as an example of an addition to its specialised personnel. Furthermore, AMOSC works not only in collaboration with its members, but also with a number of official response partners, such as the Australian Maritime Safety Authority (AMSA) and the WA Department of Transport (DoT). It is therefore useful to consider the roles and responsibilities of such government entities in the event of an oil spill.

Figure 10.5: An ‘Oiled Wildlife Response Mobile Facility’ at the AMOSC warehouse in Fremantle.

Finding 73
To discharge their regulatory responsibility in relation to marine petroleum spills, a number of oil companies formed the Australian Marine Oil Spill Centre, which allows for the pooling of resources to respond to loss of containment events.

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886 Australian Marine Oil Spill Centre, Committee Briefing, 25 February, 2015.
887 ibid.
Chapter 10

Finding 74
The Australian Marine Oil Spill Centre has a suite of oil pollution response resource stockpiles strategically located around Western Australia.

Finding 75
The Australian Marine Oil Spill Centre offers oil spill response training packages, and works collaboratively with industry and government agencies to help staff develop the practical skills and knowledge to allow them to response appropriately in the event of marine oil pollution.

Finding 76
Emergency response exercises such as those conducted and coordinated by the Australian Marine Oil Spill Centre are of significant benefit to the offshore petroleum industry as it allows the competencies of staff and the operational status of equipment to be tested and maintained.

Finding 77
An FLNG-based exercise involving all relevant stakeholders should take place once the Prelude facility is operational.

Recommendation 1
The Western Australian Government encourage the Commonwealth Government, Shell and other stakeholders to conduct an emergency response exercise based on the Prelude facility as soon as possible following its commissioning.

The role of government

10.24 The role played by various government agencies in the event of oil spill pollution occurring in Australian waters depends primarily upon whether the waters in question is in an area of state or Commonwealth jurisdiction. In Western Australia’s state waters, emergency management is ‘covered under the Emergency Management Act 2005 and the Emergency Management Regulations 2006’, with state emergency management plans, known as ‘Westplans’, being prepared by the State Emergency Management Committee.

10.25 A total of 27 Westplans are maintained by various state government agencies; these Westplans ‘set out the roles and responsibilities of government agencies in relation to prevention and mitigation, preparedness, response and recovery’. Of these plans, the ‘Westplan Marine Oil Pollution’ (Westplan MOP) and the ‘Westplan Marine Transport Emergency’ (Westplan MTE) plans—both of which are prepared and

888 Submission No. 2 from the Department of Transport, 11 July 2014, p 2.
889 ibid

224
maintained by DoT—relate to maritime emergencies. Both of these Westplans are lengthy documents that set out the emergency management arrangements that are in place for each type of incident, before detailing the strategies for prevention and mitigation, and the preparedness and response procedures that would follow were such an incident to occur.

10.26 The DoT explained that ‘if whilst in Commonwealth waters [a petroleum vessel or facility] suffers either a Maritime Transport Emergency (MTE) or Marine Oil Pollution (MOP) incident the situation would be controlled by the Commonwealth through the Australian Maritime Safety Authority’.890 If, however, a petroleum vessel or facility were to suffer either an MTE or MOP incident while moving through state waters, ‘the situation would be controlled by DoT Marine Safety as jurisdictional authority’.891 APPEA further explained that:

the WA petroleum industry works closely with the WA Department of Transport in developing increased mutual aid capacity (through the AMOSPlan) and involving the Department in key oil spill response initiatives.892

10.27 A petroleum spill in Commonwealth waters would fall under the jurisdictional authority of AMSA. In areas of Commonwealth jurisdiction, the National Plan for Maritime Environmental Emergencies ‘sets out national arrangements, policies and principles for the management of maritime environmental emergencies’.893 APPEA explained that this plan ‘is administered by the Council of Transport and Infrastructure under the Council of Australian Governments’ and is managed by AMSA. APPEA further submitted that ‘the Australian petroleum industry stays strongly committed to the National Plan, and has a strong and active relationship with AMSA’.894

10.28 The jurisdictional division of responsibilities was further emphasised by the DoT’s General Manager of Marine Safety, Mr Raymond Buchholz, who confirmed that, ‘in accordance with the “National Plan for Maritime Environmental Emergencies”’, NOPSEMA is the ‘jurisdictional authority for an environmental incident involving [a petroleum facility] in commonwealth waters, and the petroleum title holder would be the control agency’.895 Mr Buchholz further explained that the same plan establishes the DoT as ‘the jurisdictional authority for an environmental incident involving such a facility in state waters’, with the responsible petroleum company again being the

890 ibid.
891 ibid.
893 ibid.
894 ibid.
895 Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, p 2.
Chapter 10

responsible control agency.\textsuperscript{896} As Mr Buchholz put it, ‘whether it is in commonwealth waters or in state waters, effectively, the petroleum title holder would be considered the control agency for that incident’.\textsuperscript{897}

10.29 Mr Buchholz also provided some insight into how an emergency response would be managed in the event that spilled petroleum were to cross from Commonwealth into state waters: According to Mr Buchholz:

\textit{if an oil spill crosses from commonwealth waters into state waters, the jurisdictional authority for the recovery of that oil would be negotiated between NOPSEMA and the Department of Transport ... The control agency in that instance would remain with the spill source unless otherwise determined by the jurisdictional authority. In other words, the jurisdictional authority has the ability at any time to say, “We don’t believe you’re doing a good job; therefore, we’re going to take that responsibility off you”, but in doing so, it has to then nominate a new control agency, which I am sure the public would expect would be doing a better job than what they had been doing.}\textsuperscript{898}

The reality of FLNG petroleum products

10.30 A final critical element in determining the extent of any environmental damage caused by a petroleum spill—and thus the acceptable level of preparedness—is the specific composition of the petroleum product that could potentially be released. In a broad sense, heavier hydrocarbons such as crude oil are much more environmentally damaging if spilled at sea than lighter hydrocarbons, primarily because lighter hydrocarbons biodegrade much more readily.

10.31 It must be recognised that FLNG technology will be used to develop natural gas resources, the spillage of which presents much less of an environmental risk than is the case for heavier petroleum products like oil. By way of example, Shell’s \textit{Prelude} project will be used to produce natural gas hydrocarbons in three liquefied forms: LNG, LPG and condensate.

10.32 According to Woodside, any potential ‘spill impact assessment’ for an FLNG project should primarily focus on the condensate component, because ‘LNG ‘boils off’ extremely rapidly at ambient temperature and therefore presents limited environmental risk’.\textsuperscript{899} Woodside’s view was confirmed by the Principle Scientific

\textsuperscript{896} ibid.
\textsuperscript{897} ibid.
\textsuperscript{898} ibid.
\textsuperscript{899} Submission No. 8 from Woodside, 8 August 2014, p 12.
Chapter 10

Officer of the Department of Fire and Emergency Services (DFES), Dr Jeffrey Davis, who explained that, if spilled, LNG ‘being cryogenic, will boil’. 900 According to Dr Davis:

\[\text{initially, when [LNG] is cold, its density will stay at water level... As it warms up to considerably below room temperature it gets less dense than air, so the LNG, in terms of a spill, is not a major issue in that it will raise and disperse [into the atmosphere]. It is a significant greenhouse gas, so it is an environmental issue from that perspective, but in terms of creating a cloud of gas, it is not so much of an issue.}\]

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It should also be noted that LNG consists primarily of methane which, as Dr Davis described, ‘is a significant greenhouse gas’. 902 Specifically, over a 100 year period, a methane emission will have about 34 times the greenhouse effect as an emission of the same mass of carbon dioxide. A spill of LNG will not, however, have the same effect on a marine ecosystem as would a spill of a heavier hydrocarbon.

Dr Davis also explained that a spill of LPG or condensate would similarly be unlikely to cause significant environmental harm:

LPG, being propane mainly with butane, is denser than air. If that were to spill and hit the surface, there would be a gas cloud that would disperse from potentially liquid LPG on the surfaces—that is, boiling—and you would get a cloud of propane butane on the surface of the water... With the condensate, it depends very much on what the condensate is, which is dependent on the process... Condensates can be very light, sort of like a petrol-type product, right through to a heavy fuel oil almost sort of a condensate.... Given that [the Prelude project will] produce lighter hydrocarbons, it is likely to be more a lighter fraction. From an environmental perspective, that may be advantageous in that it might more readily evaporate, for example, in a spill rather than going onshore and causing onshore issues with wildlife and the coast and that sort of thing. 903

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In relation to whether a ‘cloud’ of LPG in the process of evaporating and dispersing would present a significant safety risk, Dr Davis explained that the risk of spilled petroleum igniting would depend on the existence of any ‘ignition sources... such as electrical equipment that is not protected, any point where pieces of steel may bang

900 Dr Jeffrey Davis, Principal Scientific Officer, Department of Fire and Emergency Services, Transcript of Evidence, 19 November 2014, p 8.
901 ibid.
902 ibid.
903 ibid.
Chapter 10

together or rub on each other or those sorts of thing.\footnote{904} Dr Davis also noted, however, that any such risk would likely be extremely low, because:

\[\text{[i]n the whole design of these vessels, in much the same way as say a fuel tanker that bunkers fuel for delivery from Singapore to Australia or Royal Australian Navy vessels that transfer fuel at sea to other vessels, there is an awful lot of effort put in to making sure that there are no ignition sources there so that in the worst case that you have significant spill and an ignitable cloud, that hopefully it is all going the way it is supposed to be going. They are usually very stringent with that sort of thing on those sorts of vessels and those facilities that there are no ignition sources. It goes down to the clothing that people are wearing—they are not allowed to wear anything other than what is issued because it may generate static if they have something else. That goes to Underwear and everything that people are wearing—radios, torches, everything on the vessel including not just the fixed stuff but all the portable things that people may or may not bring on board with them and how they are controlled.}\footnote{905}

10.36 Based on evidence provided by Shell, the Committee’s discussions with Shell and others in the Netherlands and Goeje, it is clear that Shell has made considerable investment to ensure that its Prelude facility, like any new petroleum facility, has been designed to meet current world’s best practice environmental standards. This view is also supported by the fact that Shell must satisfy the environmental regulatory requirements for Australia’s offshore petroleum industry before Prelude can be commissioned.

10.37 It is equally true, however, that the threat of oil spill pollution will always exist whenever petroleum products are produced. This was noted by Mr Buchholz, who observed that:

\[\text{the reality in these things [is] that you are never going to have enough capability to completely respond and ensure there is absolutely no impact; it is just very difficult to achieve in that scenario. If you look at all the oil spill incidents around the world ... there is always an impact and that impact is always tragic and not good for the environment ... it is almost impossible to 100 per cent gate keep that. You can be just as planned and ready as you can to try and do best you can.}\footnote{906}

\footnote{904} ibid, pp 8–9.  
\footnote{905} ibid.  
\footnote{906} Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, p 9.
This, of course, reinforces the need for NOPSEMA to perform their regulatory function most effectively and for operators to ensure they have not only the appropriate policies and procedures in place and working well, but that the safety culture is strong and well developed, not only on board their FLNG facilities, but throughout the entire organisation.
Chapter 11

Infrastructure: Whose responsibility is it?

Introduction

11.1 This Inquiry aimed to clarify the roles and responsibilities of FLNG project proponents and operators, and the Commonwealth and state governments in relation to providing for the safety of those who work on, or in support of, an FLNG facility, protecting the environment and ensuring the emergency response preparedness of industry and government in the case of a major accident event. Chapters 1 to 10 have described the Australian regulatory regime for the offshore petroleum industry and outlined the ways in which industry aims to protect worker safety and the environment.

11.2 One issue yet to be addressed is whose responsibility it is to provide the infrastructure that is necessary to the safe operations of an FLNG facility. After briefly outlining the value of Western Australia’s petroleum production and noting the particular value of the North West Shelf LNG project, this chapter discusses the maturity of the industry in the Northern Carnarvon Basin and, thus, the availability of infrastructure to those who wish to develop a field in that region. Those wishing to develop fields off the Kimberley coast, a relatively new region of offshore petroleum development, face a very different situation. Furthermore, when offshore petroleum resources are developed more fully, there will be multiple FLNG facilities operating in the area, each with its own proponents, operator, safety cases and environment plans. This will create its own complexity across a range of services and installed infrastructure.

11.3 This chapter discusses the safety-related infrastructure available for projects in the Browse Basin, paying particular attention to hospital, airport and port infrastructure. The lack of suitable infrastructure raises the question of whose responsibility it is to provide the necessary safety-related infrastructure. Under Australia’s objective-based regulatory regime, it could be argued that any cost relating to a project must be borne by the project proponent. This view, though, does not consider the potentially negative consequences a strict adherence to an objective-based philosophy might have on state development. These matters are also discussed below.

11.4 Throughout this Inquiry it became apparent that there is an incremental approach to safety on a project by project basis, rather than an overall approach. There is no lead agency responsible for coordinating strategic development of necessary safety-related
Chapter 11

infrastructure and services, particularly those necessary to meet likely future requirements.

Finding 78
There is no lead agency responsible for coordinating strategic development of necessary safety-related infrastructure and services, particularly those necessary to meet likely future requirements.

Recommendation 2
The Western Australian Government place on the COAG agenda the need for a lead agency for the coordination of necessary safety-related infrastructure and services.

This chapter also suggests that FLNG facilities will provide a challenge to NOPSEMA as the expert regulator and calls on project proponents and operators to be particularly candid in sharing information with NOPSEMA in relation to their FLNG facilities.

Value of the petroleum industry to Western Australia

The petroleum industry is enormously important to the Western Australian economy. For the 2013–2014 financial year, the value of the Western Australian petroleum industry’s production was $26.5 billion or more than 10 per cent of the gross state product.\(^{907}\) Of course, the value of petroleum production alone only tells part of the story as activities associated with this production have long been a significant stimulant for the wider state economy. Though it is difficult to precisely measure the extent of this effect, a 2009 report by ACIL Tasman revealed that between 1989 and 2009 the North West Shelf LNG project had contributed:

- over $70 billion to Australia’s gross domestic product (GDP);
- over $40 billion in increased household consumption; and
- approximately $0.9 billion per annum to State and local government revenue.\(^ {908}\)

Furthermore, in combination with the economic activity that has been driven by the ongoing development of the Gorgon, Wheatstone, Ichthys and Prelude projects, it is clear that petroleum resource development will remain fundamental to the ongoing prosperity of this state for some time.


The Northern Carnarvon Basin

11.8 Petroleum production in Western Australia has historically drawn almost exclusively on the significant resources located in the Northern Carnarvon Basin, which covers an offshore area of approximately 535,000 square kilometres to the north of the Pilbara coastline. Geoscience Australia describes the Northern Carnarvon Basin as ‘Australia’s most prolific hydrocarbon-producing basin’, something that is underscored by the fact that the Basin is estimated to contain some 22.2 billion barrels of oil equivalent of resources. Information compiled by the Australian Petroleum Production and Exploration Association (APPEA) for 2012 and the first quarter of 2013 indicates that there were a total of 15 production areas in the Northern Carnarvon Basin:

- the North West Shelf LNG Joint Venture and development projects, which are located mostly on the northern Rankin Platform (and draw upon the North Rankin, Cossack, Wanaea, Lambert and Hermes fields);
- the Pluto LNG project on the Rankin Platform/Exmouth Plateau (which draws upon the Pluto and Xena fields);
- the Devil Creek, Mutineer/Exeter, Stag and Wandoo projects in the Dampier Sub-basin, and the Fletcher/Finucane project in the Beagle Sub-basin;
- the Barrow, Thevenard and Varanus islands projects, and the then-recently decommissioned Woollybutt project in the Barrow Sub-basin; and
- the Enfield, Pyrenees, Macedon, Stybarrow and Vincent/Van Gogh projects in the Exmouth Sub-basin.

11.9 The Northern Carnarvon Basin, that is, is a space of significant petroleum industry activity. The Basin and the concentration of petroleum industry activity within it are illustrated at Figures 11.1 and 11.2 below.

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910 ibid p 9.
911 ibid, p 13.
Chapter 11

Figure 11.1: Structural elements of the Northern Carnarvon Basin and adjacent basins showing the locations of regional seismic sections and petroleum accumulations.

Figure 11.2: Petroleum production facilities, petroleum fields and current and proposed infrastructure in the Northern Carnarvon Basin.

912 ibid, p 25.
913 ibid, p 26.
Even though the Northern Carnarvon Basin has effectively been the home of Western Australia’s petroleum industry since the late 1970s, vast quantities of petroleum in the Basin are still to be developed. Indeed, when the *Gorgon* and *Wheatstone* LNG projects begin producing LNG—something that is scheduled to occur by 2016—petroleum production from Northern Carnarvon will essentially double.\(^\text{914}\) It seems highly likely, therefore, that this offshore area will remain the centre point of Western Australia’s petroleum industry for some time.

From the perspective of safety, the level of petroleum industry activity in the Northern Carnarvon Basin—coupled with the propensity of industry proponents to collaborate in the implementation of safety infrastructure—has seen the establishment of significant safety and emergency response resources between Onslow and Karratha along the Pilbara coastline. Furthermore, the long history of activity in this offshore region has vastly enhanced the knowledge and understanding possessed by both operators and regulators regarding the prevailing metocean conditions and specific challenges associated with this operating environment. Though the Northern Carnarvon Basin is most certainly a remote location, the actual quantity of offshore facilities operating in the area is also an aid to any emergency response situation.

This means that the challenges associated with undertaking petroleum industry activity in the Northern Carnarvon Basin are well understood and that there are significant resources in the area for responding to an emergency situation. However, it does not mean that these activities are completely safe. Offshore petroleum industry activities necessarily occur in dynamic and challenging environments—a fact clearly illustrated in March 2015 when Tropical Cyclone Olwyn passed through the Northern Carnarvon Basin.

**Tropical Cyclone Olwyn**

On Friday 13 March 2015, Tropical Cyclone Olwyn (Olwyn), having developed off the Kimberley coast, travelled south and crossed parts of Western Australia’s Pilbara coastline.\(^\text{915}\) The cyclone brought destructive wind gusts of up to 140km/h and, as it approached the coast, Olwyn strengthened to a category three system.

Figure 11.3 illustrates the area in which Olwyn developed, and its path south through the Northern Carnarvon Basin and across the mid-west coast. As Figure 11.3 shows, the point at which Olwyn developed into a category three cyclone is very near to a number of the fields illustrated in Figure 11.2. This includes both the Pluto field, which feeds the

\(^\text{914}\) Combined, the *Gorgon* and *Wheatstone* LNG plants will have the capacity to produce some 24.5 million tonnes of LNG annually. At present, the existing *Pluto* and *North West Shelf* LNG plants have a combined annual production capacity of about 21 million tonnes of LNG.

\(^\text{915}\) Emery, Kate, Boyham, Aiden and Brown, Natalie, 'Devastated: Driver critical, town is battered in Olwyn path', *The West Australian*, 16 March 2015, p 1.
Pluto LNG plant at Dampier, and the nearby lago field, which will feed the Wheatstone plant at Onslow.

Prior to the formation of Olwyn, Chevron had been conducting a drilling campaign on the lago field to prepare it for production for the Wheatstone plant. To this end, Chevron had engaged the services of offshore drilling company Atwood Oceanics, and the semi-submersible Atwood Osprey drilling rig had been deployed above the lago field.917

As Olwyn formed, workers on board the Atwood Osprey were evacuated and the drilling rig secured.918 Atwood and Chevron are reported to have ‘ballasted the rig’ in accordance with ‘standard cyclone procedures’.919 In the aftermath of the cyclone, however, it became apparent that these precautions had been insufficient. On 17 March 2015 Atwood Oceanics confirmed that Olwyn had caused the Atwood Osprey to ‘[part] several mooring lines and [drift] about three nautical miles from its original

917 Klinger, Peter, ’Chevron counts Olwyn’s toll on Osprey’, The West Australian, 16 March 2015, p 46.
918 ibid.
position’. It seems that no one was injured and, ‘based on the latest assessments’, there was no ‘measurable environmental damage’.\(^{921}\)

11.17 Despite there being no reported injuries or measurable environmental damage, the \textit{Atwood Osprey} incident forced Woodside to stop the flow of gas from the Pluto field and shut down production on the \textit{Pluto} LNG plant. This action was taken as a precaution against the drilling rig dragging its remaining moorings across the nearby \textit{Pluto} gas pipeline, potentially damaging it. Ultimately no damage was caused to the \textit{Pluto} gas pipeline, but the incident nonetheless proved extremely costly. The need to shut down the \textit{Pluto} plant reportedly cost Woodside ‘tens of millions in lost revenue’.\(^{922}\)

11.18 The Northern Carnarvon Basin is a mature petroleum development area and operators would have significant knowledge of both the operating risks and the safety and emergency response infrastructure in the area. The evacuation of the crew from the \textit{Atwood Osprey} and the ballasting of the rig help to demonstrate this. Nevertheless, and despite the maturity of the industry in this area, the \textit{Atwood Osprey} incident illustrates that the risks associated with offshore petroleum activity can never be totally eliminated. Accidents can, and do, happen.

11.19 As noted above, assessments did not reveal any evidence of measurable environmental damage resulting from this incident.\(^{923}\) This may well have been the case, but in light of reports that the drifting drilling rig breached the 500 metre exclusion zone around the \textit{Pluto} LNG plant pipeline,\(^{924}\) the incident clearly had the potential to cause significant environmental damage.\(^{925}\)

\textbf{The Browse Basin}

11.20 It is also important to recognise that, notwithstanding its immense remaining reserves, the resources in the Northern Carnarvon Basin are finite. If the Western Australian...


\(^{925}\) The Committee notes that the \textit{Atwood Osprey} incident is, in April 2015, the subject of investigation by NOPSEMA. Information on this investigation can be found in the transcript of evidence given by NOPSEMA representatives to the Committee on 7 April 2015.
Chapter 11

The economy is to continue to benefit long-term from petroleum industry activity, new and undeveloped petroleum resources will have to be developed. Fortunately, the Browse Basin—the structural basin to the immediate north of the Northern Carnarvon Basin—holds vast petroleum resources.

11.21 The Browse Basin, which covers an area of approximately 140,000 square kilometres of ocean off the north west of the Kimberley coastline, is described as ‘one of the richest hydrocarbon-bearing basins in Australia’. It is known to contain ‘several large gas accumulations’, four of which are currently proposed for development as LNG projects. Specifically, these are:

- the *Ichthys* project—in January 2012, INPEX took a positive final investment decision (FID) to develop the Ichthys field, and will process gas offshore before piping it to Darwin via an 889 kilometre pipeline to liquefaction plant. The INPEX Darwin plant will have the capacity to produce 8.4 million tonnes per annum (mtpa) of LNG for export. The *Ichthys* project is expected to begin production by the end of 2016.

- the *Prelude* project—in May 2011, Shell took a positive FID to develop the Prelude and nearby Concerto gas fields using the 3.6 mtpa *Prelude* FLNG facility.

- the *Browse* project—Woodside has held retention leases over the Torosa, Brecknock and Calliance fields since the first gas was discovered in the Browse basin in 1971. These fields have long been slated for development.

- the *Crux* project—Shell was issued with a five year retention lease for the Crux field in February 2013.

11.22 These four resources are estimated to contain reserves in the order of 34 trillion cubic feet (Tcf) of natural gas and a further 1,200 million barrels of liquid petroleum resources—conservatively, a total of approximately 7 billion barrels of oil equivalent. Furthermore, the Browse Basin is also home to a large number of other significant gas discoveries, including the Abalone, Adele, Argus, Bassett West, Boreas, Burnside,

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927 ibid, p 1.
928 ibid.
929 ibid p 9. This document estimates the Ichthys field to contain an estimated 12.8 Tcf of natural gas, the Prelude and Concerto fields an estimated combined 3 Tcf, the Brecknock, Calliance and Torosa fields an estimated 15.9 Tcf, and the Crux field an estimated 2.2 Tcf. At approximately 5,700 cubic feet of natural gas per barrel of oil equivalent, 34 Tcf would equate to around 6 billion barrels of oil equivalent. Condensate contains approximately 94 per cent of the energy in one standard barrel of oil, so 1,200 million barrels of condensate would be approximately equal to 1.1 billion barrels of oil equivalent.
Columba, Crown, Echuca Shoals, Kronos, Marabou, Mimia, Poseidon, Proteus and Zephyros fields in the Caswell Sub-basin and the Hippolyte, Libra and Octans in the Heywood Graben Sub-basin. Gas resources have also been discovered at Psepotus on the Leveque Shelf, and at Caspar, Cornea, Focus, Gwydion, Macula and Stirrup on the Yampi Shelf. 930 The Browse Basin is illustrated at Figure 11.4 below.

Figure 11.4: Structural elements of the Browse Basin and adjacent basins showing the locations of regional seismic sections and petroleum accumulations. 931


931 ibid, p 15.
The Bonaparte Basin—which lies to the immediate north-east of the Browse Basin—is another promising petroleum resource containing an estimated 10 Tcf of undeveloped gas. The development of petroleum resources in both the Browse and Bonaparte Basins, while not necessarily imminent, is ultimately inevitable. The resources in the Browse and Bonaparte Basins are illustrated at Figure 11.5 below.

Figure 11.5: Petroleum production facilities, petroleum fields, and current and proposed pipeline infrastructure in the Bonaparte and Browse Basins.

When it does occur, the development of the Browse and Bonaparte Basin resources will be complex and difficult. This, in large part, is due to the remoteness of these resources and the lack of support infrastructure in the vicinity. In particular, as this Inquiry has made clear, adequate safety and emergency response infrastructure is a critical component of any proposed offshore petroleum development.

Onshore infrastructure in the Kimberley

As noted above, the offshore petroleum industry has been developing the oil and gas resources in the Carnarvon Basin off the Pilbara coast for a considerable time. Gas has traditionally been processed onshore in the Pilbara, and the region’s petroleum industry serviced from there. In fact, the Pilbara region is ‘dominated by the mining and petroleum industries’, producing approximately 95 per cent of Australia’s iron ore exports, 70 per cent of Australia’s natural gas and 85 per cent of the country’s crude oil exports.
and condensate.933 Given the extent of industrial development in the Pilbara, the region has developed considerable processing and support infrastructure in and around the major cities and towns, including Port Hedland, Karratha, Newman and Dampier.934 This includes ports at Port Hedland, Dampier and Cape Lambert, with a new deep water port currently under construction at Anketell.935 One important consequence of this is that any proponent of a new development in the Pilbara region can have both knowledge of, and confidence in, the infrastructure and support services available for the proposed project.

11.26 The same cannot be said for the Kimberley region, particularly since the setback to the development of the proposed James Price Point precinct due to Woodside’s decision not to develop its Browse Basin reserves onshore. It should also be noted, once again, that Shell’s supply base for its Prelude facility is located in Darwin.

11.27 The Committee intends to include a more in-depth discussion of the issue of infrastructure and its important role in state development in a subsequent report on the potential opportunities for Western Australian industry arising from the development of FLNG facilities. Nevertheless, this report into FLNG safety-related matters must consider the main safety-related public infrastructure available to, or utilised by, the offshore petroleum industry operating in or adjacent to the Pilbara region.

11.28 Evidence to this Inquiry, particularly that gathered by the Committee during its investigative travel to Broome and Derby, suggests there are three main safety-related onshore infrastructure requirements for FLNG facilities operating off the Western Australian Kimberley coast. These are appropriate medical facilities, airport infrastructure in a strategic location(s) and access to port facilities that can accommodate infield support vessels, particularly in emergency situations. It should also be noted, once again, that while the following centres on the requirements for the Prelude facility, there is an expectation that over time there will be several FLNG facilities operating in the Browse Basin.

**Hospital infrastructure**

11.29 As the onshore medical facility nearest to the Browse Basin, Broome Hospital potentially has an important role to play in supporting FLNG facilities. As Chapter 9 outlined, the offshore petroleum industry generally has a three-tiered medical

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933 Pilbara Development Commission, *Pilbara regional economy*, nd, np. Available at: http://www.pdc.wa.gov.au/industry/. Accessed on 20 March 2015. There are also other minerals resources developed in the Pilbara, plus a number of other industries such as manufacturing, tourism, sheep and cattle, fishing and aquaculture.
934 Ibid.
Chapter 11

response system. Based on information provided to the Committee during its investigative travel to Broome, the Broome Regional Health Campus (Broome Hospital) would be classified as providing Level 5 health care professionals in a Secondary Health Care Unit (HCU). In brief, this means that the Broome Hospital is able to diagnose and treat complex medical conditions, manage inpatient medical and surgical cases, resuscitate and stabilise patients in preparation for transfer to a Tertiary HCU and assist in any such transfer. 936

11.30 Chapter 9 also noted that injured workers who need tertiary care at a major hospital or critical care unit would be medevaced to Perth or Darwin hospitals, either straight from the Lombadina Airport or from Broome Hospital.

11.31 Broome Hospital has undergone significant development recently and its emergency department is currently being upgraded. The Committee was impressed with the professionalism of the staff and their commitment to providing a very high standard of health care to the Broome and surrounding communities. This view was reinforced by the Kimberley Development Commission’s view of the health services provided by the hospital as excellent. 937 Staff at the Broome Hospital briefed the Committee on the state’s emergency response capacity for the region.

11.32 In line with WA’s State emergency management plan for health (Westplan–Health), and through its obligations under the Emergency Management Act 2005 (WA), the Department of Health (DoH) is a combat agency charged with managing the health and medical aspects of an emergency. 938 Westplan–Health outlines the procedures involved in the activation of the DoH’s response to a major incident. One of the DoH’s obligations under Westplan–Health is to coordinate the management of casualties.

11.33 As well as Westplan–Health, there are health disaster plans for regional areas, with the ‘local operational management, preparation and assessment of victims in a major emergency’ to be managed under the appropriate plan. 939 In line with the escalation or progressive response outlined in the Westplan–Health, if the capabilities of a region are not able to handle an emergency, support will be provided by the activation of the Westplan–Health. 940 The Disaster Preparedness Management Unit is able to track an emergency situation through WebEOC*, a crisis information management system that allows incident information to be shared within the Department and with other

936 Refer to Tables 9.1 and 9.2 in Chapter 9.
937 Kimberley Development Commission, Committee Briefing, 6 March 2015.
938 Disaster Preparedness and Management Unit, State emergency management plan for health, Department of Health, Perth, 4 December 2012, pp 8–9.
939 ibid, p 28.
940 ibid.
Staff at the Broome Hospital explained the region’s emergency response capacity using as an example the 2009 explosion on board an asylum seeker vessel on Ashmore Reef. The vessel, carrying 45 asylum seekers and two crew, had been intercepted by the Australian Defence Force (ADF), and nine ADF personnel were on board at the time of the explosion. The explosion resulted in three deaths and two missing (presumed dead) from the vessel, with multiple casualties including serious burns.

The ADF evacuation was supported by Western Australian, Northern Territory and Commonwealth Government agencies. HMAS Chiders and HMAS Albany recovered survivors from the water and delivered them to the Front Puffin, an FPSO operating in the Bonaparte Basin. A medical triage facility was established on the Front Puffin and at Mungalalu Truscott Airbase (Truscott). High priority patients were transferred from the FPSO to Truscott by helicopters operated by CHC Helicopter.

Broome was the hub hospital for the state response to that incident. Two medical nursing teams from Broome Hospital were sent to Truscott and then to the FPSO to begin emergency care procedures such as inserting IV lines. The Committee understands that there was a considerable issue in relation to the transport of casualties from the Front Puffin as only a relatively small helicopter, one able to carry one or two patients at a time, was able to land on the FPSO. A larger helicopter was available but it was not able to land on the FPSO. It is worth noting that when all casualties were evacuated and the medical staff returned to Truscott there was not transport available to take them back to Broome. Overall, Broome Hospital staff were away from Broome for three days.

To assist with this incident Royal Perth Hospital had sent equipment and staff, including burns teams and surgeons. Broome Hospital was well prepared to deal with the casualties. However, the decision was made to use a military plane to airlift patients to

941 Department of Health, WebEOC®, nd, np. Available at:  
942 Ashmore Reef is located approximately 320 km off the north west coast of Australia and 144 km south of the Indonesian island of Rote.
945 Broome Health Campus, Committee Briefing, 5 March 2015.
946 A store of medical emergency equipment is held in the Disaster Preparedness and Management warehouse in Perth.
Chapter 11

specialist facilities in Darwin, Perth and Brisbane.947 While the Committee is not aware of the total number of those evacuated to Perth, Royal Perth Hospital treated 23 burns victims. The Department of Health described this incident as ‘the most logistically challenging incident in WA disaster history’.948

11.38 While this incident relates to an explosion on a vessel at sea, the emergency is not dissimilar to that which might occur on an FLNG facility; that is, an explosion resulting in multiple injuries, including serious burns, and requiring the medevac of casualties to onshore medical facilities for assessment, treatment and, where necessary, evacuation to other facilities.

11.39 Broome Hospital’s capacity to manage an emergency is, understandably, dependent upon the number of casualties, the types of injuries, the location and the resources available. Factors such as these will determine what response is required. In discussing the Broome Hospital’s preparedness to respond to an FLNG facility medical emergency, hospital staff explained that they can increase their capacity if required. This involves increasing the resources at hand by, for example, calling in extra staff and clearing beds. Teams can also be brought in from other hospitals such as Port Hedland and Perth. Broome Hospital is also supported by infrastructure such as airports at Broome and Derby, and can charter aircraft when required. This allows them to syphon patients through particular airfields when logistics are at risk of being overwhelmed.949

11.40 When considering the need for medical facilities to meet the needs of FLNG facilities operating off the Kimberley coast there are a number of factors to consider. First is the decision of operators to medevac high priority patients from Lombadina to Perth or Darwin, using Broome Hospital for more minor injuries. Second, while the results of major offshore incidents are often catastrophic, their frequency is relatively low. Third, equipment and medical staff can be despatched from Perth and arrive in Broome within three hours. Fourth, under Australia’s objective-based regulatory regime, it is the responsibility of the operator to ensure that it has access to the necessary infrastructure.

11.41 In light of these factors, and particularly given relatively low incidence of major accident events, the staff at Broome Hospital suggested there was not a lot that government could do for the hospital to enhance the region’s FLNG medical emergency

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949 Broome Health Campus, Committee Briefing, 5 March 2015.
response capacity. For medical staff working in the region, there are far more pressing health problems for people in the Kimberley requiring government funding.  

**Airfield infrastructure**

11.42 Lombadina Airport is situated on the Dampier Peninsular approximately 200 km north of Broome. According to the Broome International Airport (BIA), which manages and operates the airport on behalf of the Djarindjin Corporation, Lombadina Airport is ‘the only all weather, Sealed and Pilot Activated Runway Lighting airport on the Dampier Peninsular’. This means that not only is it ‘an important asset to the communities in the region’, the airport is important to the oil and gas industry, ‘providing [a] strategic refuelling facility for their offshore operations in Browse Basin’.  

11.43 In relation to the use of Lombadina Airport in an offshore emergency response, its key features include a dedicated helicopter apron, a dedicated Jet A1 refuelling facility for large helicopters only and two transportable buildings for use by the oil and gas industry.  

11.44 During the Committee’s investigate travel to Broome, two main issues were raised in relation to the use of Lombadina Airport during an offshore emergency event. The first of these is all-year access on the Cape Leveque Road, the only road access to the airport and communities in the region. The Shire of Broome advised that 88 km in the middle of this 220 km road is unsealed. This makes it vulnerable to flooding during the wet season, with the road often closed for between seven to ten days at a time.  

11.45 According to the Shire of Broome, the road needs to be relocated to higher ground and sealed. A program was developed by the state government to provide Main Roads WA with funding to allow 15 km per year to be sealed. However, the prominence of the environmental aspects associated with the proposed James Price Point development led to the Commonwealth Department of the Environment requiring particular mitigation measures for the potential impact of moving the road to higher ground. Combined with land tenure and heritage issues, this requirement delayed the project for a considerable time. While funding had been provided in forward estimates, it was reallocated. Some three years on, Main Roads WA are now able to satisfy the Commonwealth requirements. However, the issue of funding remains. The Shire of Broome advised that the Minister is aware of the situation and that the Shire’s number

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950 ibid.  
952 ibid.  
953 ibid.
Chapter 11

one priority is the Cape Leveque Road, but has stated that funding in the current economic situation is difficult. 954

11.46 It is important to note concerns raised in relation to the sealing of the Cape Leveque Road. While acknowledging that the road is a community and safety access road, the Kimberley Development Commission advised that sealing the road will result in increased visitor numbers to the region, which will have significant impacts, both positive and negative, on the local communities. Given this, work needs to begin to prepare communities through providing infrastructure and education and training for local employment, for example. 955

11.47 Not only do Cape Leveque Road closures in the wet season pose risks to the health and safety of the communities in the region, they also presents a risk those working in the offshore petroleum industry operating in the Browse Basin. As noted in Chapter 9, Lombadina Airport will play a key role in the evacuation of medical casualties from FLNG facilities operating in the Browse Basin. Lombadina Airport is also used by INPEX to refuel helicopters used for its ichthys project and, according to the Shire of Broome, the airport refuels four helicopters at once. 956 Clearly, Lombadina Airport is an important logistics base for the area, one that could be improved by reliable, all-year road access.

11.48 A second, and related, safety issue for Lombadina Airport is the availability of fuel for helicopters. Concern was expressed that the fuel dump at the airport may not have sufficient fuel to meet emergency requirements, particularly if fuel delivery is delayed due to tankers not being able to use the Cape Leveque Road. This is exacerbated by the period during which the road may be closed due to flooding coinciding with the cyclone season, which is when offshore severe weather events are prevalent. 957 Concern was also expressed that because of the high quality of fuel required for helicopters, fuel sitting in the airport tanks may deteriorate over time. An additional issue raised was that, while the fuel supply may be sufficient in terms of quality and quantity to manage one event, if several events occur together or in sequence, as they can in cyclone prone regions, the situation would be difficult to manage. Safety is clearly contingent on adequate fuel supplies. 958

11.49 The Department of State Development (DSD), however, advised that BIA is of the view that ‘the fuel tanks at Djarindjin are of substantial size to negate the risk’. 959 The Committee also raised the above concerns relating to helicopter fuel availability and

954 Shire of Broome, Committee Briefing, 6 March 2015.
955 Kimberley Development Commission, Committee Briefing, 6 March 2015
956 Shire of Broome, Committee Briefing, 6 March 2015
957 ibid.
958 ibid.
959 Ms Jenness Gardner, Executive Director, Browse, Department of State Development, Transcript of Evidence, 12 March 2015, p 9.
quality with BIA. In relation to the capacity of the fuel tanks, BIA advised that the original two fuel tanks at Lombadina Airport had a combined capacity of 57,000 litres, one holding 22,000 litres and the other 35,000 litres.  

11.50 In 2013, the system was upgraded and a new 55,000 litre tank was installed, bringing the total airport fuel capacity to approximately 110,000 litres. Through daily measurement, the tank levels are monitored and when the amount of fuel held approaches 65,000 litres, an order for approximately 36,000 litres is placed for delivery at one time. To date, the maximum number of helicopters using Lombadina Airport in any one month has been 90. With each using approximately 1,000 litres per flight, as BIA advised, ‘there is always approx 3 weeks fuel availability’.  

11.51 BIA also advised that its subsidiary, Peninsular Airport Management Services, ‘is currently negotiating with oil companies to develop a new fuel storage and dispensing process that will see storage double to approx 200,000 lt within 12 months’.  

11.52 In relation to maintaining the quality of the fuel, BIA stated that ‘standard and best practice and techniques with Jet A1 transport and storage (JIG 4) are that when fuel is not being used regularly, circulation of the fuel will keep this within specifications’. BIA also advised that ‘there was a period of approx 6 months, back in late 2011 early 2012, where there was no activity at Lombadina, and no refuelling took place at the Airport’. Furthermore, ‘a sample of the stored Jet A1 was sent to the BP Refinery in Kwinana and was tested and met all the necessary specifications’.  

11.53 BIA acknowledged that there are times during which Cape Leveque Road is impassable in the wet season. However, BIA assured the Committee that:

with enough capacity storage at Djarindjin/Lombadina Airport, very close monitoring of the fuel levels in relation to available ullage within the tanks on site, there has been no period where the Airport has not had enough quantities or quality of fuel for expected operations during the past 5 years.

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960 Mr Rodney Evans, Operations Manager, Broome International Airport and Djarindjin Airport, Broome International Airport, Electronic Mail, 26 March 2015. Mr Evans advised that ‘a 110,000 lt [fuel tank] was provided by a third party in 2010, however it was never able to be used due to it not meeting aviation standards’.  
961 Mr Rodney Evans, Operations Manager, Broome International Airport and Djarindjin Airport, Broome International Airport, Electronic Mail, 26 March 2015.  
962 ibid.  
963 ibid.  
964 ibid.  
965 ibid.  
966 ibid. Ullage is the amount of empty space in the tank.
Chapter 11

11.54 In fact, ‘fuel has always been available all year round’. 967

11.55 Nevertheless, BIA agreed that ‘whilst not critical to the level of operations, the sealing of the Cape Leveque road will only increase the availability of fuel supplies during the wet seasons’. 968

11.56 In relation to the use of Lombadina Airport as part of an offshore operation’s emergency response, BIA advised that that airport is ‘rarely used for medivac operations as medivac flights are extremely low in numbers’. 969 Furthermore, ‘cyclone demanning and upmanning is not considered an emergency event. It is considered normal operations albeit at a heightened level of activity’. 970

11.57 While this may be the case to date, consideration will need to be given to the impact of the initial Prelude facility and subsequent FLNG operations in the region.

11.58 The Committee discussed the issue of limited access on Cape Leveque Road with DSD. Mr Stephen Wood, DSD’s Director General, agreed that, ‘for the purposes of fuel dumps and the like, that road will be inaccessible in certain conditions’. 971 When asked what could be done in relation to Cape Leveque Road, Mr Wood stated that:

\[\text{it is not a matter of what State Development will do about that; that is a matter for the project proponent to make sure they have got the logistics chain right for the purposes of their fuel servicing.}\] 972

11.59 The issue of proponent responsibility to provide or upgrade infrastructure is discussed further below.

Finding 79
Project proponents are responsible for the development of all infrastructure, including support infrastructure, necessary for the safe operation of their facilities.

Finding 80
Relocating and sealing the unsealed section of Cape Leveque Road will ensure the all-year availability of fuel supplies to Lombadina Airport and local communities.

967 ibid.
968 ibid.
969 ibid.
970 ibid.
971 Mr Stephen Wood, Director General, Browse, Department of State Development, Transcript of Evidence, 12 March 2015, p 9.
972 ibid.
Chapter 11

Port Infrastructure

While there are two ports, namely Broome and Dampier ports, operating in the region adjacent to the Kimberley coastline and, thus, the Browse Basin, as Broome port has been nominated by Shell and Woodside to support their Browse Basin operations, the following discussion is limited to that port. The Committee acknowledges the importance of both Broome and Dampier ports to the economic development of the state and intends to include further discussion of port infrastructure in its second report on the economic impact of FLNG on the Western Australian economy.

According to the Kimberley Ports Authority, ‘Broome Port is the largest deep-water access port serving the Kimberley region and is open to shipping on a 24 hour basis seven days a week’.973 There are three berths in the port: ‘the outer berth is 331 metres long and two inner berths are 170 metres and 96 metres respectively’.974 While the depth of the port varies, the maximum draft of a vessel it can accommodate is 9.1 metres.975 The port is also subject to 10 metre tides, with ‘strong tides experienced across the entrance channel and at berth’.976

Apart from providing supply base facilities for offshore developments, ports play an important safety role for the offshore petroleum industry. Depending on their characteristics, they can provide cyclone moorings, a safe haven in bad weather and bunkering facilities to allow vessels to refuel and then manoeuvre away from the storm.

The three infield support vessels (ISVs) that will support the Prelude facility on rotation will be based in Broome. These 42 metre ISVs are understood to have a 7.91 metre draft.977 This means that, because of the maximum draft and tidal issues in Broome port, the ISVs will not be able to access the port 365 days per year. For example, in the event of a 10 metre tide, an ISV may drop below the berth. The Kimberley Port Authority advised that it is working hard with Shell to develop a system whereby they can support the ISVs 338 days per year.978 This is a particularly important issue. As discussed in Chapter 8, in the event of a major storm, the ISV’s safest course of action is to move away from the storm. To do this, they may need to travel to Broome to refuel. It is essential that the risks associated with any reduced access to the port are reduced to levels that are as low as reasonably practicable (ALARP).

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974 ibid.
975 ibid.
976 ibid; and Kimberley Port Authority, Committee Briefing, 4 March 2015.
978 Kimberley Port Authority, Committee Briefing, 4 March 2015.
Kimberley Port Authority advised that cyclone moorings in Broome are restricted to 35 metres. This presents a problem for the Prelude ISVs as they are 42 metres long. While, ideally, the ISVs would be at sea during a cyclone, and particularly as Wyndham is currently the next closest safe haven along that section of the coast with road access, an ISV may need to seek cyclone refuge in Broome port. The Kimberley Port Authority advised that they are currently in discussions with Shell in relation to where some safe havens or cyclone moorings may be situated. The Kimberley Port Authority also acknowledged that the Lombadina area near Cape Leveque is the best available in the region and that this area will be used by Shell.

Nevertheless, and particularly given the reliance on the Lombadina area by operators such as Shell, the Kimberley Port Authority expressed concern about the current accuracy of the hydrographic information available. It is useful, here to outline the means by which mariners are able to have confidence in marine charts and the survey information they contain, namely ‘Zones of Confidence’ (ZOC). ZOC are ‘a charting standard’ or ‘method of encoding data quality information’ and classify bathymetric data and when included on charts provide mariners with the level of confidence placed in it by the national charting authority. According to the Australian Maritime Safety Authority (AMSA), ‘all larger scale AUS charts carry a Zone of Confidence (ZOC) diagram’ which ‘enables the mariner to assess the limitation of the hydrographic data from which the chart was compiled and the degree of risk associated with navigating in a particular area’. Table 11.1 below lists the six ZOC and outlines the feature detection criteria or search requirement for each zone.

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979 ibid.
980 ibid. A hydrographic survey identifies environmental factors such as changes in water depths, sand drift, tidal streams etc.
Table 11.1: ZOC Feature detection criteria

<table>
<thead>
<tr>
<th>ZOC</th>
<th>Position Accuracy</th>
<th>Depth Accuracy</th>
<th>Search requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZOC A1</td>
<td>± 5m</td>
<td>0.50m + 1%d</td>
<td>Full area search undertaken, all significant seafloor features detected and have had their depths measured.</td>
</tr>
<tr>
<td>ZOC A2</td>
<td>± 20m</td>
<td>1.00m + 2%d</td>
<td>Full area search not achieved, uncharted features hazardous to navigation may exist.</td>
</tr>
<tr>
<td>ZOC B</td>
<td>± 50m</td>
<td>1.00m + 2%d</td>
<td>Full search area not achieved, depth anomalies may exist.</td>
</tr>
<tr>
<td>ZOC C</td>
<td>± 500m</td>
<td>2.00m + 5%d</td>
<td>Full search area not achieved, depth anomalies may be expected.</td>
</tr>
<tr>
<td>ZOC D</td>
<td>Worse than ZOC C</td>
<td>Worse than ZOC C</td>
<td>Full area search not achieved, large depth anomalies may be expected.</td>
</tr>
<tr>
<td>ZOC U</td>
<td>Unassessed</td>
<td>Quality of bathymetric data yet to be assessed.</td>
<td></td>
</tr>
</tbody>
</table>

11.67 The Royal Australian Navy’s (RAN’s) Australian Hydrographic Service (AHS) charts the Lombadina/Cape Leveque area. AHS charts are not based solely on RAN surveys, but ‘from a range of sources’. The Lombadina/Cape Leveque area appears to have been last surveyed in the 1960s, ‘and much of the charted data arises from information that is older than that’.

11.68 According to AHS, and as the map at Figure 11.6 shows, while other areas in the region have a higher confidence level, the Lombadina/Cape Leveque area ‘is regarded as having a confidence rating of ZOC C which means that the positional accuracy is +/- 500M and the depth accuracy is =2m +5% depth’. Under the adopted ZOC system, ‘this rating means that depth anomalies may be expected’.

983 International Hydrographic Organisation, Manual on Hydrography, Publication IHO M–13, International Hydrographic Bureau, Monaco, May 2005, p 201; and Zone of Confidence Diagram, Chart AUS733.
984 Australian Hydrographic Service, Royal Australian Navy, Department of Defence Electronic Mail, 30 March 2015. The AHS advised that ‘the best detail of this area appears on chart AUS733 (1:150,000 scale) and the area appears on several other charts in less detail’.
985 Australian Hydrographic Service, Royal Australian Navy, Department of Defence Electronic Mail, 30 March 2015.
986 ibid.
987 ibid.
988 ibid.
The Committee is not aware of when the next survey of the Lombadina/Cape Leveque area will occur and, given the extent of Australia's coastline, the AHS would not resurvey all areas as a matter of course. Given that it is the responsibility of the operator to ensure that the risks associated with its development has been reduced to ALARP, the Committee expects that Shell and Woodside (perhaps in collaboration) would need to undertake a survey of the Lombadina/Cape Leveque area to increase the confidence level.

Finding 81
There is an apparent paucity of hydrographic information for the Lombadina/Cape Leveque area.

Infrastructure is the responsibility of the project proponent/operator

This Inquiry has demonstrated that the development of any offshore petroleum resource is contingent upon NOPSEMA accepting that the proponent will take appropriate measures to mitigate project risk. In relation to proposed developments within the Northern Carnarvon Basin, this burden has been reduced by the long history of petroleum industry activities in that region and the associated establishment of significant safety and emergency response resources in key strategic locations. The
same cannot be said, however, for the Browse Basin. Having only recently become a space of committed petroleum industry activity, the Browse Basin is not yet endowed with similar onshore or offshore infrastructure.

11.71 Because the safety case and environment plan requirements of any petroleum development proposal places the onus on developers to ensure that appropriate safety infrastructure is available, a proposal to develop Browse Basin resources, in effect, requires the proponent to address any existing deficiencies. The lack of onshore infrastructure along the Kimberley coast, therefore, has required Shell and INPEX to make substantial investments in the infrastructure directly required for their respective Prelude and Ichthys projects. In time, this infrastructure should become common infrastructure able to support offshore operations in the region generally. Shell’s dedicated search and rescue helicopter based in Broome provides an example of new infrastructure that can be available to others in the region.

11.72 The gradual development by operators of offshore and onshore support infrastructure in and around the Browse Basin clearly reflects the philosophy underpinning objective-based regulation—that the duty of managing a risk should lie with the creator of the risk.

11.73 This is also the position adopted by DSD in relation to the provision of infrastructure by the State. For example, during a hearing DSD acknowledged the access issue relating to the Cape Leveque Road between Broome and the Lombadina Airport, which, as noted above, will be used to facilitate air transfers between the Prelude facility and the mainland. As noted above, DSD’s position is that the condition of the road is a matter for the project proponent.989

11.74 According to Mr Wood, any work on that road is a ‘project proponent cost’:990

> Why should government be putting their hands in the pocket for what is actually a part of their logistics chain?991

11.75 Similarly, in discussing possible development of the Broome Port, Mr Wood argued that:

> if there are some additional facilities that are required for a particular proponent, why should that facility not be accommodated by the proponent, rather than built by government in the hope that the

989 Mr Stephen Wood, Director General, Department of State Development, Transcript of Evidence, 12 March 2015, p 9.
990 ibid.
991 ibid.
Chapter 11

proponent will have a development and contract to that particular port for that particular development.\(^{992}\)

11.76 While this position reflects the objective-based regulation philosophy, it raises a number of issues in relation to potential state development.

Infrastructure and state development

11.77 First, requiring individual petroleum companies to address the present lack of appropriate safety infrastructure in the Kimberley region would add to the overall project cost and may act as an impediment to the development of individual resource projects in the Browse Basin. However, given the overall costs and returns of such major developments, new safety infrastructure or upgrades of existing infrastructure is unlikely to stop a development from proceeding. A search and rescue helicopter or an upgrade of a regional medical facility would represent a relatively minor proportion of the overall project cost. The Committee acknowledges, though, that the need for a project proponent to provide for a completely new supply base and a gas processing hub in the Kimberley region, for example, particularly for the first project in the area, may well be a barrier to local development.\(^ {993}\)

11.78 Second, holding petroleum project proponents totally responsible for the infrastructure required for the development of the industry effectively delegates decisions relating to Western Australia’s state development to the directors and shareholders of petroleum companies. As a result, not only does the State relinquish the power to direct how the development should occur, the State’s opportunity to harness petroleum industry activity as a stimulus to general economic development is markedly reduced. This has already occurred in relation to both the Prelude and Ichthys projects.

11.79 Third, the petroleum resources in the Browse Basin are largely located in Commonwealth waters. Because of this, and in combination with way that the regulatory regime functions, the Western Australian Government could quite appropriately allow proponents of offshore projects to fund and develop infrastructure as required along the Kimberley coastline. However, and particularly in light of the current status of the James Price Point development, this represents a reactive, rather than proactive, approach to state development. This approach risks petroleum projects being serviced out of Darwin or perhaps Singapore, a situation clearly not in Western Australia’s best interests.

\(^{992}\) ibid, p 11.
The Committee raised with DSD the issue of what work was being done by the State in relation to providing infrastructure, particularly that impacting on the safety of offshore developments. In response to the question of whether barriers to the development of the Browse Basin had been identified, the Director General of DSD, Mr Stephen Wood, advised that discussions between DSD and Browse Basin titleholders had not been fruitful:

At this stage, for Browse it is difficult [for DSD] to answer that question and it is difficult for them to answer that question. We have had quite a lot of detailed discussion with them on this and we have also had our own assessments which I think [...] I mentioned last time in terms of what we think might work or might not work, but the difficulty is you are at the very early phase of that project. Once you define your requirement, how you translate that into sort of something that is a build or a commercial proposition is another issue. In addition to that, whether the actual product launches at all, of course, is part of the assessment at the moment. It is very difficult to answer that question with any sort of specifics at the moment.  

However, as the Committee noted, the Prelude project could hardly be described as being ‘at the very early phase’ and very specific information as to what else might be required for that project should be available. In response, Mr Wood stated:

Would I have liked the Prelude information sooner? Yes. Do I hope I get it this month? Yes. Hopefully, I get it in a state that we can be much clearer about some of the things that you are likewise interested in.

In relation to air transport infrastructure, DSD advised that it was still in the process of determining what might be required. Furthermore, when questioned on the State’s ‘overarching strategy’ for Browse Basin development, Mr Wood was noncommittal, explaining that while DSD was ‘in the process of building’ such a strategy, there was still some work to be done in this area. According to Mr Wood:

what the exact level of activity is that can justifiably be garnered, even in the Kimberley or broader, is what we are trying to do at the moment. Out of that, we have done some work to say, “Yeah, okay we’ll look at what’s actually available; who holds the leases; what level of activity does that tolerate; does it have a proper lift” and those sorts of things. Yes, we have got some views on that, but until we get a better definition project-wise that would marry, you cannot match that

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994 Mr Stephen Wood, Director General, Department of State Development, Transcript of Evidence, 12 March 2015, p 3.
995 Ibid.
Chapter 11

with what we think about location. For any location, of course, also you have got to treat questions about native title; you have got to treat questions of timeliness because it takes a long time to deal with the native title issues.996

11.83 It seems that DSD have adopted a ‘wait and see’ approach to Browse Basin development—an approach that the Committee regards as inappropriate for two reasons. First, the Browse Basin resources will ultimately be developed, whether that be by FLNG technology or more conventional onshore processing. Second, and perhaps more importantly, this approach has left DSD in a position where it is unable to provide useful timely insight into the development intentions of proponents.

11.84 Other evidence given by Mr Wood, however, demonstrates that DSD has a good understanding of many of the issues that are critically important to future development. As indicated above, DSD are aware of the condition of the Cape Leveque Road between Broome and the Lombadina Airport and of the proposed upgrades to facilities at Broome port, both of which could be considered as critical strategic facilities for the future development of Browse Basin resources. Given DSD’s position on these facilities, as described above, the Committee can only assume that the approach taken by DSD has been deliberate.

11.85 The Committee can appreciate the logic of DSD’s approach. Nonetheless, the Committee’s view is that at least part of DSD’s role should be to determine where government might usefully contribute to major projects that would facilitate state development. While it is not the role of government to fund the infrastructure requirements of private industry, government does have a role in managing the state’s economic development and it would be a significant missed opportunity not to harness the development of the Browse Basin resources in this way.

11.86 The important issue of the role of infrastructure in state development will be discussed further in the Committee’s report on opportunities that may arise from FLNG developments.

FLNG presents a challenge to the expert regulator model

11.87 One of the recurring themes throughout this report is that while the offshore petroleum industry is charged with the responsibility of ensuring the safety of its operations, the role played by the regulator in this objective-based model is critical. Under Australia’s regulatory regime, NOPSEMA necessarily takes on the role of ‘expert regulator’. This relies on NOPSEMA being able to properly probe and assess submitted safety cases and environment plans before deciding whether or not to accept them.

996 ibid, p 12.
Furthermore, NOPSEMA's inspection regime is critical to the process of the 'continuous improvement' that is so fundamental to the safety case and environment plan model.

In relation to FLNG facilities, Shell's Prelude will be one of the world's first and certainly the first to operate in Australian waters. As mentioned previously, while some argue that FLNG is an evolution of FPSO technology and others argue that it is revolutionary technology, FLNG facilities are different from those currently operating anywhere in the world. Furthermore, Prelude will be anchored in the Browse Basin, a relatively new region for petroleum development. This means that NOPSEMA is reviewing safety cases and environment plans for new technology in different environments.

As discussed in Chapter 4, NOPSEMA has been granted exemptions in relation to public service salary levels to allow it to recruit and retain experienced professionals. This allows a good level of reassurance that NOPSEMA will have the technical expertise to undertake its assessment, monitoring and inspection functions.

What was less clear is the level of expertise NOPSEMA will have in relation to the local knowledge upon which many aspects of safety cases and environment plans are based. For example, as this chapter has discussed, there are particular concerns surrounding the condition of the Cape Leveque Road and on the capacity of the coastline to service FLNG facilities as required. It is not clear how NOPSEMA will have sufficient local knowledge to allow it to assess an operator's safety case that relies on ISV and rescue helicopter access to Lombadina, for example.

NOPSEMA advised that not all details of a safety case are verified. The information provided by proponents is taken at face value; that is, it is taken as fact, with those facts being verified and tested through the program of inspections. NOPSEMA argues that this is appropriate given they are regulating a mature and sophisticated industry and, therefore, they need to have a level of confidence in the information provided.

In further explaining that assessing the capacity of onshore infrastructure such as hospitals and road’s is ‘not within NOPSEMA’s remit’, Mr Guyan provided specific insight into the safety case verification process. 997 In informing the Committee that NOPSEMA ‘will look at and consider [each safety case] in terms of claims made by the operator,’ Mr Guyan explained that:

> if there is an assumption—let us say it is four hours from time of incident to hospital treatment, that would be something that we can approach from the point of view of: have you tested your emergency response plan arrangements? So it is a matter of inspection, rather than assessment and safety case. So, to an extent, yes, we will take

997 Mr Gavin Guyan, Acting Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 7 April 2015, p 18.
Chapter 11

that description of the emergency response plan as written and as committed. It becomes legal binding as part of the safety case that these arrangements are viable and then by inspection we can test, and in this sort of arena then we would potentially be asking questions around: What level of drills and exercises have you undertaken? How have you tested the functionality of these emergency response plan arrangements? That is how we are approaching it. Certainly, no doubt, NOPSEMA does not inspect onshore hospital facilities or, indeed, the condition of roads onshore.998

11.93 In scrutinising a safety case, NOPSEMA advised that ‘there are a number of checks and balances within the scheme that involve certifying authorities agreeing that [the submitted] design... is to normal industry standards and engineering specifications.’999 To discharge this function, NOPSEMA maintains an appropriate level of in-house engineering expertise.1000

11.94 It is clear that Shell, itself, will continue to learn from the commissioning and subsequent operation of the Prelude facility. It is therefore critical that NOPSEMA is in a position to also learn those lessons. Only then will NOPSEMA quickly become expert in regulating FLNG technology. The expectation is that NOPSEMA will conduct numerous thorough inspections of the Prelude facility, including its support infrastructure, once it is operational. This will ensure that NOPSEMA can properly develop its understanding of the technology. It is similarly expected that Shell will be very candid in sharing its knowledge and understanding of FLNG with NOPSEMA.

Emergency response command

11.95 One of the Committee’s terms of reference was to inquire into the roles and responsibilities of state and federal governments in relation to FLNG emergency situations. While various aspects of this term of reference have been discussed throughout the report, this important issue deserves further consideration, particularly because it appears to be a complex and, at times, confusing issue.

11.96 Some of this confusion possibly relates to the language used in the governing legislation, regulations, policies, guidelines and plans, which contain a raft of terms that are defined in very specific ways. For example, there are control agencies, combat agencies, support agencies and incident controllers, to name a few. These terms notwithstanding, it is important to clarify who, in the event of an offshore petroleum facility incident, is ‘in command’; that is, who has overall control and the mandated

998 ibid, p 17.
999 ibid, p 7.
1000 ibid.
responsibility to determine when an incident will transition from one level of response to another.

11.97 Who controls or coordinates the response to an offshore emergency depends on the severity and type of incident. While all offshore incidents or accidents are serious, some have far more severe consequences than others. For relatively minor incidents, and in accordance with Australia’s regulatory regime, the operator must be capable of managing, including coordinating and controlling, that incident using its own resources, capacities and processes. In effect, this means that the operator, as control authority, is in command.

11.98 There are times, though, when an incident is escalated and an operator may request the assistance of others, including multiple government agencies. A situation may also arise where NOPSEMA, in monitoring the incident, decides to issue a direction to an operator to take particular action. NOPSEMA’s authority to issue a direction to a registered title holder is provided under s 574 (2) of the OPGGS Act, while s 574(3) provides that NOPSEMA is able to direct parties other than the titleholder.1001

11.99 This was explained by Mr Gavin Guyan, NOPSEMA’s General Manager, Safety and Integrity, who, in discussing the Authority’s ability to intervene in an incident response, stated that:

\[
\text{there are powers in the act that allow NOPSEMA to intervene by making directions to an operator or a titleholder to do a number of things, but they do have to relate to health and safety or damage to the environment, the potential thereof. So there is that option for NOPSEMA to intervene. Before we would consider doing that, it would have to be a case that NOPSEMA would have to be convinced that, indeed, the titleholder or operator was not acting in accordance with the plan and reasonable contingency arrangements, or managing the risk to the health and safety of people or damage to the environment appropriately.}^{1002}
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11.100 In any situation involving the deployment of resources from multiple sources, such as one or more operators, private industry and government agencies, the command

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1001 Mr Gavin Guyan, Acting Chief Executive Officer, National Offshore Petroleum Safety and Environmental Management Authority, Letter, 15 April 2015. See also: Submission No. 28, Submission from Department of Industry and Science, 16 April 2015, p 3. This submission also explains the Minister’s general power to give direction to a petroleum titleholder.

1002 Mr Gavin Guyan, Acting Chief Executive Officer and General Manager, Safety and Integrity, National Offshore Petroleum Safety and Environmental Management Authority, Transcript of Evidence, 7 April 2015, p 5.
Chapter 11

structure is critical. Appropriate emergency response, including command, can mean a major emergency does not develop into a catastrophic disaster.\footnote{The Australian Emergency Management Arrangements define a catastrophic disaster as ‘an extreme hazard event that affects one or more communities, resulting in widespread, devastating, economic, health, social and environmental consequences, and that exceeds the capability of existing state and territory emergency and disaster management arrangements. An event could be of sudden impact or sustained impact over an extended timeframe’. See: \textit{Australian emergency management arrangements}, The Attorney-General’s Department, Commonwealth of Australia, 2009, p 17.}

11.101 APPEA’s understanding of such situations is that:

\begin{quote}
the Operator will plan to maintain primary responsibility (combat agency) for its petroleum operations throughout any level of response. External stakeholders with expertise in specific tactical emergency response capability, for example, search and rescue, oil spill, terrorism, will be asked to plan and work with the Operator and will maintain responsibility for those specific activities during any response, but under the overall control of the Operator.\footnote{Mr Adam Welch, Senior Policy Advisor—Western Region, Australian Petroleum Production and Exploration Association, Electronic Mail, 14 April 2014, p 1.}
\end{quote}

11.102 The following outlines the role of the Offshore Petroleum Incident Coordination Committee (OPICC) and the \textit{National plan for maritime environmental emergencies} (the National Plan), and considers their relationship to offshore facility operators’ emergency response responsibilities.

11.103 Chapters 2 and 9 introduced the OPICC—established according to the Offshore Petroleum Incident Coordination Framework (the Framework)—and its role in providing leadership and strategic coordination to an incident. Chapter 9 also noted that OPICC is not a deployment agency as deployment of resources is the operator’s responsibility, one that is coordinated in accordance with their NOPSEMA-accepted emergency response plans. OPICC is also not responsible for incident control as this is the responsibility of the control agency, and does ‘not assume any aspect of the Combat Agency role as designated under the National Plan’.\footnote{Mr Martin Squire, General Manager, Offshore Resources Branch, Resources Division, Department of Resources, Energy and Tourism, \textit{The offshore petroleum regime}, presentation at the Offshore Petroleum Forum, Cairns, 8 April 2013, np. Available at: \url{http://www.nopsema.gov.au/assets/Presentations/Presentation-Offshore-Petroleum-Forum-8-April-2013-web-version.pdf}. Accessed on 9 April 2015; and Submission No. 28, Submission from Department of Industry and Science, 16 April 2015, p 2.}

11.104 OPICC’s purpose ‘is to effectively coordinate Australian Government efforts and resources, and communicate to the public and affected stakeholders all matters
relevant to a significant offshore petroleum incident in Commonwealth waters.\textsuperscript{1006} The Department of Industry and Science (DoIS) advised that the OPICC’s key functions are:

\textit{to provide situational awareness, advice to ministers, coordinate public information and enable whole of government strategic collaboration to resolve conflicts and identify gaps in support of crisis response activities.}\textsuperscript{1007}

11.105 DoIS further advised that:

\textit{this includes facilitating interaction and communication as required with the titleholder/operator, state and territory government agencies, the offshore petroleum industry, foreign governments, other stakeholders and the public.}\textsuperscript{1008}

11.106 NOPSEMA and AMSA are key members of the OPICC.

11.107 The Framework, which establishes the OPICC, is ‘intended to interface with other emergency incident response/coordination frameworks’,\textsuperscript{1009} including the National Plan.\textsuperscript{1010} Chapter 10, in discussing oil spill response, noted that the National plan for maritime environmental emergencies (the National Plan) sets out the arrangements for the management of maritime environmental emergencies. AMSA has jurisdictional authority under the National Plan.\textsuperscript{1011} Nevertheless, as NOPSEMA submitted:

\textit{titleholders are responsible for setting out the arrangements and capability that will be in place, for the duration of the activity, to ensure implementation of control measures necessary for a timely response to an oil spill. Typically, this will include a tiered capability which draws upon titleholder, industry association and government resources.}\textsuperscript{1012}


\textsuperscript{1007} Submission No. 28, Submission from Department of Industry and Science, 16 April 2015, p 2. 1008 ibid.


\textsuperscript{1010} ibid.

\textsuperscript{1011} Australian Maritime Safety Authority, National plan for maritime environmental emergencies, Commonwealth of Australia, Canberra, 1973, p 27.

\textsuperscript{1012} Submission No. 20 from National Offshore Petroleum Safety and Environmental Management Authority, 11 December 2014, p 2.
11.108 The National Plan ‘applies to potential and actual pollution of the sea or harm to the marine environment by oil or hazardous and noxious substance, originating from [... sources or situations including] oil or hazardous and noxious substance pollution incidents from offshore petroleum activities’. The term ‘offshore petroleum activities’ is not defined in the National Plan, but it does note that NOPSEMA is the ‘primary regulator for offshore petroleum activities in the Commonwealth marine area,’ and that environmental plan requirements are outlined in the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGSE Regulations). NOPSEMA, though, is not a responder or combat agency, or a coordinator of incident response activities.

11.109 According to AMSA, the National Plan:

\[
\text{consists of a range of legal and administrative arrangements which are applied through a tiered management structure [...]. International conventions and domestic legislation provide the legal context [...] which is underpinned by national policies and implemented through jurisdictional and local contingency plans.}
\]

11.110 One of the principles of the National Plan is to ‘provide a single integrated response arrangement’. According to the National Plan, ‘the management of maritime environmental emergencies is the shared responsibility of all levels of government, industry and business, the non-government sector and the community’. This is achieved through ‘fostering cooperative relationship(s)’; the ‘commitment of all stakeholders to collaboration across all levels of government, industry stakeholders and the community’; and ‘consultative decision making and shared responsibilities’.

11.111 The National Plan also recognises that ‘major or catastrophic maritime environmental emergencies have the potential to significantly impact on the national interests of Australia’. Such major incidents, which ‘will generally be of a large scale and require the coordination of national and international level interests’, may include situations where:

- the incident exceeds the capability of the nominated Control Agency [... or]

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1014 ibid, p 22.
1015 ibid, p 16.
1016 ibid, p 11.
1017 ibid.
1018 ibid.
1019 ibid, p 30.
11.112 Furthermore, such incidents ‘may require extraordinary strategic coordination across governments and stakeholders for their effective management’.\(^{1021}\) According to the National Plan, major incident coordination of stakeholders is provided ‘through the application of four core concepts’:

- **Strategic leadership**
- **Coordination across Australian jurisdictions and sectors**
- **Coordination with international governments**
- **Processes for the orderly transfer of Control Agency responsibility.**\(^{1022}\)

11.113 For situations not covered in the National Plan, the Commonwealth’s *Model arrangements for leadership during emergencies of national consequence* (the Model Arrangements) would apply.\(^{1023}\) The Model Arrangements, which shows how Australian governments ‘work together to coordinate major incidents’, specifically apply to ‘incidents that require coordination of national level policy, strategy and public messaging or inter-jurisdictional assistance, where such assistance and coordination is not addressed by existing arrangements’.\(^{1024}\) The National Plan is intended to be consistent with the Model Arrangements, which ‘will be applied where the coordination processes outlined within [section 2.4 of the National Plan] require additional support to manage coordination issues’.\(^{1025}\)

11.114 As maritime environmental emergencies can involve two or more jurisdictions, the National Plan includes a *Guideline on the coordination of multiple jurisdiction incidents*, which provides for the ‘establishment of an incident coordination process’ and the ‘determination of a “lead” jurisdiction, if appropriate’.\(^{1026}\) The National Plan also

\(^{1020}\) ibid.
\(^{1021}\) ibid. Emphasis added.
\(^{1022}\) ibid.
\(^{1023}\) ibid. The *Model arrangements for leadership during emergencies of national consequence* are part of the Australian Emergency Management Arrangements. MALDENC was endorsed by COAG on 3 July 2008.
\(^{1024}\) ibid, p 31.
\(^{1025}\) ibid.
\(^{1026}\) ibid, p 32.
Chapter 11

includes Guidelines on the change of control agency to facilitate the ‘orderly escalation from local response operations to incidents requiring international assistance’.1027

11.115 Because the National Plan falls under the jurisdiction of AMSA, it is AMSA’s responsibility to ‘coordinate the national arrangements in support of a Control Agency’s response operation’, including the deployment of equipment stockpiles, dispersant capability and the National Response Team, and providing support services, and technical and other advice.1028 An AMSA officer, known as the Maritime Emergency Response Commander (the MERCOM), is personally ‘responsible for coordinating and managing serious maritime incidents’.1029 Under the Protection of the Sea (Powers of Intervention) Act 1981 (Cth) the MERCOM is authorised to intervene in a maritime incident in the Exclusive Economic Zone (EEZ), ‘when pollution is occurring, or is likely to occur’.1030

11.116 As noted, the OPICC provides strategic leadership and strategic coordination in response to a significant offshore petroleum incident, while the National Plan relates to maritime environmental emergencies. While there is no National Plan-equivalent for significant offshore petroleum incidents not involving the environmental damage, as noted throughout this report, no FLNG facility can operate without approved safety cases and environment plans, which include emergency response and oil pollution emergency plans. These documents also include details of cooperative arrangements between titleholders, operators and governments for situations when government assistance is required. In explaining this requirement, DoIS advised that:

AMSA has a number of memorandums of understanding (MOUs) with offshore petroleum operators in relation to oil spill preparedness and response. It is anticipated new MOUs may be agreed with any new upstream operations, for example FLNG facility activities.1031

11.117 APPEA also advised that every facility safety case:

outlines the emergency response arrangements (including for example, chain of command, tiered and scaled responses, access to equipment, capabilities, competencies, MOUs etc) that will be in place for that

1027 ibid.
1028 ibid, p 62.
1031 Submission No. 28, Submission from Department of Industry and Science, 16 April 2015, p 1.
facility to be able to respond, mitigate and recover from the full range of potential major accident events that have been identified for that specific facility and for the activities undertaken at or near that facility and environment.  

Furthermore, APPEA made it clear that industry expertise is critical in any emergency response. According to APPEA:

where a government decides that it needs to take over an incident, experience suggests (ref Deepwater Horizon) that there will still be a need for support from relevant industry experts to assist with the response. This would include relevant Operator staff, most likely through the Operator’s defined emergency response structure.

Nevertheless, because safety case details are generally confidential, the question as to who is responsible for command in a significant emergency situation (particularly where multiple facilities and/or operators are involved) is not easy to answer. This question is discussed further below.

The need for clarity

This Inquiry has revealed a level of confusion in relation to the emergency response arrangements in place for Australia’s offshore petroleum industry activities. For example, in July 2014, the Department of Mines and Petroleum (DMP) advised that an incident on an FLNG facility in Commonwealth waters would fall under NOPSEMA’s jurisdiction. DMP submitted that in the event of an emergency involving the Prelude facility, ‘NOPSEMA—in conjunction with Shell and Prelude management and team members—is responsible for the effective management of any emergency situation’. The Department clearly contemplates not only that NOPSEMA would manage an offshore emergency, but that its management would include coordination and control responsibilities.

In discussing government oversight of collaborative emergency response arrangements, Mr Raymond Buchholz, the Department of Transport’s (DoT’s) General Manager, Marine Safety, described NOPSEMA as the ‘jurisdictional authority’ that would be ‘getting support instantly from the national response team, from AMSA and from ourselves [DoT]’. Furthermore, in discussing jurisdictional responsibilities for petroleum spills in Commonwealth waters, Mr Buchholz noted that AMSA manages the

1032 Mr Adam Welch, Senior Policy Advisor—Western Region, Australian Petroleum Production and Exploration Association, Electronic Mail, 14 April 2014, p 1.
1033 ibid.
1034 Submission No. 4 from Department of Mines and Petroleum, 14 July 2014, p 6.
1035 Mr Raymond Buchholz, General Manager, Marine Safety, Department of Transport, Transcript of Evidence, 19 November 2014, p 6.
Chapter 11

National Plan, but stated that under that Plan NOPSEMA is the ‘jurisdictional authority for an environmental incident involving [a petroleum facility] in commonwealth waters’. Mr Buccholz also stated that if an oil spill crosses from Commonwealth to state waters, NOPSEMA and DoT would negotiate jurisdictional authority.

In addition, Session 10 of the April 2013 Offshore Petroleum Forum, Spill Preparedness and Response, included the following in a list of general areas of agreement that were reached:

- There are areas of the National arrangements that need clarifying.
- There are areas of the National arrangements that can be strengthened.

During this forum session, NOPSEMA also noted the following emerging issues and priorities:

- Consultation requirements
- Jurisdictional boundaries
- Clarity in roles and responsibilities
- Clarification of control
- Transfer of control and intervention
- Government intervention and triggers.

These comments, together with the views expressed by DMP and DoT in relation to NOPSEMA’s role in an emergency, demonstrate that a level of confusion exists about NOPSEMA’s actual role. This confusion needs to be addressed so that agencies and other stakeholders are better informed of the arrangements that are in place.

The Committee accepts that offshore petroleum industry stakeholders, be they industry or government agencies, maintain a predominant focus upon preventing incidents from occurring. While this focus is essential, it is equally important that emergency response arrangements are clear and that an appropriate command structure is not only in place, but is well-known throughout all relevant stakeholder

1036 ibid, p 2.
1037 ibid, p2.
1039 ibid.
organisations. This will become increasingly important as the level of offshore petroleum activity, including FLNG activity, increases off the Western Australian coast.

The Committee’s understanding is that Commonwealth policy focuses on the response to a major maritime environmental emergency in Commonwealth waters, and that under the National Plan, AMSA is responsible for the control and coordination of a government-assisted response. It also seems that if the emergency is escalated to a major hazard or catastrophe, the Australian Emergency Management Arrangements could be called upon, with state and federal governments taking on their respective roles and responsibilities as outlined in documents such as the Model Arrangements.  

It is again important to recognise that there is ‘no statutory response agency for offshore petroleum safety incidents’. An operator is responsible for the safety emergency response for its facility, and maintains that responsibility through all levels of emergency. In discussing the possible need for a statutory response agency for safety emergencies, APPEA explained that this ‘would be fundamentally in contradiction to the safety case based regulatory regime applying to offshore petroleum facilities’.

For APPEA, and particularly because the onus is on operators to have ‘the full and demonstrated technical skills, capabilities, experience and competency to identify and reduce risks’ to ALARP levels, ‘the establishment of government operated organisations and assets (either federal or state) to respond to oil and gas safety incidents would shift the responsibility away from the operator—who should be best placed to know the specific risks and the facility and activities’.

According to APPEA:

\[
\text{where government has found it appropriate to invest in combat agencies (AMSA, BPC, emergency services etc.), the investment has been deemed justified because the industries involved and risks to Australia are not all adequately managed through such a risk based,}
\]

1040 According to the Australian emergency management arrangements, two defining features of a catastrophic disaster are that it will: ‘not be possible to immediately meet the needs of those requiring assistance within the existing capability of an individual state or territory, or nationally; [and it will] take a considerable time from which to recover’. See Australian emergency management arrangements, The Attorney-General’s Department, Commonwealth of Australia, 2009, p 17. The Committee sought confirmation of its interpretation of these emergency response provisions from the Department of Industry. At the time this report was tabled the Department’s response had not been received.

1041 Mr Adam Welch, Senior Policy Advisor—Western Region, Australian Petroleum Production and Exploration Association, Electronic Mail, 14 April 2014, p 1.

1042 ibid.

1043 ibid.
robust and rigorous regulatory regime as the safety case and need to be managed and reduced for an appropriate cost. The existence of these agencies for reasons not solely related to the oil and gas industry, then creates a need for Operator response plans to interact in order to realise ALARP risk management outcomes.\textsuperscript{1044}

11.130 It is clear that individual titleholders and operators are responsible for human and environmental safety under the terms of their individual environmental and safety emergency response plans. These documents address the risk profile of individual facilities, including the details of any third-party agreements for assisted emergency responses. As safety cases are not public documents, the command and coordination arrangements in place for responding to a major incident are generally unknown.

11.131 This situation differs from that in Norway where there is a far greater level of transparency in relation to offshore petroleum industry activity.

11.132 It was also not clear to the Committee what command structure would be in place for an incident that required both safety and environmental responses. The Committee sought advice from DoIS in relation to command responsibilities for a combined emergency event and whether there would be two separate responses or a concurrent process. DoIS advised that:

\textit{in the event of a significant offshore incident that involved both a safety issue and an environmental emergency, these would be managed as separate incidents. The operator of the facility is responsible for implementing the response plan [...] Simultaneously, the titleholder [...] is responsible for activating its Oil Pollution Emergency Plan [...]}.\textsuperscript{1045}

11.133 DoIS further advised that:

\textit{the Australian Government promotes an “all hazards, all agencies” approach to crisis management, which reflects the multifaceted nature any incident is likely to have. It is likely that the operator and the titleholder would be communicating and potentially coordinating their responses to the incident. Both would also likely be liaising with other State/Commonwealth agencies as the incident unfolds. The OPICC is designed to coordinate the whole-of-government strategic approach}

\textsuperscript{1044} ibid.
\textsuperscript{1045} Mr Damien Tregear, Assistant Manager, Environment, Safety and Security, Offshore Resources Branch, Department of Industry and Science, Electronic Mail, 17 April 2015, p 1.
and assist and liaise with the relevant Control Agency where Commonwealth resources are being deployed.\footnote{ibid.}

**The need for a regional emergency response command**

While the above provides a level of reassurance to the Committee, the issue of emergency response command needs to be considered in the context of the overall development of offshore petroleum resources in a region. A number of agencies contribute to the assessment and acceptance of individual safety cases and environment plans. However, these plans are for individual facilities and address an individual titleholder or operator’s capacity to respond to an emergency.

At present, FLNG is the preferred technology of a number of titleholders for the development of their petroleum leases. Given the potential operation of multiple FLNG facilities off the Western Australian coast in the Browse Basin, the question of command must be regarded as an essential element in strategic safety planning for the region. However, in the assessment processes consideration is apparently not given to the need to develop a regional plan for emergency response; that is, there is no overarching body that considers first, the aggregate effect of multiple FLNG operations on supporting and enabling safety infrastructure or second, the complexity of concurrent multiple FLNG operations.

Environmental and safety emergency response plans for each offshore facility are provided to NOPSEMA as components of individual Safety Cases and Environment Plans. As noted above, these are not public documents. It seems unlikely that emergency response plans would contain proprietary or confidential information and operators generally seem willing to cooperate in relation to safety matters. As ConocoPhillips’ Mr Mark Leigh put it, there are ‘no secrets in safety’.\footnote{Mr Mark Leigh, Team Leader, Asset Integrity and process Safety, ConocoPhillips, *Transcript of Evidence*, 10 November 2014, p 4.} An increased transparency for the details of a facility’s emergency response arrangements would enhance the ability of those preparing documentation for NOPSEMA assessment better understand the types of arrangements that are possible, and the chain of command responsibilities for safety and environmental emergencies. It would also help state agencies such as DMP and DoT better understand the arrangements in place, and contribute to the development of a regional approach to emergency response.
Chapter 11

Finding 82
There is a lack of transparency in relation to the emergency response plan information provided by operators in their safety cases.

Recommendation 3
The Western Australian Government place on the COAG agenda the need for increased transparency from the National Offshore Petroleum Safety and Environmental Management Authority in relation to emergency response plan information.

Finding 83
There is a lack of certainty surrounding the command structure in place for a major emergency incident at an offshore petroleum facility, particularly an incident requiring both a safety and environmental emergency response.

Recommendation 4
The Western Australian Government place on the COAG agenda the need to develop a program to educate stakeholders in relation to the emergency response responsibilities of government agencies.

Finding 84
The aggregate effect of multiple FLNG operations on safety infrastructure and the complexity of an emergency response involving concurrent multiple FLNG operations is currently not being considered by government.

Recommendation 5
The Western Australian Government place on the COAG agenda the need for a regional plan for offshore emergency response, one that considers the aggregate effect of multiple FLNG operations on safety infrastructure and the complexity of an emergency response involving concurrent multiple FLNG operations.

MR IAN BLAYNEY, MLA
CHAIRMAN
Appendix One

Inquiry Terms of Reference

On 15 May 2014, the Economics and Industry Standing Committee announced that it will inquire into and report on safety-related matters relating to FLNG projects in Australian waters off the Western Australian coast. The Committee will investigate:

- the measures taken by project proponents to ensure the safety of workers on FLNG facilities, particularly in relation to extreme weather events and emergency evacuation preparedness;
- the adequacy of Western Australia’s emergency capacity and preparedness to respond to a safety or environmental incident involving FLNG; and
- the role and responsibilities of the state and federal governments in relation to FLNG emergency situations.
Appendix Two

Committee’s functions and powers

The functions of the Committee are to review and report to the Assembly on:

a) the outcomes and administration of the departments within the Committee’s portfolio responsibilities;

b) annual reports of government departments laid on the Table of the House;

c) the adequacy of legislation and regulations within its jurisdiction; and

d) any matters referred to it by the Assembly including a bill, motion, petition, vote or expenditure, other financial matter, report or paper.

At the commencement of each Parliament and as often thereafter as the Speaker considers necessary, the Speaker will determine and table a schedule showing the portfolio responsibilities for each committee. Annual reports of government departments and authorities tabled in the Assembly will stand referred to the relevant committee for any inquiry the committee may make.

Whenever a committee receives or determines for itself fresh or amended terms of reference, the committee will forward them to each standing and select committee of the Assembly and Joint Committee of the Assembly and Council. The Speaker will announce them to the Assembly at the next opportunity and arrange for them to be placed on the notice boards of the Assembly.
## Appendix Three

### Submissions received

*Published submissions are available at:* www.parliament.wa.gov.au/eisc/flngsafety

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<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
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<tr>
<td>Mr Luke Musgrave</td>
<td>Vice President–LNG</td>
<td>Mobil Australia Resources Company Pty Ltd</td>
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<tr>
<td>Mr Reece Waldock</td>
<td>Director General</td>
<td>Department of Transport</td>
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<td>Capt Vic Justice</td>
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<td>Mr Shane Daniel</td>
<td>Critical Risk</td>
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<tr>
<td>Ms Janet Hann</td>
<td>Project Development Manager</td>
<td>GDF Suez Bonaparte Pty Ltd</td>
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<tr>
<td>Ms Gail McGowan</td>
<td>Director General</td>
<td>Department of Planning</td>
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<td>Mr Stephen Wood</td>
<td>Director General</td>
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<td>Ms Lauren Gorton</td>
<td>Communications Advisor</td>
<td>Shell Development (Australia) Pty Ltd</td>
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<td>Mr Bill Townsend</td>
<td>General Manager External Affairs and Joint Venture</td>
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<tr>
<td>Mr Adam Welch</td>
<td>Senior Policy Advisor—Western Region</td>
<td>Australian Petroleum Production &amp; Exploration Association Limited</td>
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<td>Mr Todd Creeger</td>
<td>President</td>
<td>ConocoPhillips Australia Pty Ltd</td>
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<td>Mr Larry hand</td>
<td>National Policy and Strategy Coordinator</td>
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<td>Mr Richard Sellers</td>
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<td>Department of Mines and Petroleum</td>
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<td>Vice President Corporate Affairs</td>
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<td>16</td>
<td>Hon Ken Baston</td>
<td>A/Minister for Emergency Services</td>
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<td>Mr Craig Donaldson APM</td>
<td>Acting Assistant Commissioner, Traffic and Emergency Response</td>
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<td>Mr Greg Guppy</td>
<td>Director, School of Applied Engineering and ACEPT</td>
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<td>Mr Mike Bergin</td>
<td>Regional Director (Western Australia)</td>
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<td>24</td>
<td>Prof Bryant Stokes</td>
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<td>Mr Damian Doherty</td>
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<td>28</td>
<td>Mr Bruce Wilson</td>
<td>Head of Division, Resources</td>
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### Appendix Four

**Hearings**

*Published transcripts are available at: www.parliament.wa.gov.au/eisc/flngsafety*

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<td>7 November 2014</td>
<td>Mr Richard Sellers</td>
<td>Director General</td>
<td>Department of Mines and Petroleum</td>
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<td>Mr Simon Ridge</td>
<td>Executive Director, RSD/Chief Dangerous Goods Officer</td>
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<td>Mr Ross Stidolph</td>
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<td>7 November 2014</td>
<td>Mr Shaun Gregory</td>
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<td>10 November 2014</td>
<td>Mr Mark Leigh</td>
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<td>Mr Lloyd Bailey</td>
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<td>Mr Russell Stringer</td>
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<td>Mr Bradley Santos</td>
<td>Acting Regional Manager, Severe Weather Services</td>
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<td></td>
<td>Mr Jeremy Dunster</td>
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Appendix Five

**Briefings**

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<td>Mr Roel van de Lint</td>
<td>Head, Department of Operations / Deputy Inspector General of Mines</td>
<td>State Supervision of Mines, Ministry of Economic Affairs, Agriculture &amp; Innovation, The Hague, the Netherlands</td>
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<td>Ir RPH Van Elsen</td>
<td>Head, Department of Engineering</td>
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<td>Ing JDR (Hans) Weenink</td>
<td>Deputy Head, Department of Operations</td>
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<td>JM (Jan) van Herk</td>
<td>Head, Department of Geo-Engineering</td>
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<td>21 July 2014</td>
<td>Mr Jeroen Zanting</td>
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<td>GATE Terminal, Rotterdam, the Netherlands</td>
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<td>Ir Olaf Waals</td>
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<td>Ir Jos van Doorn</td>
<td>Manager, Nautical Centre MSCN</td>
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<td>Mr Gerry Dixon</td>
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<td>22 July 2014</td>
<td>Mr John Dagostino</td>
<td>Government Relations Advisor (Australia)</td>
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<td></td>
<td>Ms Catherine Aitken</td>
<td>CX PT Business Manager, Projects &amp; Technology (the Netherlands)</td>
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<td>Winthrop Professor</td>
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<td></td>
<td>Mike Efthymiou</td>
<td>Shell EMI Chair of Offshore Structures</td>
<td>The University of Western Australia</td>
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<td>Mr Simon Durkin</td>
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<td>Ms Winda Evers</td>
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<td>Winthrop Professor</td>
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<td>Mr Johannes Kjøde</td>
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<tr>
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<td>Mr Arne Holhjem</td>
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<td>Mr Håkon Skretting</td>
<td>Regional Director Arctic, Australia, Azerbaijan, Canada, China, Russia and Kazakhstan</td>
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<td>Mr Thor Gunnar Dahle</td>
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<td>Mr Kjell Marius Auflem</td>
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<td>24 July 2014</td>
<td>Mr Tore Jacobson</td>
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<td>Mr Owe Hagesæther</td>
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<td>Mr Are Nordahl</td>
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<td>Mr Bill Murray</td>
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<td>Mr Liam Smyth</td>
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<td>Mr Julien Massé</td>
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<td>Mr Tony Hetherington</td>
<td>Head of Energy Division, Operations</td>
<td>United Kingdom Health &amp; Safety Executive</td>
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<td>Mr Peter Brown</td>
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<td>Mr Jim Stancliffe</td>
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<td>Mr Stuart Russell</td>
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<td>Mr David Rennie</td>
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<td>Mr Robin Watson</td>
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<td>Mr Steven Wayman</td>
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<td>Cr George Adam</td>
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<td>Mr Song-Bay Chung</td>
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<td>Mr Chris Gunner</td>
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<td>Mr Evangelos Koukoulis</td>
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<tr>
<td>27 August 2014</td>
<td>Mr Nick Quinn</td>
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<tr>
<td></td>
<td>Mr Phillip Starkins</td>
<td>Manager of Preparedness</td>
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<td>Mr Dale Jolly</td>
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<td>25 February 2015</td>
<td>Mr Paul Ryan</td>
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<td>Mr Ian Grose</td>
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## Appendix Five

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<td>Mr Terry O’Connor</td>
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<td>Mr Charles Kleiman</td>
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<tr>
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<td>Captain Vikas Bangia</td>
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<td>Mr Scott Brawls</td>
<td>A/Operations Manager</td>
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<tr>
<td></td>
<td>Ms Julie Hollingworth</td>
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<td></td>
<td>Dr Sue Phillips</td>
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<td>Ms Carmen Morgan</td>
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<td>Clinical Nurse Manager Emergency Department</td>
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<td>Mr Paul Ryan</td>
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<td></td>
<td>Mr Jamie Mc Alindon</td>
<td>Aviation Supervisor, Upstream International</td>
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<td></td>
<td>Mr Rob Wilkinson</td>
<td>Broome Operations Supervisor, UIZ Logistics</td>
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<td>Mr Shane Cyr</td>
<td>Base Manager, Broome</td>
<td>CHC Helicopter Services</td>
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<td>5 March 2015</td>
<td>Mr Phillip Starkins</td>
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<td>Australian Marine Oil Spill Centre</td>
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<td>Mr Phil Leigh</td>
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<td>Ms Anna Johnson</td>
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<td>Ms Elsie Archer</td>
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# Appendix Six

## Glossary

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<td>ACEPT</td>
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<td>ALARP</td>
<td>As low as reasonably practicable</td>
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<td>ADF</td>
<td>Australian Defence Force</td>
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<td>AGCMF</td>
<td>Australian Government Crisis Management Framework</td>
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<td>AOPSC Review</td>
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<td>AWU</td>
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<td>AMWU</td>
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<td>BOD</td>
<td>Basis of design</td>
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<td>Bureau of Meteorology</td>
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<td>Broome Hospital</td>
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<td>CPU</td>
<td>Central processing unit</td>
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<td>CSIRO</td>
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<td>DSD</td>
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<td>DSMS</td>
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<td>Evacuation, escape and rescue</td>
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<td>EERA</td>
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<td>EESC</td>
<td>Early engagement safety case</td>
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<td>Fire and explosion risk analysis</td>
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<td>FLNG</td>
<td>Floating liquefied natural gas</td>
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<td>FPSO</td>
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<td>IPIECA</td>
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<td>km/h</td>
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<td>LNG</td>
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<td>the Manual</td>
<td><em>National Search &amp; Rescue Manual</em></td>
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<td>MARIN</td>
<td>Maritime Research Institute Netherlands</td>
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<td>MLA</td>
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<td><em>National Plan to Combat the Pollution of the Sea by Oil and Other Noxious and Hazardous Substances</em></td>
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<tr>
<td>Tcf</td>
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<td>Territorial Sea Baseline</td>
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<td>Western Australian Resources Medical Evacuation</td>
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<td>State emergency management plan for health</td>
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<td>Well operations management plan</td>
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<tr>
<td>PREVENTATIVE BARRIERS</td>
<td>MAJOR ACCIDENT EVENTS</td>
</tr>
<tr>
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</tr>
<tr>
<td>Material selection, coating, pipeline design, cathodic protection, field layout, pressure relief valves and the safety management system (SMS).</td>
<td>MAE-01 Process Hydrocarbons Loss of Containment - Subsea</td>
</tr>
<tr>
<td>Risers design, material selection, coatings, pressure relief valves (MEG only) and the SMS.</td>
<td>MAE-01 Process Hydrocarbons Loss of Containment - Riser</td>
</tr>
<tr>
<td>Piping and equipment design, material selection, coatings, corrosion monitoring, insulation, emergency shutdown (ESD) systems, emergency release couplings, interlocks, equipment trips and the SMS.</td>
<td>MAE-04 Process Hydrocarbons Loss of Containment - Substructure</td>
</tr>
<tr>
<td>Piping and equipment design, material selection, inert gas systems, valve management, tank layout, weatherproofing design, load management and the SMS.</td>
<td>MAE-05 Non Process Loss of Containment</td>
</tr>
<tr>
<td>Equipment and piping design, material selection, coatings, pressure relief valves, ESD systems, safe venting, secondary containment, control of ignition sources, bilge system and alarm, ballast and cargo system and the SMS.</td>
<td>MAE-06 Loss of Control of Suspended Load</td>
</tr>
<tr>
<td>Design safety factors, fail safe systems, equipment design and specifications, alarms and switches, testing, certification and the SMS.</td>
<td>MAE-07 Loss of Marine Vessel Separation</td>
</tr>
<tr>
<td>Field layout, exclusion zones, weatherproofing, thrusters to aid berthing, field support vessels (FSV), communication systems, navigation and the SMS.</td>
<td>MAE-08 Loss of Structural Integrity</td>
</tr>
<tr>
<td>Material selection, equipment design, coatings, cathodic protection, weatherproofing design and the SMS.</td>
<td>MAE-09 Loss of Stability / Position</td>
</tr>
<tr>
<td>Material selection, equipment design, load management, monitoring, tenders, weatherproofing, and the SMS.</td>
<td>MAE-10 Loss of Controlled Flight</td>
</tr>
<tr>
<td>Helideck lighting, second helideck, equipment design, communications and the SMS.</td>
<td>MAE-11 Occasional Hazards</td>
</tr>
<tr>
<td>Equipment design, communications, gas detection and the SMS.</td>
<td>MAE-12 Accommodation Fire</td>
</tr>
<tr>
<td>Appropriate design and installation, electrical protection, certified equipment, housekeeping, dedicated chemical storage and the SMS.</td>
<td>MAE-13: Fire</td>
</tr>
</tbody>
</table>
Appendix Eight

Example of a High Potential Incident Alert

High Potential Incident Alert - 165
February 2014

Wire parts on pullback winch while running riser

INCIDENT SUMMARY

A pullback winch wire under tension parted, causing a 12-tonne riser joint to swing uncontrolled across the drill floor.

At the time of the event the riser joint was picked up and lifted towards well centre with the top drive. When the pullback winch wire was tensioned to assist with the controlled placement of the riser joint, it parted causing the riser joint to swing across well centre. The swinging riser joint struck the forward dolly cart before being lowered and coming to rest against the riser shump.

CRITICAL FACTORS

1. Previous damage to winch wire.
2. Recent relocation of the winch made it more difficult for the winch operator to continuously monitor the wire spooling onto the winch drum.
3. There was no rig-specific procedure for this operation.

KEY LESSONS

- Obtain design and engineering approvals for the relocated winches and associated systems, and for all other changes related to the riser handling system.
- Develop a rig-specific operating procedure for running riser.
- Risk assess all horizontal pull winches and verify that the potential “snap back” risk to the operator is reduced to ALARP.