Woodside submission to the Inquiry into safety-related matters relating to FLNG projects

August 2014

Table of Contents

Terms of Reference (TOR)

Western Australian Legislative Assembly Economics and Industry Standing Committee – *Inquiry into safety-related matters relating to FLNG projects*.

The Committee will inquire into and report on safety-related matters relating to FLNG projects in Australian waters off the Western Australian coast. In particular 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 incidents involving FLNG; and
- The role and responsibilities of the state and federal governments in relation to FLNG emergency situations.

1. Key Points in response to ToR

The dynamic global environment has led oil and gas operators to pursue the use of innovative technical and commercial solutions such as floating liquefied natural gas (FLNG) technology.

The application of FLNG technology is a natural evolution in the oil and gas industry, similar to the development of floating production storage and offloading (FPSO) facilities for offshore oil fields in the 1980s. FLNG technology integrates established practices, processes and equipment for upstream and downstream developments on a floating facility.

Woodside has a comprehensive management system that provides assurance that adequate health, safety and environmental (HSE) controls, mechanisms, processes and procedures are in place for all our assets.

These processes and procedures are central to Woodside's development of offshore and liquefied natural gas (LNG) facilities, with an emphasis on inherently safer design.

Woodside has a demonstrated capability of operating within an objective based (or goal setting) regulatory regime as exists in Australia, where the onus is placed on the operator to identify, evaluate and manage its risks. This approach requires the operator to demonstrate that for each development the adopted risk management controls are effective and fit-for-purpose and that such risks are reduced to as low as reasonably practicable (ALARP)[1].

Woodside has significant offshore development expertise as well as land based LNG expertise and has developed internal knowledge and understanding of FLNG technology as a result of considering FLNG technology for the development of Sunrise and Browse resources.

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.

The FLNG technology enables the use of remote subsea wells to physically separate the hazards of the well from the facility. This separation distance ensures events from drilling activities will not impact the facility and provides ample space to conduct safe concurrent activities.

[1] A risk is considered as being ALARP if the cost of any reduction in that risk is grossly disproportionate to the benefit obtained from the reduction. One of the main objectives of the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* [OPGGS(S)] is to ensure that the risks to health and safety of people at offshore facilities are reduced to a level that is as low as reasonably practicable (ALARP). NOPSEMA Guidance Note N-04300-GW 0166 Rev 5 June 2014

Offloading of the produced LNG is carried out in the field via side-by-side loading to LNG carriers, while condensate is offloaded by a traditional tandem arrangement.

A robust suite of controls have been identified to eliminate, prevent or mitigate risks of major events. For Browse FLNG these controls align with relevant Woodside operating standards and existing Woodside operating facilities providing confidence that process safety can be managed effectively over the facility lifecycle.

Ongoing assessment of FLNG technology requires Woodside to continuously assess and document its understanding of the specific HSE implications of FLNG.

2. Introduction

Woodside welcomes the opportunity to make this submission to the Western Australian Legislative Assembly Economics and Industry Standing Committee's Inquiry into the safety-related matters relating to FLNG Projects.

This submission should be read in conjunction with Woodside's submission to the Western Australian Legislative Assembly Economics and Industry Standing Committee Inquiry into the Economic Implications of Floating Liquefied Natural Gas Operations found at: http://www.parliament.wa.gov.au/parliament/commit.nsf/(Evidence+Lookup+by+Com+ID)/81D394D067B26BC148257CD900256B98/$file/24+20130904+Woodside+Submission.pdf.

This submission provides an overview of Woodside's approach to safety and risk management and general comment on FLNG safety based on Woodside's extensive offshore development experience and its own FLNG studies and the understanding of Shell's FLNG technology gained from work conducted on Sunrise and Browse.

This submission also details key HSE considerations that underpin FLNG design, field wide support and emergency response requirements; and a case study of the Browse FLNG Development.

3. Woodside Management System

Woodside 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, as shown in Figure 1. Woodside is targeting continued improvement in health and safety to support our aspiration of global top quartile performance.

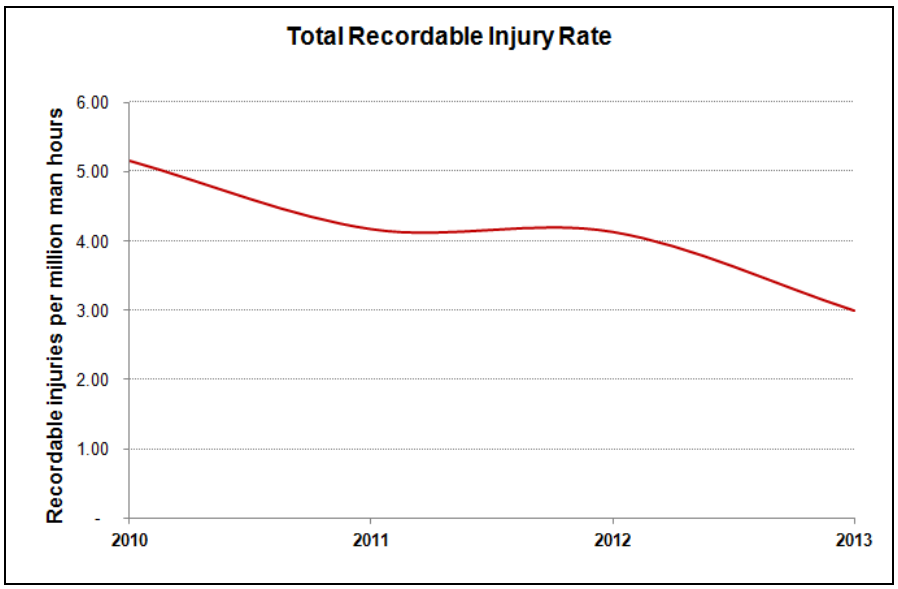

Figure 1: Woodside health and safety performance

A key element of Woodside's approach to health and safety management, and in particular the prevention and mitigation of major accident events is the Woodside Management System (WMS). The WMS provides a structured governance framework across Woodside's processes with defined accountabilities and performance requirements for Woodside's managers, employees and contractors.

The WMS outlines systems and processes that will be used for identification, control and assurance of safety risks to all Woodside-operated and business related activities and sites. Woodside's health and safety policies detail process safety management and promote a safety culture. Woodside's internal processes support continuous improvement and dynamic identification of safety risks.

Risk Management

An important element of any management system to support business decision making is robust risk management processes.

Woodside's approach to risk management reflects industry standards and provides a structured approach to identification, assessment and treatment to ensure that HSE risks are managed effectively.

Recognising the importance of attaining the maximum level of safety performance from a design, risk management controls are identified and selected using 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.

Inherent safety design is an approach to design in which the hazards associated with materials and operations have been reduced or eliminated, adopting the hierarchy of risk management controls as listed above. 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. Application of the above hierarchy of controls results in fewer and smaller hazards, fewer causes and consequences, reduced severity and more effective management of residual risk.

The inherently safety design goals can be seen in Figure 2.

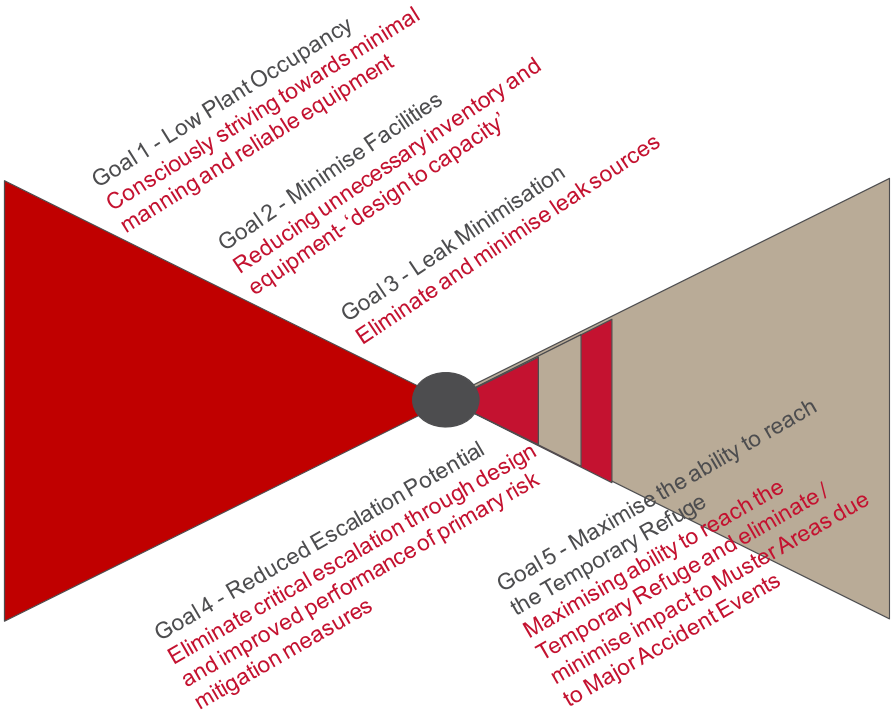

Figure 2: Inherently Safer Design Goals

Formal Safety Assessment Process

For all of Woodside's oil and gas facilities, identified risks are managed under the same structured approach. However, events with potential to result in multiple fatalities or significant environmental impacts are subject to a more formal assessment process. Such events are typically termed Major Accident Events (MAE)[2] or Major Environmental Events (MEE)[3].

All major hazard activities conducted by Woodside are subject to a formal safety assessment process. The formal safety assessment process used by Woodside is consistent with Australian safety regulations[4] and industry good practice guidance notes. This process systematically identifies hazards, while identifying and assessing the control measures to be adopted. The formal safety assessment process comprises of a number of standard studies that address the following key areas. These studies mirror the requirements of current Australian safety regulations:

- 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.

A summary of these processes is typically provided within any safety case submission, as part of requirements of the regulatory regime regulated by National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)[5]. 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.

[2] Woodside defines a MAE as an event having the potential to lead to multiple fatalities.
[3] Woodside defines a MEE as an event with potential to result in major long term environmental impacts to ecosystems, species or habitats.
[4] Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Cth).
[5] A facility cannot be constructed, installed, operated, modified or decommissioned without a safety case in force for that stage in the life of the facility.

4. Hazard Management

Layout

The layout of any hydrocarbon facility has a major effect on the consequences of major events and on the arrangements required for emergency response. The impact of layout design is reviewed within the formal safety assessment process to support development of a layout that minimises risks.

Consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262) and the Woodside Safety in Design Engineering Standard (W10005SF5568513), key controls adopted within the layout design for a FLNG Development would include:

- Subsea wells located a significant distance away from a facility to reduce the potential interaction due to dropped objects, loss of containment (e.g. well blowouts) and simultaneous operations associated with drilling activities;
- Subsea layout and pipeline route selection considers minimum and maximum clearances to facilitate safe installation, maintenance and operation;
- Subsea design to accommodate buckling and expansion requirements to maintain integrity of equipment;
- Wells and subsea infrastructure interfaces with an Emergency Shutdown (ESD) system and have multiple barriers which isolates and limits subsea inventories impact on facilities;
- Equipment with the highest hazard potential located furthest away from the accommodation and temporary refuge;
- Accommodation located outside of hazardous areas and not above hydrocarbon storage tanks or process areas;
- Clear approach paths to support helicopter and marine availability;
- Well ventilated and open process areas to reduce the build-up of flammable materials to limit the potential for fire scenarios to escalate and minimise the potential damage from explosions;
- Self draining decks designed to remove cryogenic spills overboard as quickly as possible;
- A Turret Mooring System (TMS) and risers protected from external events;
- Flare and vent stacks positioned to reduce exposure of personnel to thermal radiation, noise and potential toxic releases; and
- Diverse escape routes to maximise personnel ability to reach a temporary refuge, protected from fire and explosion events.

Management of Flammable Hazards

Loss of containment of hydrocarbons on any oil and gas facility presents a flammable hazard with potential to cause harm to people and the asset. Due to the volume and high pressure of hydrocarbons being produced on oil and gas facilities there is potential for a release to occur from the process or storage. A hydrocarbon release that finds an ignition source presents a fire or explosion risk to personnel.

Successful design for fire and explosion protection requires a systematic approach to identifying and assessing hazards and risks that may be present. The selection of fire and explosion protection measures is determined by an evaluation of the hazards for a specific facility. Fire and explosion hazards are generally assessed in detail to identify, analyse and understand the potential event and any escalation. This identification and assessment of flammable events is conducted to ensure suitable systems and processes are in place to protect personnel from these events.

A FLNG facility presents similar fire and explosion hazards to other offshore assets and therefore good industry practice is adopted to ensure safety measures are in place to prevent and mitigate a fire or explosion. FLNG introduces the risk of structural embrittlement that may arise when cryogenic liquid contacts unprotected steel structures and equipment. Cold Spill Protection (CSP) material is qualified by an independent third party to demonstrate effectiveness after contact with cryogenic liquids. CSP is applied to prevent escalation for a defined period of time based upon risk analysis.

Consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262) and the Woodside Safety in Design Engineering Standard (W10005SF5568513), risk management controls for a FLNG design relevant to the management of flammable hazards would include:

- Minimisation of leak sources through the reduction of unnecessary equipment, connections and flange joints;
- Separation and segregation of temporary refuges from the flammable hazards risks;
- Well ventilated and open process areas to reduce the build of flammable materials, limit the potential for fire scenarios to escalate and minimise the potential damage from explosions;
- LNG and condensate storage tanks operated at atmospheric pressure to reduce the risks inherent in the storage of large pressurised hydrocarbon inventories;
- Self draining decks designed to remove cryogenic spills overboard as quickly as possible;
- Adoption of an offshore philosophy to emergency shutdown and depressurisation;
- Control of ignition sources through hazardous area classification; and
- Protection of critical structures and equipment from thermal hazards through the use of passive fire and cold spill protection.

Environmental Spills

Environmental spills may result from a loss of hydrocarbons from topsides containment or damage to subsea infrastructure, pipelines or risers. LNG 'boils off' extremely rapidly at ambient temperature and therefore presents limited environmental risk, given this spill impact assessment focuses on the liquid condensate component.

Uncontrolled well blowouts present a major risk for all offshore developments. This risk is not altered by the shift to a FLNG concept as the wells required to extract hydrocarbons from the reservoir are still present. The well integrity and control technology utilised for FLNG does not fundamentally differ to other existing subsea tiebacks for recent gas developments.

The use of FLNG eliminates the need for long liquid export pipeline networks, typical of other offshore developments. The subsea flowlines for FLNG are significantly shorter and carry multiphase reservoir fluids, therefore significantly reducing the environmental impact from long subsea liquid export pipelines.

The offshore storage and offloading of liquid hydrocarbons does not present a new safety or environmental risk. Design measures such as "dry break" couplings, collision protection measures and mooring systems are designed to withstand metocean conditions and reduce the likelihood of spills.

The risk of loss of containment during condensate offtake and transport exists for onshore LNG developments. FLNG transfers these risks offshore, however, the risk and control measures are the same as FPSOs.

Collision Risks

Credible ship collision scenarios can be divided into those by field-related vessels, for example attendant vessels which come alongside for a specific purpose (e.g. LNG carriers and condensate tankers) and passing traffic whose route takes the vessel close to an offshore facility.

The nature of the hazard that each collision presents is highly dependent on the type of vessel and approach speed. The consequences of a collision could range from localised damage to a breach of the hull and wall of the storage tank.

The risk of collision for a FLNG facility is not significantly different to any other offshore asset. Woodside has successfully managed condensate tanker berthing at offshore FPSOs. Additionally Woodside has safely managed LNG carrier berthing at onshore plants for many years.

Shipping routes and marine traffic in the area of any development are studied to inform field layout and the facility location. The facility and its associated exclusion zones are added to navigation charts and posted in a notice to mariners as per the process for other oil and gas facilities. A FLNG facility will be equipped with automatic radar plotting aid to detect approaching vessels. A FLNG facility will also have a dedicated Stand-by Vessel in attendance to monitor vessel entry into the facility exclusion zone.

A FLNG facility can provide for offloading requiring both carriers and tankers to approach. However, the possible threat of collision from such vessels is managed by the very low speed approach under controlled 'static tow' conditions and in restricted weather windows.

Consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262) and the Woodside Safety in Design Engineering Standard (W10005SF5568513), risk management controls for a FLNG design relevant to collision risks would include:

- The hull to withstand particular low energy collisions from a LNG carrier and condensate tankers;
- The cargo tanks further protected from a collision by a deep void space around the tanks;
- The substructure is double skinned over the full length of the LNG and condensate tanks which provides protection against collision;
- Fenders provided to protect the structure from contact by visiting LNG carrier;
- Facility based navigational aids, collision avoidance systems, radar and a variety of communication systems to ensure robust communication to marine vessels;
- Adequate space for the offtake carriers to make their approach; and
- The TMS and risers protected from external impact events.

Structural Integrity

Hull failure and/or structural member failure has the potential to result in significant asset damage, potential escalation to topsides hydrocarbon systems and/or loss of life. Some of the common causes of structural failure include extreme weather events, fire and explosion events, collision risks and loss of position events.

The hull of a permanently moored FLNG facility is designed to resist the most onerous operating, construction and heavy weather environmental conditions, up to and including a 10,000 year return period extreme weather event which includes those conditions associated with a category 5 cyclone. This is reflective of good industry practice and avoids the complexity and risks associated with disconnecting and reconnecting for cyclone avoidance.

Loss of Position or Stability

Facility design shall enable positive stability in all conditions. Loss of stability or mooring integrity failure may potentially result from severe environmental conditions or failure of the ballast system leading to flooding or foundering of a floating offshore facility.

The design of the substructure for a permanently moored FLNG development has sufficient water ballast storage capacity enabling the hull to be kept on an even keel at all operating cargo and consumable conditions, including during offloading operations. The ballast arrangements provide sufficient immersion of the hull to manage vessel motion in severe weather conditions. Statutory stability requirements are managed by an online loading computer over the full range of operating conditions.

The design of the substructure for a permanently moored FLNG Development mooring system is based on resisting the most onerous environmental conditions, up to and including the 10,000 year return period event.

Consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262) and the Woodside Safety in Design Engineering Standard (W10005SF5568513), risk management controls for FLNG design relevant to loss of position or stability would include:

- The FLNG substructure designed to satisfy the requirements of all relevant IMO requirements. The facility to be designed in accordance with the Rules and Recommendations of a Classification Society with experience of both offshore installations and trading LNG carriers;
- The fatigue design of the mooring lines significantly greater than the service period required for the mooring lines;
- Failure of any single mooring line in any principal loading condition not leading to progressive failure of the mooring system or exceed riser design limits;
- Ballast arrangement providing sufficient immersion of the hull to provide satisfactory motion in severe weather conditions;
- FLNG has positive stability in all conditions, including the simultaneous handling of all inventory and ballast during production and offloading operations; and
- A Mooring Load Monitoring system used to constantly monitor tension in the mooring lines.

Personnel Transportation Risks

Woodside's operating offshore assets all utilise helicopters as the primary means of transport. Woodside manages the risk from crew transfers by helicopter on a daily basis. Potential risks are therefore well understood in the context of supporting a FLNG Development.

Escape, Temporary Refuge, Evacuation and Rescue

All offshore oil and gas facilities are designed to ensure personnel are able to escape from the immediate effects of an incident, muster in a safe location while assessing the incident, communicate with rescue services and evacuate the facility. FLNG facilities are no different.

The selection of escape, temporary refuge, evacuation and rescue facilities is determined by evaluation of the hazards on a facility, in particular an assessment of the fire and explosion hazards. A range of control measures are selected for facility design to maintain the safety of personnel, these controls typically include raising alarm, diverse escape routes and a temporary refuge designed to be available for the time required under the range of major accident events. Additionally, life saving equipment is provided to support escape, evacuation and rescue, this equipment generally includes items such as lifeboats, portable fire extinguishers and lifejackets.

Consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262) and the Woodside Safety in Design Engineering Standard (W10005SF5568513), risk management controls for FLNG design relevant to escape, temporary refuge, evacuation and rescue would include:

- Communication systems to alert all personnel of an incident and enable appropriate and timely action;
- Multiple and diverse escape routes provided to maximise ability for personnel to reach the primary temporary refuge;
- Appropriate number of temporary refuges;
- Primary and secondary means of evacuation in the form of helicopters (primary) and freefall lifeboats (secondary); and
- Facilities for the Command and Control team to coordinate and manage response.

Health and Wellbeing

Woodside conducts health risk assessments for all our oil and gas facilities to provide a systematic means to identify and prevent risks posed by occupational health and hygiene hazards to which people may be exposed.

Risk management controls for a FLNG development relevant to health and wellbeing will be consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262), the Woodside Safety in Design Engineering Standard (W10005SF5568513) and the Woodside Occupational Health in Design Engineering Standard (W1000SF5568536).

Health risk assessments are conducted as early as possible to ensure inherently safer design measures can be implemented to eliminate or substitute the hazard wherever possible. Typical health hazards include:

- Exposure to chemical substances, products or toxic material;
- Physical hazards e.g. noise, vibration, heat and radiation;
- Biological hazards e.g. viruses, food and water containments;
- Ergonomic hazards e.g. manual handling; and
- Psychological hazards e.g. shift work, work relationships and lack of sleep.

5. Incident Management

Emergency and Crisis Management Arrangements

Emergency management arrangements at Woodside are focused around prevention, preparedness, response and recovery philosophy based on an 'all hazards' approach. People, processes and systems are in place to effectively manage emergency response and incident management efforts across all of our assets.

Woodside uses a three tiered approach to emergency management, as shown in Figure 3, which 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.

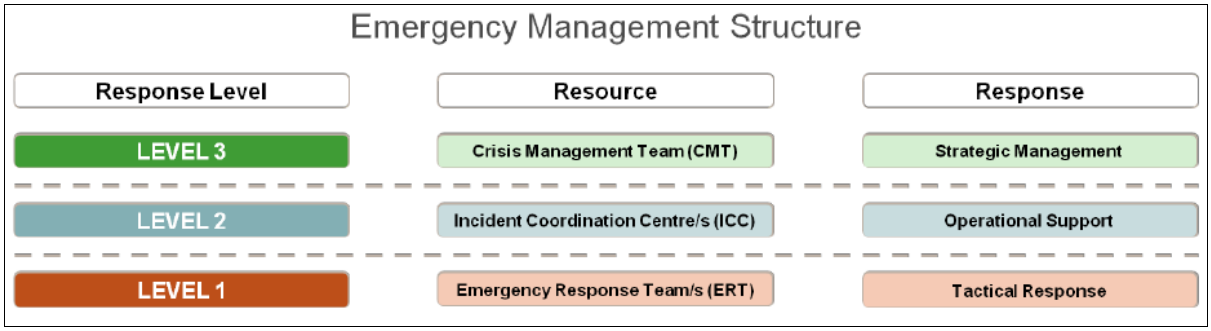

Figure 3: Tiered approach to Emergency Management

The Woodside emergency response structure is based on the principles of the Australasian Inter-service Incident Management System (AIIMS) namely, span of control, management by objectives, functional management, flexibility and unity of command. The adoption of AIIMS facilitates interoperability between Woodside facilities and external agencies that may respond to assist or assume overall control of an emergency. The Woodside emergency management structure contains the necessary mechanisms to establish effective liaison and coordination across agencies with different jurisdictional roles. It also enables improved understanding, a common language and a consistent approach to emergency management, linking our own response to State Government WESTPLANS.

Woodside has an established framework to enable the organisation to act quickly, decisively and cooperatively in a crisis. The framework allows escalation of response as required by the event. Our priorities and focus areas during a crisis are:

- 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.

An overview of the management of the focus areas in a crisis is outlined in Figure 4.

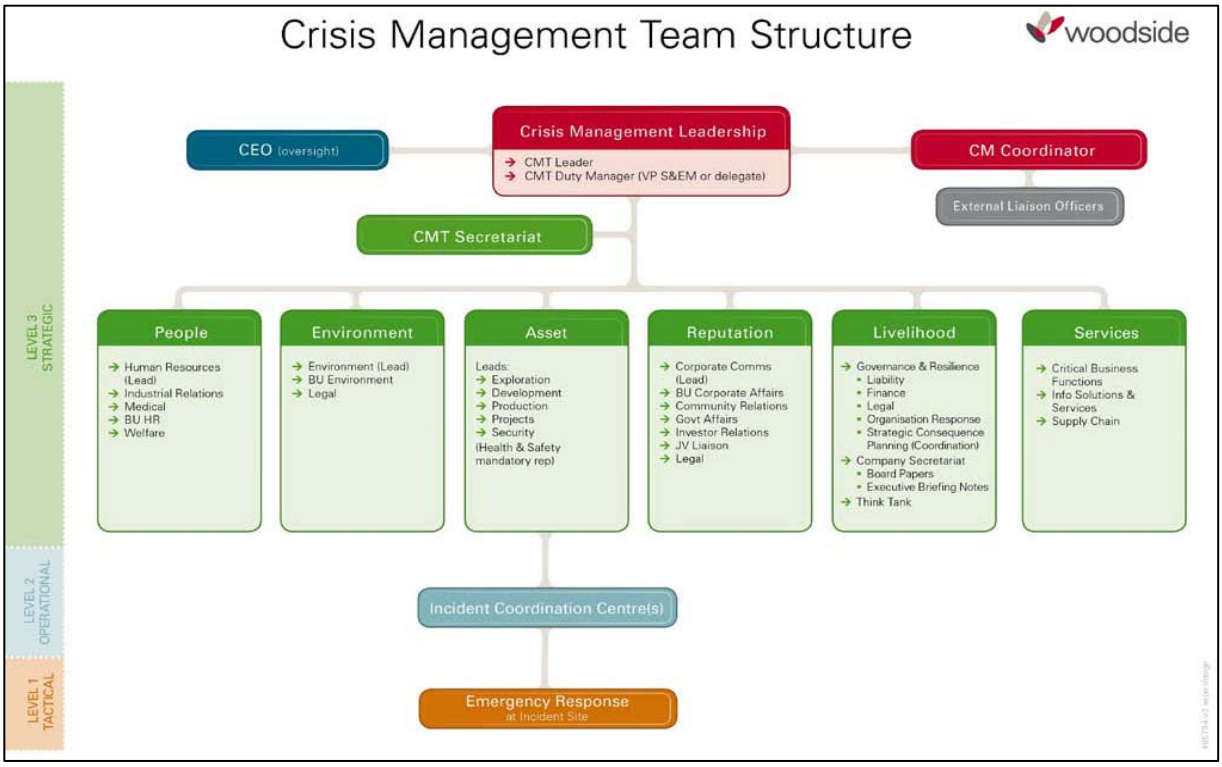

Figure 4: Crisis Management Team Structure

Emergency and Crisis Management Preparedness

Woodside personnel involved in emergency and crisis management arrangements are trained via an ongoing competency based training and a crisis management capability development program. 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.

Woodside maintains an internal Emergency Management Steering Group to provide an avenue for collaboration on the enhancement of emergency management capabilities across the company's various operating environments. This group shares emergency management risk trends and learning's, provides advice on improvement opportunities and promotes standardisation and consistency across the company. There is also a risk-based, structured assurance and compliance framework that contributes to an overall 'emergency preparedness' corporate score.

Woodside regional response teams maintain groups of trained personnel to respond to site based incidents. Emergency response skills include incident management, oil spill, fire fighting, communications, aviation, marine and logistics. 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.

Woodside promotes self reliance in the first instance and also has a number of mutual aid arrangements with other oil and gas and minerals companies in the same geographical

areas. Due to resources required to respond to major emergency incidents, precinct-style agreements are common in Woodside's operating areas.

Woodside 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. These include the:

- Energy Sector Group (Trusted Information Sharing Network – TISN – Attorney Generals);
- Oil and Gas Security Forum,
- APPEA Security Task Force;
- Pilbara Critical Infrastructure Collective;
- Burrup Emergency Management Committee; and the
- Northern Territory Critical Infrastructure Collective.

Woodside personnel also 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.

Engagement with regulators, such as NOPSEMA and the Department of Mines and Petroleum, is facilitated through a wide variety of forums, audits and periodic facility inspections. Woodside emergency response provisions are governed by facility Safety Cases and relevant legislation for each specific location and follow best practice Australian standards. Security response arrangements are regulated under the *Maritime Transport Offshore Facility Security Act 2003 (Cth),* which in turn is enforced by the Office of Transport Security.

Environmental Incident

Woodside has a strong focus on prevention and preparedness followed by response and recovery to address the risk associated with a spill.

To prepare for a response to a major oil spill Woodside focuses on five key pillars:

- Contingency planning;
- Visible and accountable leadership;
- Capability (equipment, services and contracts);
- Competency (training and exercising); and
- Compliance and assurance (regulatory and internal).

To achieve the level of preparedness required to respond to a major spill includes internal first strike response capabilities, membership of oil spill response organisations (e.g. Oil Spill Response Limited, Australian Marine Oil Spill Centre), mutual aid arrangements and strategic initiatives by industry associations (e.g. APPEA and other Industry Forums) and support from National arrangements (e.g. AMSA National Plan).

Search and Rescue

The Emergency Management Act 2005 (WA), in conjunction with the *Emergency Management Regulations 2006 (WA)* establishes the Commissioner of Police as the Hazard Management Agency for Marine Search and Rescue within Western Australia. Activities previously mentioned such as local committee representation, joint exercises and the linkages through incident management systems all enable a integrated approach to search and rescue events. Woodside regularly participates in industry working groups[6] to discuss emerging issues and potential synergies in the Broome region.

Woodside 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. 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.

Cyclone Management

As an experienced operator in storm/cyclone-prone areas Woodside 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 Response Plans are in place for all of Woodside facilities that may be impacted.

FLNG facilities that are permanently moored will remain on-station with personnel remaining onboard during cyclonic conditions. As previously stated, the design of the facility will be based on resisting environmental conditions, up to and including the 10,000 year return period event.

Adverse weather conditions have the potential to impact the health and safety of the employees and the potential to compromise facility integrity. FLNG facility design has evolved with due consideration to cyclone survivability and maintaining a safe environment for the workforce. As with other offshore facilities, for a FLNG facility, during adverse weather conditions, restrictions will typically be placed on operations such as lifting and personnel working outside. Similarly, field vessels will depart at pre-determined weather conditions.

[6] For example the Oil and Gas Operators Working Group in Broome

Case Study - Browse FLNG Development

The Basis of Design (BOD) reference case for the Browse FLNG Development is premised on the Shell FLNG design.

Shell has matured the health and safety aspects of its FLNG technology over 15 years. Shell's FLNG technology is designed to minimise risks to the health and safety of personnel on board or working near the facility to a level comparable to other offshore oil and gas facilities.

Woodside in its role as operator of the Browse FLNG Development continues to apply robust technical evaluation of Shell's FLNG design to assure consistency and alignment with Woodside processes.

Consistent with the Woodside Health and Safety Management Operating Standard (WM1040SF5599262) and the Safety in Design Engineering Standard (W10005SF5568513), safety in design features of the Browse FLNG Development include:

- Optimised field layout with subsea wells located a significant distance away from the facility to reduce the potential interaction due to dropped objects, loss of containment and simultaneous operations associated with drilling activities;
- The facility layout has positioned equipment and process with high hazard potential furthest away from the accommodation;
- Diverse escape routes maximise the ability of the workforce to reach a safe location in the event of an emergency;
- Safety gaps have been incorporated in the design to maximise the effects of natural ventilation thereby minimising explosion overpressures and limiting fire escalation potential;
- An open process design which maximises the use of grated decks, thus optimising natural ventilation which prevents build up of flammable releases;
- To reduce potential leak sources, through minimisation of piping connections and maximised use of welded connections;
- The flare and vent stacks have been positioned to reduce exposure of personnel to thermal radiation, noise and potential toxic releases; and
- The substructure is double skinned over the full cargo tank length which provides protection against vessel collision.

In the event of an incident, Woodside 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.

Figure 5 provides an overview of the safety in design features of the Browse FLNG Development.

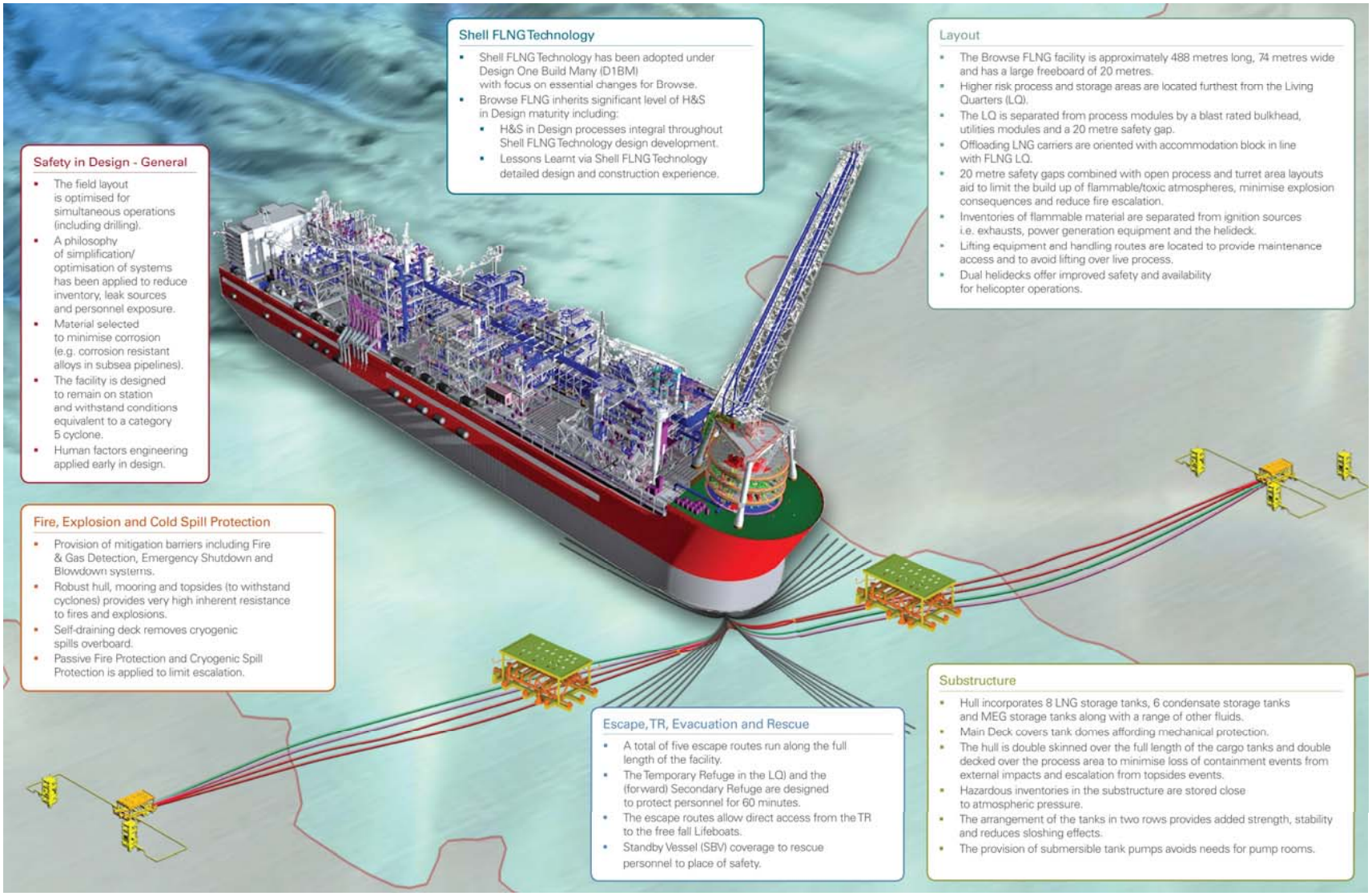

Figure 5 – Browse FLNG Safety in Design (Image provided courtesy of Shell)

References

- NOPSEMA website - NOPSEMA Guidance Note N-04300-GW 0166 Rev 5 June 2014 http://www.nopsema.gov.au/assets/Guidance-notes/N-04300-GN0166-ALARP.pdf

- The International Association of Oil and Gas producers website - Oil and Gas Producers, Managing Health for field operations in oil and gas activities (definition of Oil and Gas Producer Association Level 4 hospital) http://www.ogp.org.uk/publications/health-committee/managing-health-for-field-operations-in-oil-and-gas-activities