NOPSEMA
Australia's offshore energy regulator

GUIDANCE NOTE

Vessel facilities subject to external hydrocarbon hazards

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Core concepts

- This guidance note is primarily targeted at vessel facilities: providing accommodation for persons working on a production facility, undertaking well servicing activities that do not involve bringing well fluids onto the vessel facility, laying pipes for petroleum (including manufacturing such pipes or doing work on existing pipes) and the construction, installation, dismantling or decommissioning of production facilities.
- The safety case for an offshore facility that an operator submits to NOPSEMA must comply with the safety case contents requirements of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 (Safety Regulations) in order to be accepted by NOPSEMA.
- This guidance note provides supplementary guidance on the content and level of detail expected to be included in a vessel facility safety case in relation to each of the major aspects of a safety case submission (i.e. facility description, safety management system (SMS) description, formal safety assessment description) such that it complies with requirements of Safety Regulations.
- The safety case must be appropriate to the facility and to the activities conducted at that facility.
- Only by inclusion of a sufficient level of detail in the safety case will NOPSEMA be able to make a decision on the appropriateness of the safety case in accordance with regulation 2.26 (for new safety cases) or regulation 2.34 (for revised safety cases) of the Safety Regulations.
- The safety case must be a stand-alone document that is sufficient to meet the contents and level of detail requirements of the Safety Regulations without needing to refer to other documents external to the safety case (i.e. the safety case must provide adequate descriptions of documents referenced within the safety case).
- The safety case that the operator prepares for an offshore facility must identify the safety-critical aspects of the facility (i.e. technical controls) and other safety management system-related controls (i.e. policy and procedural controls) with respect to major accident events.
- The adopted control measures for any particular identified major accident event must be shown to collectively eliminate, or reduce to a level that is as low as is reasonably practicable, the risk to health and safety of persons at or near at the facility.
- In order to provide evidence that the SMS is comprehensive and integrated for all aspects of the control measures, it needs to be shown to fully support and maintain the performance of the control measures within an integrated management framework.
- Overall, a well-structured, coherent safety case will facilitate an operator's ability to demonstrate to others that they have a clear understanding of the factors that influence risk and the controls that are critical to minimising risk to the health and safety of persons at or near the facility.

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Abbreviations/acronyms

ABS	American Bureau of Shipping
AHU	air handling unit
ALARP	as low as reasonably practicable
AOP	associated Offshore Place
ARPA	automatic radar plotting aid
ASOG	activity specific operating guidelines
DHSV	down hole safety valve
DP	dynamic positioning
ECR	emergency control room
EERA	evacuation, escape and rescue analysis
EDS	emergency disconnect system
ERP	emergency response plan
ESD	emergency shutdown
ESSA	emergency system survivability analysis
FD	facility description
FERA	fire and explosion risk analysis
FO	fuel oil
FSA	formal safety assessment
GA	general alarm
HAZID	hazard identification (study)

HRC	hyperbaric rescue craft
HVAC	heating, ventilation and air-conditioning
H_2S	hydrogen sulphide
IMO	International Maritime Organisation
LARS	launch and recovery system
LoC	loss of containment
MAE	major accident event
MODU	mobile offshore drilling unit
MOPS	manual overload protection system (cranes)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OPGGS Act	*Offshore Petroleum and Greenhouse Gas Storage Act 2006*
PA	public address
POB	persons on-board
PTW	permit to work
RLWI	riserless light well intervention
ROV	remotely operated vehicle (underwater)
RWI	riserless well intervention
Safety Regulations	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009
SCE	safety-critical equipment
SCSSV	surface-controlled sub-surface valve
SIMOPS	simultaneous operations
SMS	safety management system
SNA	social network analysis
SPS	special purpose ship
TEMPSC	totally enclosed motor-propelled survival craft
TR	temporary refuge

Key definitions for this guidance note

As low as reasonably practicable (ALARP) – Refers to reducing risk to a level that is ALARP. In practice, this means that the operator has to show through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce risks further.

Reasonably practicable – The legal definition on this was set out in England by Lord Justice Asquith in Edwards vs. National Coal Board [1949] who said:

'*Reasonably practicable' is a narrower term than 'physically possible' and seems to me to imply 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 it be shown that 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.*

This English decision has since been confirmed by the Australian High Court.[1]

Major accident event - An event connected with a facility, including a natural event, having the potential to cause multiple fatalities of persons at or near the facility regulation 1.5 of the Safety Regulations.

Performance standard - Means a standard, established by the operator, of the performance required of a system, item of equipment, person or procedure which is used as a basis for managing the risk of a major accident event regulation 1.5 of the Safety Regulations.

Vessel facility – A vessel located at a site in Commonwealth waters; and is being used, or prepared for use at that site:

- for the provision of accommodation for persons working on another facility, whether connected by a walkway to that other facility or not; or
- servicing a well for petroleum or doing work associated with the servicing process; or
- for laying pipes for petroleum, including any manufacturing of such pipes, or for doing work on an existing pipe; or
- for the erection, dismantling or decommissioning of a facility.

i.e. excludes vessels being used, or prepared for use at that site:

[1] Slivak v Lurgi (Australia) Pty Ltd (2001) 205 CLR 304 cited in Bluff & Johnstone (2004) The relationship between Reasonably Practicable and Risk Management (WP 27 ANU National Research Centre for OHS Regulation)

- for the recovery of petroleum, for the processing of petroleum, or for the storage and offloading of petroleum, or for any combination of those activities; or
- drilling a well for petroleum or doing work associated with the drilling process.

e.g. floating production storage and offload facilities, floating storage facilities, drillships and mobile offshore drilling units.

The following are some useful definitions for verbs and nouns used in the regulations (The Macquarie Dictionary Online ©). They are a suggested starting point only and are not prescriptively defined.

Adequate:	equal to the requirement or occasion; fully sufficient, suitable or fit
Appropriate:	suitable or fitting for a particular purpose, person, occasion, etc.
Comprehensive:	inclusive; comprehending much; of large scope
Consider:	to make allowance for; to regard with consideration or respect
Demonstrate:	to describe and explain with the help of specimens; to manifest or exhibit
Describe:	to set forth in written or spoken words; give an account of
Detail:	particulars collectively; minutiae; item by item
Evidence:	ground for belief; that which tends to prove or disprove something; proof
Identify:	to recognise or establish as being a particular person or thing
Include:	to contain, embrace, or comprise, as a whole does parts or any part or element; to contain as a subordinate element; involve as a factor
Integrated:	to make up or complete as a whole, as parts do
Provide for:	to make arrangements for supplying means of
Specify:	to mention or name specifically or definitely; state in detail
Systematic:	having, showing, or involving a system, method, or plan

1. Introduction

1.1. Case study

Most industry personnel will recall the Montara blowout incident in late 2009 and the associated Montara wellhead platform (WHP) and West Atlas facilities. What many fewer people may recall is that at the time of this incident a moored pipelay/construction vessel facility was working in close proximity to the production and drilling facilities.

At the time of the incident, the vessel facility had 214 personnel on-board and was located 25m from the adjacent facilities.

Abridged timeline:

- 05:40 The West Atlas reports a gas alarm has sounded and queries wind directions and vessel facility welding operations
- 07:25 West Atlas advises uncontrolled release of hydrocarbons
- 07:25 Vessel facility superintendent advises to clear the deck
- 07:27 Riggers are sent to connect wire to air tugger to allow the vessel facility to move away
- 07:40 The vessel facility moves away from the West Atlas/Montara WHP
- 07:45 A general muster alarm is sounded on the vessel facility
- 12:50 Hydrocarbons surround vessel facility
- 13:14 Vessel facility superintendent orders evacuation of area, vessel facility cuts anchors S3 and P4 using an oxy acetylene torch (hot work)
- 14:38 support vessels tow vessel facility clear of area.

NOPSEMA's investigation of the incident in the context of the vessel facility identified the following key deficiencies associated with external hydrocarbon hazards:

- The safety case did not include consideration of working adjacent to another facility where there was the potential for hydrocarbon releases
- The vessel facility was not equipped with lifeboats (let alone lifeboats that would have been appropriate in the event of a sea fire)
- The muster location was external to the accommodation, in a hazardous area and personnel were exposed to hydrocarbons
- There was a risk of ignition from operations such as anchor running and anchor wire cutting while surrounded by hydrocarbons
- Emergency response procedures did not address this type of emergency and the Emergency Management Team did not mobilise
- It took nine hours from initial gas detection to the vessel facility moving clear of the area
- No one foresaw the tide change and potential for the slick to engulf the vessel facility

NOPSEMA subsequently issued the vessel facility operator with five improvement notices and two requests to revise the vessel facility's safety case.

1.2. Intent and purpose of this guidance note

Since 2009, NOPSEMA has progressively increased its assessment focus on how vessel facilities address external hydrocarbon hazards in their safety cases. While there have been some noticeable improvements in safety cases over time, there remains a range of areas that continue to form the basis for NOPSEMA either requesting further written information or rejecting safety cases.

This guidance note is focused on vessel facilities being exposed to external hydrocarbon hazards; it is not intended to specifically address vessel facilities undertaking well servicing activities that include (intentional or accidental) piped flow of well fluids onto the facility (other than trace amounts). Section 3.2.4 of this guidance note does however briefly touch on some items for consideration noting that in general terms, facilities subject to internal hydrocarbon hazards (production facilities, drill-ships etc) are already addressed in the existing substantive safety case content and level of detail guidance note.

This guidance note is effectively a supplement to the Safety Case Content and Level of Detail Guidance Note and, as such, should be read in conjunction with the main document and not in isolation, as the majority of information contained in the main guidance note is not repeated within this document.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

This guidance note provides guidance on the technical and other control measures to reduce the risks associated with external hydrocarbon hazards to a level that is ALARP that should be considered by vessel facility operators when developing a safety case for the vessel facility.

This guidance note is not a substitute for legal advice on interpretation of the regulations or the Acts under which the regulations have been made.

1.3. Risk management processes applied for vessels subject to external hydrocarbon hazards

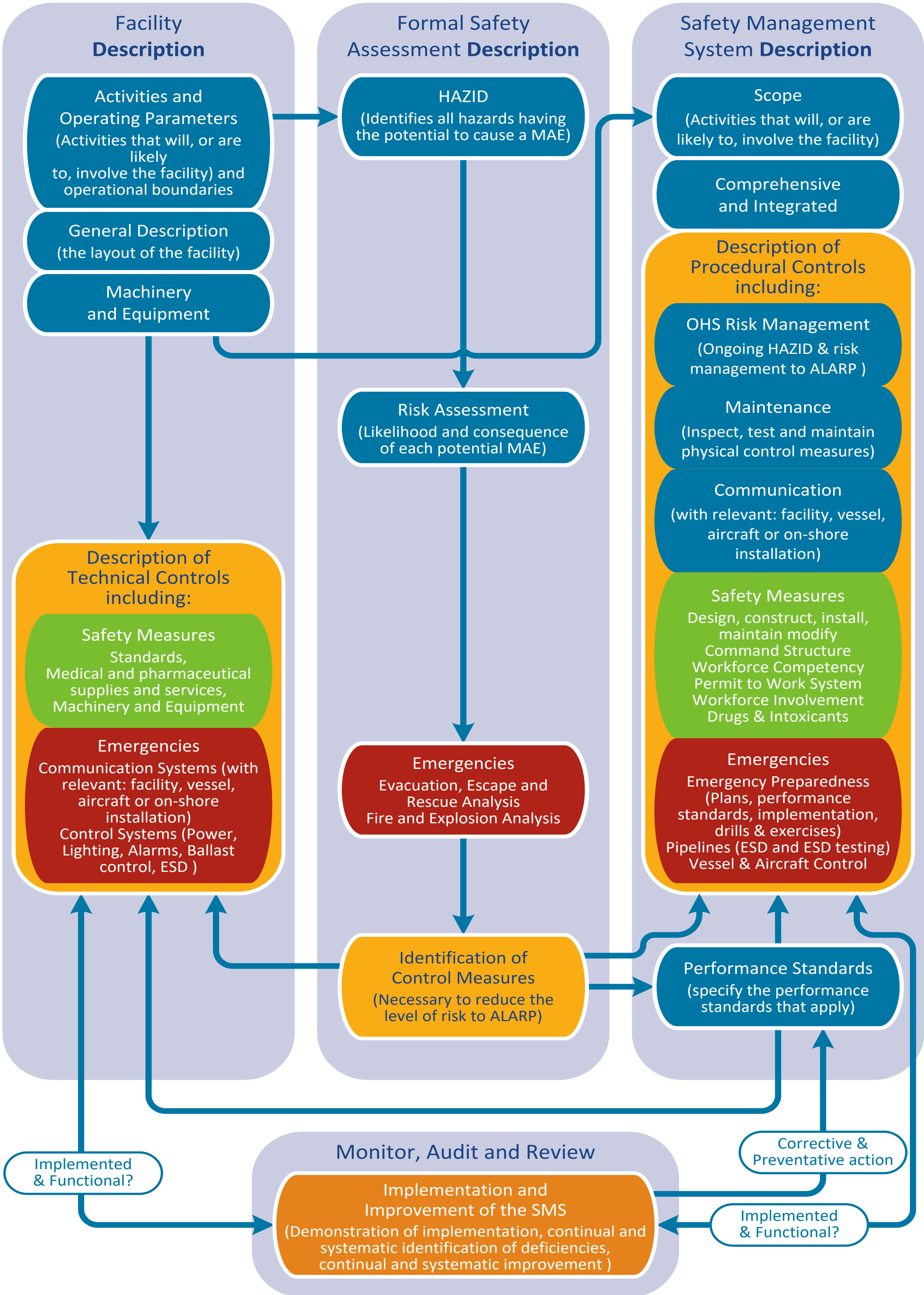
The safety case must include a description of the facility, a detailed description of the formal safety assessment and a detailed description of the safety management system for a facility.

For vessel facilities, any external hydrocarbon hazards associated with undertaking activities in close proximity to production facilities (which includes any associated wells, plant and equipment and pipes) must be identified, assessed and controls established to demonstrate risks are reduced to a level that is ALARP.

Overall, a well-structured, coherent safety case will facilitate the operator's ability to demonstrate to others that they have a clear understanding of the factors that influence risk and the controls that are critical to managing risk associated with any external hydrocarbon hazards.

Figure 1 below shows the main elements of a safety case and their interrelationship as they are set out in the Safety Regulations. It is a visual representation of what the regulations require to be included in each part of the safety case.

Figure 1 – A Graphical representation of the Safety Regulations



2. General considerations

2.1. Safety case must be appropriate

Safety case acceptance criteria

Reg 2.26(1)(a) ***NOPSEMA must*** *accept the safety case if the safety case is appropriate to the facility and to the activities conducted at the facility.*

In order to meet the first acceptance criteria, descriptions within the safety case must be relevant to the facility and activities. That is, there should be a suitable level of detail that accurately explains the physical characteristics of the facility, its operating envelope, the management systems in place and the activities that take place at or in connection with the facility.

There is also an element of proportionality with respect to the level of detail: a higher level of risk or uncertainty should result in an equivalently higher level of detail in the safety case.

Example – level of detail

The safety case must make adequate provision for the facility, in the event of an emergency, in respect of emergency shutdown systems regulation 2.19(f)] of the Safety Regulations. Whether or not these emergency shutdown systems are suitable and fit-for-purpose will vary depending on facility location, number of personnel on board, types of activities being carried out, access to other supporting services, etc. The risks and extent to which these emergency shutdown systems are responsible for significant risk reduction should provide a guide to the level of detail the safety case requires.

Consequently, the hydrocarbon-hazard related emergency shutdown systems that would be appropriate for a vessel facility with a large workforce conducting pipelay activities located no less than a kilometre away from any operating production facilities posing external hydrocarbon hazards are likely to be quite different to a vessel facility with a smaller workforce undertaking construction and installation activities tens of metres from a large operating production platform.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

2.2. Safety case scope

The scope of a safety case can be considered in terms of breadth (number and diversity of activities) and specificity of scope (where, when and in proximity to what production infrastructure). Scopes can be characterised as being either 'generic' or 'campaign/project-specific'.

Well-prepared safety cases with generic scopes can preclude the need for ongoing campaign/project-specific revisions; however, this comes at the cost of considering, in detail, a much wider range of hazards and making assumptions that effectively become the operational boundaries for the facility. It should be noted that NOPSEMA is unlikely to accept a safety case that commits to future assessment of risks and implementation of yet unspecified controls for hazards that could lead to a MAE.

In contrast, a campaign or project-specific safety case typically has a narrower range of activities and the benefit of specific information around the location of the activities, the proximity to external hydrocarbon hazards and the details of those hazards.

Generic scopes that do not include the potential for exposure to external hydrocarbon hazards are relatively common and are often successfully accommodated in a safety case. Generic scopes, that include the potential for exposure to external hydrocarbon hazards are less common and, although achievable, are less likely to be successfully incorporated into a safety case.

Operators should consider the type of activity scope, either generic or project-specific that their safety case will cover and carefully consider the advantages and disadvantage of each, including:

For project-specific scopes:

- Operational boundaries are well-defined and there is ability to access actual data from the hydrocarbon facility operator.
- Will likely be simpler, have less uncertainty and have a reduction in conservatism.
- Will likely result in the incorporation of only those additional control measures that are actually required.
- Revisions on a project-by-project basis will be required.

For generic (non-project specific) scopes:

- Requires operational boundaries to be assumed and associated data sourced or estimated.
- Potentially are more complex and have greater uncertainty, which requires a greater level of conservatism. For example, the largest external hydrocarbon inventory anticipated should be considered.
- May result in the incorporation of additional control measures that are seldom required.
- Revisions would only be required if there is a gap between the project activities (and associated risks) and required risk control measures, and those that are described in the accepted safety case for the facility.

Example – Generic scope verse project specific scope

Generic scopes typically include a broad range of activities that may be undertaken, in some cases explicitly exclude certain activities/circumstances, for example:

This safety case covers the following activities the vessel will undertake whilst undertaking activities as a facility:

- installation of subsea equipment and infrastructure
- flexible pipelay operations using the vertical lay systems
- helicopter refueling.

The scope of this safety case includes the vessel working as a facility above subsea infrastructure capable of a hydrocarbon release if barriers were to fail. However, it excludes undertaking activities as a facility whilst adjacent to topside hydrocarbon production facilities.

In contrast, campaign/project-specific scopes are focused on a narrower set of specific activities that are planned to occur, with details of when and where, for example:

This safety case covers the following activities the vessel will undertake during Q3 of 2017 whilst undertaking activities as a facility adjacent to the V17 production platform located in permit area WA-993-L within the Browse Basin:

- air diving within the platform structure
- replacement of four subsea welded cathodic protection anodes on the platform structure
- replacement of flexible flowline SN2-K.

2.3. Design and validation

Many of the construction, installation and maintenance vessel facilities that seek to undertake activities in Commonwealth waters were not originally designed to be exposed to hydrocarbon hazards from external sources such as wells, trunklines, pipelines, flowlines and production facilities. Technical and other control measures therefore need to be identified for such hydrocarbon hazards. Vessels may require a number of additional technical control measures, which could include for example, gas detection systems and associated shut-down/isolation systems, totally enclosed motor-propelled survival craft (TEMPSC) deluge systems and modifications to the accommodation to provide temporary refuge. All technical control measures identified in the formal safety assessment as being necessary to reduce the risks of MAEs associated with hydrocarbon hazards will require validation. Particular care needs to be taken when considering the appropriate standards for such control measures noting many of the marine-focused standards do not adequately address hydrocarbon hazard scenarios.

Further Guidance is available in the NOPSEMA guideline:

"Validation"

3. Facility description

3.1. General

Content Required

Reg 2.5(1) The ***safety case for a facility must contain a description*** *of the facility that gives details of:*

(a) the layout of the facility;

(b) the technical and other control measures identified as a result of the formal safety assessment; and

(c) the activities that will, or are likely to, take place at, or in connection with, the facility; and

(d) for a facility that is a pipeline:

(i) the route corridor of the pipeline and the pipeline's interface start and end positions; and

(ii) the compositions of petroleum that are to be conveyed through the pipeline when it is operating; and

(iii) the safe operating limits for conveying those compositions through the pipeline; and

(e) any other relevant matters.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

3.2. Activities

3.2.1. General considerations

Content Requirement:

Reg 2.5(1)(c) ***The safety case for a facility must contain a description*** *of the facility that gives details of the activities that will, or are likely to, take place at, or in connection with, the facility.*

Operators of vessel facilities must consider carefully what activities are to be addressed and provided for by the safety case. Vessel facilities are generally designed to perform a range of specific tasks, but the locations and circumstances of each project will be different, and certain activities do not require the vessel to have an accepted safety case. Care should be taken in the safety case to clearly identify and differentiate between the vessel capabilities and the activities that are actually being fully addressed by the safety case.

Example – Capabilities versus safety case activities

A vessel facility safety case includes light well intervention activities. The description of the facility includes the full capabilities of the well intervention system and equipment, which includes the following capabilities:

- slickline
- electric line
- mechanical plug and packer setting and replacement
- perforating
- pumping/bullheading
- well circulation and flushing
- down hole safety valve repairs
- cementing
- coiled tubing
- well intervention activities (flexible riser).

Although the safety case lists the well intervention equipment capability, the safety case clearly specifies that well-related activities that are planned to be undertaken and addressed by the safety case are limited to:

- slickline
- electric Line
- mechanical plug and packer setting and replacement
- perforating
- no recovery of wellbore fluids to the vessel.

The safety case also clearly acknowledges that if, at a later date the operator decides to conduct activities which were not listed in the safety case activities scope, the operator will submit a revised safety case to NOPSEMA for acceptance, addressing the additional activities.

3.2.2. Facility, associated offshore place or neither

A fundamental consideration for a vessel intending to undertake petroleum operation related activities in an offshore area is whether those activities cause the vessel to be a facility (clause 4 of schedule 3 to the OPGGS Act), an associated offshore place (AOP) (clause 3 of schedule 3 to the OPGGS Act), or neither (clause 4(6) of schedule 3 to the OPGGS Act and regulations 1.6 and 1.7 of the Safety Regulations. However, where activities exclude a vessel from being an AOP (refer to regulation 1.7 of the Safety Regulations) once a facility is causing a risk (other than an ordinary marine risk) to the vessel, such as by introduction of hydrocarbon hazards, these exclusions do not apply and the vessel will be an AOP. In this case the hazards and risks to the personnel working on or from the vessel need to be addressed in the facility safety case.

Example – A facility causing a risk (other than an ordinary marine risk)

A vessel proposes to place foundation piles on the seabed for a platform jacket. According to regulations 1.6 Item 7 and 1.7(1) Item 5, this activity would normally exclude the vessel from being either a facility or AOP. However, the placement of the piles is in close proximity to an existing pipeline containing hydrocarbons (i.e. close enough that the hydrocarbons present a hazard). The piles, if dropped onto the pipeline, have the potential to rupture the pipeline, which could result in the release of hydrocarbons from the pipeline that could affect the vessel. Given that the pipeline facility is introducing a risk (other than an ordinary marine risk) to the vessel, regulation 1.7 would not exempt the vessel from being an AOP.

Further information is available in the NOPSEMA Guidance Note:

"Vessels subject to the Australian Offshore Petroleum Safety Legislation"

3.2.3. Activities involving external hydrocarbon hazards

A vessel facility's safety case must provide sufficient details of the activities that will, or are likely to, occur that involve, or which may be impacted by, external hydrocarbon hazards. For example, activities that may involve:

- subsea maintenance (for example, welding, valve change-out, SCE replacement, etc.)
- lifting operations in close proximity to a hydrocarbon facility (for example, close enough to hydrocarbon containing subsea infrastructure that the hydrocarbons present a hazard in the event of a dropped object)
- facility maintenance by remotely operated vehicle
- installation and construction (e.g. Christmas tree installation)
- pipe lay and repair
- accommodation support
- diving activities
- choke and flow meter change-out (e.g. breaking into the production flow path)
- hot-tapping
- servicing a well (see also section 3.2.4).

This may be a challenge for a safety case that intends to include a variety of activities involving, or potentially impacted by, external hydrocarbons, given that the factors effecting the nature and scale of the hazards will vary for each project, including:

- proximity to hydrocarbon containing infrastructure (e.g. production facilities, pipelines, flowlines, wells and manifolds)
- proximity to other obstructions (e.g. moorings and vessels)
- fluid composition (e.g. gas, oil, water and contaminants such as Hydrogen Sulphide (H2S))
- containment pressures (e.g. high temperature high pressure gas wells, to artificial lift oil wells)
- isolatable inventory size (e.g. risers, pipelines, wells and topsides facility inventories)
- met ocean conditions including normal and extreme weather conditions
- water depth
- location (e.g.proximity to external emergency services and support).

It is necessary to state clear operational boundaries of the vessel and any limitations of the activities that involve, or that are potentially impacted by, external hydrocarbons within the safety case, to provide sufficient detail to demonstrate compliance with regulation 2.5(1)(c).

Example – Insufficient detail of hydrocarbon-related activities

A vessel's safety case contains a description of its activities, which includes doing work on an existing hydrocarbon containing pipe.

No operational boundaries are described regarding limitations on inventory size and fluid compositions associated this activity, and the formal Safety assessment description only includes a hazard identification and risk assessment for 'hydrocarbon releases' from a pipeline with no maximum inventory. The safety case would unlikely be accepted without further written information that clarifies the limitations of activities, e.g. work on hydrocarbon liquid pipelines only (with no gas) with a maximum inventory specified.

3.2.4. Well servicing

For the purposes of this guidance note "well servicing" is considered to encompass all activities on a well that has been drilled and completed (i.e. work-over and intervention activities). NOPSEMA appreciates that that the scope of "rigless" or "Light" well servicing activities continues to grow and already includes activities such as:

- well stimulation
- logging
- gauging
- installation of plugs and packers
- perforating

- scale removal
- hydrate removal
- mechanical work in the well, such as installation of side pocket valves and surface-controlled
- subsurface safety valve inserts
- bull-heading
- Christmas tree installation and removal
- preparations for permanent plugging
- abandonment (well diagnostics, well kill and installation of mechanical plugs).

It is also acknowledged that there is a range of technologies to enable such activities to be undertaken from a vessel facility including:

- wireline
- slickline
- electric line
- coiled tubing.

A key factor when considering well servicing activities is the extent to which there are any piped connections between the vessel and the well, and monitoring and isolation controls described that prevent any potential well fluids back-flowing up through any piped connections to the vessel. If the activities intend to recover trace well fluids elements on board, the maximum anticipated inventories and controls to manage these risks should also be clearly described.

Similarly, if the activities involve intentionally (or accidentally) bringing well fluids onto the vessel facility, a description of the related hazardous substances inventory data, including well fluid composition, well head shut-in pressures, volumes of isolated and isolatable sections, should be provided. This will allow for a clear understanding of the hazards that the vessel facility is exposed to while undertaking the various types of proposed well servicing activities.

Example – 'Light well intervention' conduits between well and vessel

A vessel facility safety case includes 'light well intervention' activities including pumping and bull-heading. As these activities include operations where a conduit or potential flow path exists between the well and the vessel facility, the safety case must provide a description of these potential flow paths. Consideration should also be given to both routine well intervention conditions and abnormal conditions such as reverse flows on the identified flow paths.

A description of the conduits between the vessel facility and the well includes the following:

- list all conduits (e.g. flushing umbilical) between the vessel and the well
- maximum diameters of the associated conduits
- maximum pressures the equipment will be exposed to (i.e. wellbore and pumping spread)
- routine isolations and barriers
- emergency isolations and barriers and their activation means
- well fluid and pumping fluid composition
- pressure monitoring and control systems to manage containment
- controls to prevent potential unplanned flow of well fluid to vessel
- maximum potential volumes of well fluid received on vessel.

NOPSEMA notes that whilst many vessel facilities comply with the International Maritime Organisation (IMO) special purpose ships (SPS) Code, existing codes and standards are available that address light well intervention activities on vessels, such as:

- DNVGL-RU-OU-0101 Rules for Classification of Offshore Units, Offshore Drilling and Supporting Units, Section 3 Supplementary Requirements for Service Notation Well Intervention Unit 1 (well intervention without introducing well fluids/hydrocarbons on board).
- BS Rules for Building and Classing Offshore Support Vessels 2016 – Part 5 Specialised Services, Chapter 10 Well Intervention (limited to riserless well intervention systems).

It is recommended that the operator review such applicable codes, and conduct a gap analysis between the vessel controls and the controls identified in the classification codes, to assist in ensuring that appropriate technical and other controls have been considered for the intended well servicing activities as part of the formal safety assessment.

This guidance note is not intended to comprehensively address vessel facilities undertaking activities that introduce internal hydrocarbon hazards (i.e. intentionally or accidentally bringing well fluids onto the vessel, other than trace amounts). Operators of vessel facilities intending to undertake such activities should refer to the broader Safety Case Content and Level of Detail guidance note.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

3.3. Machinery and equipment and layout of the facility

3.3.1. Layout

Content requirement:

Reg 2.5(1)(a) The **safety case for a facility must contain a description** of the facility that gives details of the layout of the facility.

The facility layout should provide an effective overview of the location of key physical elements of the facility, their spatial distribution and relative locations.

With regard to equipment associated with external hydrocarbon hazards the details of the facility layout should include descriptions of items including, but not limited to, the following:

- gas detection systems
- well servicing equipment
- hazardous area classified zones
- explosion protected (Ex) equipment
- ventilation system and main ventilation intakes
- exhaust outlets
- emergency shutdown devices
- emergency disconnect systems
- hydrocarbon emergency muster station(s)
- survival craft and other hydrocarbon emergency evacuation equipment
- hyperbaric rescue craft and positioning with respect to the working side of the vessel nearest to the platform.

3.3.2. Machinery and equipment

Content requirement:

Reg 2.14(1) **The safety case for a facility must specify** the equipment required on the facility (including process equipment, machinery and electrical and instrumentation systems) that relates to, or may affect, the safety of the facility.

There is a broad requirement here to specify the equipment required on the facility that may affect the safety of the facility. This is linked to one of the fundamental purposes of the facility description, which is to provide information required to be able to gain an understanding of the activities to be carried out at the facility.

In general terms, the equipment referred to in this instance should not be solely the equipment or systems necessary to control MAE risks (which is addressed in section 3.4) but rather equipment required for the functional operation of the facility. This is equipment (e.g. lifting equipment, well servicing equipment, pipe lay equipment, etc.) which will be taken into consideration in the hazard identification but may not necessarily be carried further into the detailed risk assessment stage with respect to MAEs.

Example – Inadequate description of well intervention equipment

A vessel facility safety case includes well intervention activities and the equipment is only installed on the vessel as and when required. No details are provided regarding what codes and standards the equipment will meet, any relevant performance standards or the equipment's safety features. The safety case does not therefore demonstrate the equipment is fit for its function in normal use and in an emergency. A safety case which fails to adequately describe these arrangements is unlikely to be accepted.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

Level of detail requirement – machinery and equipment:

*Reg 2.14(2) The **safety case must demonstrate** that:*

(a) the equipment is fit for its function or use in normal operating conditions; and

(b) to the extent that the equipment is intended to function, or to be used, in an emergency – the equipment is fit for its function or use in the emergency.

Regulation 2.14(2) serves as a reminder of the requirements specified elsewhere in the regulations and can be linked to the more general requirement of subregulation 2.12(1) (discussed in the SMS description section 5) with respect to design, construction, installation, maintenance and modification.

The facility description describes the design and operating envelope for facility systems, considering that the safety case covers normal operations anywhere within the set of conditions described. When considering equipment functioning under normal operating conditions, it can be argued that any equipment which fails, or fails to operate correctly, has the potential to affect safety.

For the purposes of demonstration required in the safety case for regulation 2.14(2)(a), evidence that equipment is fit for purpose can be provided with reference to design standards, risk assessment, function testing, certification, maintenance, inspection regime, etc.

The requirements of regulation 2.14(2)(b) are linked to the performance standards that apply as required under regulation 2.20. Operators may wish to conduct survivability studies for key equipment and systems to provide evidence that the requirements of regulation 2.14(2) are met (see section 4.5.3).

Example – Survival craft (lifeboats) fitness for service

A vessel facility proposes to work in close proximity to a production facility exposing it to risks associated with an ignited oil spill. The facility description indicates that there are two TEMPSC, one on each side of the facility, each with 100% Persons on-board capability. The facility description does not include any details of the TEMPSC's ability to survive an oil-based sea fire. The safety case would unlikely be accepted as it does not sufficiently demonstrate the TEMPSC will be fit for their intended function in an oil-based sea fire scenario. For example, the safety case would need to describe the safety features of the TEMPSC including, but not limited to, the external deluge and self-contained air support system features.

Example – Emergency lighting

Emergency lighting is required to facilitate evacuation of personnel on the facility to their place of refuge, typically the internal muster or mess area for vessels. Unless a safety case limits activities to daylight operations only, the provision of deck emergency lighting would typically be expected to be provided. Vessel emergency lights are often powered from a number of sources, including the emergency switchboard, or from ships batteries. Some emergency lights are also fitted with internal batteries.

In the event of a loss of containment of hydrocarbon resulting in a gas cloud, the vessel's main and emergency power may need to shut-down to reduce potential ignition sources (both electrical and from internal combustion engines). Emergency lights not fed directly from the ship's batteries or fitted with internal batteries may not be able to function in a loss of containment emergency without further modification. Any emergency lights operating on deck during a loss of containment emergency would need to be rated for use in explosive atmospheres.

Further guidance is available in the NOPSEMA guidance note:

"Control Measures and Performance Standards"

Further guidance is available in the NOPSEMA guidance note:

"Emergency Planning"

3.4. Technical and other control measures

3.4.1. General considerations

Content Requirement:

Reg 2.5(1)(b) ***The safety case for a facility must contain*** *a description of the facility that gives details of the technical and other control measures identified as a result of the formal safety assessment.*

Sub-regulation 2.5(2)(c) relating to the formal safety assessment (FSA) description requirements requires the safety case to identify the technical and other controls necessary to reduce risk to ALARP, and sub-regulation 2.5(1)(b) requires these controls to be described in the facility description. There is therefore a degree of overlap between regulation 2.14, relating to machinery and equipment safety case contents requirements (as discussed in section 3.3.2 above) and sub-regulation 2.5(1)(b), in that the description of machinery and equipment required by regulation 2.14 will likely either be a technical control or contain technical controls (safety features).

For vessel facilities subjected to external hydrocarbons hazards the facility description needs to contain details of the technical and other control measures identified in the FSA related to activities where such hazards are present, and may include:

- fire and explosion related controls
- escape, evacuation and rescue controls
- medical and pharmaceutical supplies and services
- control systems.

3.4.2. Fire and explosion related controls

Hydrocarbon-related fire and explosion technical and other controls need to be adequately described in the facility description and should be linked to the outcomes of the fire and explosion risk analysis within the FSA. The information must be appropriate to the facility and the activities to be conducted at the facility and may address, but is not necessarily limited to:

- gas detection and alarm systems – fixed and portable
- ignition prevention controls, including isolation and shut-down systems
- fire and explosion protection systems
- essential services.

Gas detection and alarm system

Gas detection and alarm systems need to be adequately described within the vessel facility safety case. The description should include key locations of any gas detectors, their type and details of their control and alarm system. The detector locations should be carefully considered to ensure the system is capable of detecting gas promptly to enable timely action to avoid ignition. Locations may include:

- peripheral gas detection around outer decks
- elevated locations, including crane cabins and personnel transfer gangways
- moonpools
- ventilation inlets for engine room(s), machine spaces, emergency generators, and accommodation and muster areas.

Further guidance is available in section 4.4.3 'Alarms' of the NOPSEMA guidance note:

"Emergency Planning"

Ignition prevention controls

The controls that the vessel has in place to minimise the risk of hydrocarbon ignition should be adequately described in the facility description. Particular focus is necessary for ignition controls on the deck or where gas ingress can contact any ignition sources, given that these areas would typically be the first areas on the facility to be exposed to any gas release. A description of the ignition controls may include:

- hazardous area classification
- prohibiting personal electronic devices and smoking in designated areas
- recall of all hot work permits
- electrical Isolation systems for any deck ignition sources (i.e. any non-Ex protected electrical equipment). Electrical isolation controls could include, for example:
  - shunt-trips – Remote shutdowns fitted in the bridge. Shunt trips can be wired to trip certain key circuit breakers, which isolate deck loads including cranes. Shunt-trip shutdowns can be operated remotely from a safe location and can isolate a number of deck electrical sources quickly. Shunt trips can also be linked to an automated ESD systems)
  - switchboard Isolations – Personnel isolate deck loads from the main switchboard or engine control room. Frequently, circuit breakers requiring prompt isolation are clearly marked on the switchboards. This can be supported with a shutdown checklist, which identifies which loads are isolated and the location of the isolations
  - manual isolations – The deck loads and the locations of where the isolations are to be performed are identified. Selected personnel are assigned to complete the isolations when instructed or prompted, for example on hearing certain gas alarms or public address (PA) announcements. Isolation checklists and clearly marked isolation points, for example breakers or isolators ensure the assigned personnel isolate all their assigned loads (e.g. bridge external navigation loads could be isolated by the bridge crew).
- shut down of deck internal combustion engines or deck plant having potential ignition properties such as air compressors etc. Ignition controls could include:
  - explosive atmosphere equipment packages that are pressurised, fitted with gas detection on the air intakes and internal gas detection which will initiate a unit shut down on a gas alarm

    - flame arrestors are provided and exhausts are lagged to reduce surface temperatures. Air intakes and exhaust outlets are ducted clear of the unit or wired with a remote shutdown so the unit can be remotely shut down from a safe place on activation of certain gas alarm(s)
    - units that are constantly manned when operational. On hearing a gas alarm or other instruction, the unit operator can locally shut down the unit.
- explosion protected (Ex) equipment, e.g. gas detectors, emergency lights, lifeboat over-boarding lights and public address/general alarm (PA/GA) annunciators on outer decks
- power ventilation shutdown and damper closure systems to minimise gas ingress into enclosed spaces with ignition sources, e.g. automatic closure of dampers in the accommodation area and machinery spaces
- consideration of when to shut down vessel combustion engines, that have the potential to result in gas ingress into machinery spaces caused from engine aspiration, which could result in either an ignition of the gas ingress or alternatively an engine runaway, both of which can lead to a fire or explosion event
- consideration of the vessel's built-in redundancy systems which could result in ignition sources including:
    - the DP system design's built-in redundancy
    - uninterruptable power supply for essential vessel services including vessel navigation equipment (e.g. automatic radar plotting aid, marine radio equipment and navigation lights, etc.)
    - inhibiting or over-riding the automatic starting of the emergency generator
    - many deck loads are provided with redundant supplies and isolation methods which may need to be considered, including for example, dive spread redundant generator.

It is common for multipurpose vessel to include a range of activities that require the use of contractor's specialist equipment. The ignition controls of any contractor's equipment will need to be adequately described in the facility description. For example describing the explosion protection (Ex) requirements for contractor equipment, or stipulating that the plant is constantly manned while operating, to ensure immediate shut-down in a gas alarm and specifying key safety features including spark arrestors on internal combustion engines.

Fire and explosion protection systems

The facility description should include a description of any passive and active fire and explosion protection systems necessary to reduce risks to ALARP. Passive systems may include fire resistant coatings, fire divisions and blast protection, fire protection of electrical cabling for emergency/safety systems. Active protective systems may include water curtains, foam systems, water cannons from support vessels, deluge systems and any portable fire equipment.

Essential services

The facility description should provide an adequate description of the essential services that are required up to the point at which the vessel is abandoned; these may include:

- internal communications (alarm and PA/GA for both internal and deck areas)

- emergency lighting (internal and external) and lifeboat overside lights
- energy sources and associated utilities required to drive essential and emergency functions (for example, emergency power and supplies to the dive system)
- emergency disconnect systems (e.g. crane manual overload protection system (MOPS), riserless well intervention (RLWI) shutdown and release system, choke running tool emergency release system, ROV tooling release system i.e. release from flow-line pull-in tooling package, hot tap release systems, etc.)
- external communications.

Example – Description of light well intervention emergency release systems

A vessel facility safety case includes light well intervention activities, and contains a description of the emergency release or emergency disconnect system (EDS).

The description of the EDS system includes the following items:

- a list all downlines to the subsea equipment package
- the equipment disconnect locations for both routine and emergency conditions
- routine disconnection system/process
- emergency disconnect system/process
- emergency disconnect primary and secondary/emergency power/energy sources
- the key system operational constraints including maximum release angles, maximum vessel position envelopes, crane or winch over-pull requirements
- primary and emergency release station(s)
- external loads on well intervention package including vessel drive-off or vessel power loss, maximum operational sea-state or environmental loading etc.

The key performance standards for all fire and explosion related systems should be described in the facility description (FD) and the description should be aligned with and any FERA and survivability studies completed as part of the FSA.

Further guidance is available in the NOPSEMA guidance note:

"Control Measures and Performance Standards"

3.4.3. Escape, evacuation and rescue

A description of the equipment and procedures identified as control measures in the FSA, in particular the evacuation, escape and rescue analysis (EERA), needs to be provided in the facility description. For vessel facilities working in close proximity to hydrocarbons this may include a description of the following:

- primary and secondary escape routes from areas and equipment that may be exposed to hydrocarbons
- temporary refuge areas

- evacuation survival craft, rescue vessels and aircraft including any hyperbaric evacuation/rescue systems for diving scopes.

Escape routes

Primary and secondary escape routes should be adequately described for the various types of hydrocarbon emergencies that could occur on the vessel facility. Specifically:

- the escape and evacuation requirements for operators of fixed equipment (e.g. crane and gangway operators)
- accessibility to temporary refuge for back deck personnel and/or provision of additional lifesaving appliances in the vicinity of the back deck areas for personnel unable to reach the main temporary refuge (e.g. dive supervisor and standby diver assigned to in-water divers, who cannot readily leave dive control).

The description of any evacuation and survival craft should include their capability to survive and function during a hydrocarbon-related event. For example, the description of a TEMPSC may include adherence to suitable design standards for hydrocarbon use, and address deluge systems and passive fire protection for sea fires and provision of internal air system to enable the TEMPSC engine to operate in a hydrocarbon gas environment.

Temporary refuge

In emergency events, including fire, vessel personnel often muster at their appointed muster stations, which is frequently their lifeboat station on outer decks (with specialised personnel mustering at their respective emergency station, for example: bridge, ECR or fire station). These muster locations may not be appropriate locations for hydrocarbon-related emergencies, particularly in a potential large hydrocarbon gas release event. Personnel may be exposed to greater risk at their external muster stations than within the vessel facility from, for example, a flammable gas atmosphere or a hydrocarbon flash fire. During these types of events, it is often safer to remain in an enclosed space within the vessel facility in a designated temporary refuge.

Production and drilling facilities typically have specifically designed areas for this purpose, which include a number of control measures to protect the occupants from a hydrocarbon release. Vessel facilities may not have the same level of protection ordinarily provided at such facilities (for example, the provision of temporary refuge airlocks, temporary refuge differential air pressure monitoring or 'H' class fire divisions). However, it is expected that a vessel facility safety case will provide suitable temporary refuge(s), which reduce associated risks to a level that is ALARP.

The description of the temporary refuge(s) should contain the control measures identified, as part of the EERA in the FERA, that are required to reduce risk to a level that is ALARP. The EERA should consider a range of controls, which may include:

- fully enclosed spaces
- positioning away from hydrocarbon inventories
- structural fire protection ('A' Class fire divisions) provided between temporary refuge and deck areas
- normally positively pressured

- gas detection provided at heating, ventilation and air-conditioning (HVAC) intakes
- temporary refuge HVAC damper closure on gas detection
- emergency communications, lighting and services provided within temporary refuge
- ready access to TEMPSC and their position away from hydrocarbon hazards
- alternative muster locations if the primary muster area is compromised.

Further guidance is available in the NOPSEMA guidance note:

"Control Measures and Performance Standards"

*Further guidance is available in section 5 'Survivability Studies' of the NOPSEMA guidance note **"Supporting Safety Studies"***

*Further guidance is available in section 5.2.2 'Members of the workforce must be competent' of the NOPSEMA guidance note **"Safety Case Content and Level of Detail"***

*Further guidance is available in section 3.2 'Workforce Competency' of the NOPSEMA guidance note: **"Emergency Planning"***

3.4.4. Medical and pharmaceutical supplies and services

Content requirement:

Reg 2.13 *The **safety case for a facility must specify** the medical and pharmaceutical supplies and services, sufficient for an emergency situation, that must be maintained on, or in respect of, the facility.*

The facility description must specify the medical and pharmaceutical supplies available and maintained on, or in respect of, the facility for an emergency situation. This should include location, quantity and storage arrangements for the supplies. The description needs to also contain enough information to demonstrate that the supplies provided are sufficient for emergency situations identified as part of the FSA.

Vessel facilities may need to provide supplies and services additional to their normal provisions when undertaking activities where they are subject to external hydrocarbon hazards, due to the type and quantity of injuries that may occur. For example, there may be a requirement for additional burn dressing supplies and additional hospital beds based on the potential number of injuries identified as part of the formal safety assessment from a hydrocarbon fire or explosion. In addition, personnel protection requirements appropriate for chemical and/or hydrocarbon fluids that may be encountered, including the provision of decontamination facilities (showers and eye wash stations) will need to be considered.

The facility description will therefore need to specify any additional supplies and services necessary to demonstrate sufficient services and supplies for hydrocarbon-related emergencies. These services and supplies may include:

- additional medical centre equipment and changes to any layout arrangements
- hydrocarbon emergency triage arrangements
- additional first aid equipment
- any additional personnel protection equipment
- any additional rescue and evacuation equipment
- onshore medical support and equipment
- medical staffing requirements including doctors (or access to medical advice from doctors), medics and first aiders
- medical transport arrangements
- exercises or other activities to assure the effectiveness of project-specific medical transport arrangements.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

Further guidance is available in the NOPSEMA guidance note

"Emergency Planning"

3.4.5. Control systems

Content requirement for control systems:

Reg 2.19 *The safety case for a facility must make adequate provision for the facility, in the event of an emergency, in respect of:*

(a) back-up power supply; and
(b) lighting; and
(c) alarm systems; and
(d) ballast control; and
(e) emergency shutdown systems.

Content requirement:

Reg 2.20(6) The safety case for a mobile facility must also specify systems that:

(a) in the event of emergency, are adequate to shut down or disconnect all operations on the facility that could adversely affect the health or safety of persons at or near the facility; and

(b) are adequate to give appropriate audible and visible warnings of the shutting down or disconnecting of those operations.

Detailed guidance on the content requirements of control systems is contained in section 4.4 of the Emergency Planning guidance note and is not repeated within this guidance note. For external hydrocarbon emergencies the safety case needs to demonstrate that the back-up power supply, lighting, alarm, ballast control and emergency shutdown systems are adequate. This can be a challenge since vessel facility control systems are typically primarily designed to control internal fires emanating from machinery spaces and accommodation areas; and are not ordinarily designed for work in external hydrocarbon environments.

Demonstration that the control systems are adequate should be made in the FERA and EERA. Typically, modifications to the alarm and emergency shutdown systems of a vessel are made in order to demonstrate the control systems are adequate for hydrocarbon emergencies.

Emergency shut down (ESD) systems and alarms

Vessel facilities are typically provided with a number of ‘conventional’ marine shut down systems in compliance with class rules, which typically include for example: power ventilation shutdown, ventilation and dampers shutdown, galley isolation, fuel oil (FO) and lube oil (LO) quick closing valves, and thruster main engine shutdown. These shutdown systems primarily provide controls to mitigate against internal machinery space fires (FO and LO) and accommodation space fires. Emergency shutdown protection against external hydrocarbon hazards, in particular hydrocarbon gas, is not ordinarily provided for in class rules for conventional marine vessels. In a hydrocarbon gas release event, control of vessel external ignition sources on deck and protection against potential gas ingress into the vessel internal spaces needs to be considered.

A detailed description of the ESD system in place for hydrocarbon emergencies may consider the following items:

- vessel ‘conventional’ marine emergency shutdown systems (e.g. power ventilation, fire dampers, galley isolation, FO and LO quick closing valves, main engines)
- gas detection system
- automatic and manual closure of ventilation and air intake dampers
- shutdown of ignition sources. The description may include a tiered shutdown response based on the threat of ignition due to the quantity/location of hydrocarbons detected. For example, a low concentration of gas may require the vessel to move away under power, while a gas high concentration detected at the machinery space intakes may require the vessel to go ‘black’ (i.e. shutting down all

internal combustion engines and fired boilers providing power generation and propulsion) and drift away from the facility

- cranes shutdown controls
- well servicing shutdown controls
- contractor equipment shutdown controls
- any host facility shutdown controls – shutdown and blowdown controls
- a description of the hydrocarbon alarms system (audible and visual)

Note: the locations of the ESD stations should be addressed in the description.

Example – Description of 'light well intervention' ESD system

A vessel facility safety case that includes light well intervention activities needs to contain a description of the ESD system for the well intervention system. The ESD system for the well intervention package can be independent from the vessel's ESD systems, or fully integrated with the vessel's systems (e.g. a purpose-built well intervention vessel operating an integrated ESD system utilising a central control unit).

The description of the well intervention ESD system could consider items including:

isolation barriers and locations (e.g. valve isolations on tree, subsea intervention package and vessel (surface) intervention equipment packages)

primary well intervention control station

secondary emergency control station (situated in remote safe area)

ESD station location and types (e.g. manual ESD Level 2 station, forward main deck adjacent changing room door)

manual and automatic isolation system (e.g. any interface with gas detection system, well intervention venting package/process control system)

ESD hierarchy

ESD cause and effects summary (e.g. key ESD initiators [causes] and key ESD actions [effects]) if not identified in ESD hierarchy. For example, multiple low level gas alarms, or a DP yellow alert etc. initiates a well intervention ESD Level 1

well intervention ESD system inter-relationship with other vessel ESD systems

ESD control system primary and secondary power systems

ESD actuating system primary and secondary power (e.g. hydraulic actuated ESD valves, provided with a redundant accumulator system)

ESD failsafe configuration (e.g. fail-safe [open or closed] spring actuated valve actuators).

Emergency disconnect

Vessel facilities operating over/adjacent to hydrocarbon hazards are also required to specify the systems in place for emergency disconnection in a hydrocarbon-related emergency. Vessels exposed to a large hydrocarbon gas cloud, may need to go 'black' in order to reduce ignition sources and prevent gas ingress into machinery spaces caused from running internal combustion engines. The ability of a 'black' vessel to drift off location is dependent on their ability to disconnect from loads securing it to its location, for example connections to trees and subsea infrastructure, or anchored to seabed through large lifted loads which are still connected to vessel. These emergency disconnect systems should be capable of operating in a hydrocarbon release situation where the provision of facility's main power may not be readily available.

A detailed description of the emergency disconnect systems must be provided (inclusive of appropriate audible and visual warnings); these may include:

- lifting operations disconnect processes
- well intervention disconnect systems
- running tool emergency disconnection systems
- pressure testing disconnect systems
- anchor disconnection
- gangway disconnection
- pipe lay disconnect systems
- ROV and subsea tooling package emergency disconnect or release systems
- downlines, hoses, etc., that would prevent the vessel from drift off.

4. Formal safety assessment description

4.1. General considerations

Content requirement (formal safety assessment overall):

Reg 2.5(2) *The safety case for the facility* ***must also contain a detailed description of the formal safety assessment for the facility****, being an assessment, or series of assessments, conducted by the operator that:*

(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.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

4.2. Hazard identification

4.2.1. General

Level of detail requirement:

Reg 2.5(2) ***The safety case for the facility must also contain a detailed description*** *of the formal safety assessment for the facility, being an assessment, or series of assessments, conducted by the operator that:*

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

A vessel facility's safety case must identify all hazards (non-hydrocarbon and hydrocarbon related) having the potential to cause a major accident for the activities proposed. Hydrocarbon-related hazards can typically be separated into two types that should be considered:

- direct hydrocarbon hazards – Hazards associated with the activities of the vessel facility e.g. a light well intervention vessel 'working over' a well, or a vessel colliding with a production platform
- indirect hydrocarbon hazards – Hazards that arise from concurrent activities by other facilities and vessels that have potential to impact on the vessel facility.

Direct hydrocarbon hazards are more easily identifiable as vessel facility operators should be fully aware of the hazards associated with their facility and its activities. Indirect hydrocarbon hazards require further consideration due to vessel facility operators needing to identify hazards arising from another facility's activities. This can be challenging for generic vessel facility safety cases that include hydrocarbon-related activities.

Operators may be tempted to exclude consideration of hazardous events because they are perceived to be extremely unlikely. The assessment of low likelihood can often result from an assumption that the existing controls are highly effective. This type of exclusion is undesirable for the following reasons:

- the control (that was thought to eliminate the risk) may not be as robust as first thought; for example, controls can deteriorate over time and the effectiveness of 'new' controls is often unproven – the effectiveness of technical controls should be regularly tested, including the final element, where practicable
- controls may not be adequately managed if their importance is not recognised
- the initial assessment may not be based on adequate grounds, and further detailed assessment may indicate that the risk is higher due to site-specific considerations
- knowledge of all potential events is essential for emergency planning.

Operators need to be aware that there is a difference between a hydrocarbon release being 'not credible' and being of a very low likelihood. Multiple robust controls do not eliminate the possibility of the event occurring; they do however make the event less likely.

When considering the consequence of a hydrocarbon release, operators need to consider the worst-case scenario in which all controls have failed. Operators should not eliminate consequences from further consideration simply because they have a very low likelihood.

It is unlikely that NOPSEMA will accept a safety case where a MAE has been ignored, especially where related incidents have been experienced elsewhere in industry. Examples of MAEs which have previously been inappropriately excluded include accommodation fire and engine room fire which, although are uncommon, have occurred in the offshore industry.

Example – 'Credible' hazards

A vessel facility safety case sets specific operating boundaries that commits to only approaching and completing work on subsea infrastructure when wells are shut-in and all isolations are tested and functioning. The operator describes the risk of a hydrocarbon release as 'not credible' within their safety case (i.e. the likelihood is very low) and is subsequently discounted from further consideration. The formal safety assessment subsequently does not identify the hazard as having MAE potential, risk assess it or identify controls to demonstrate the risks have been reduced to a level that is ALARP.

Example – Eliminated hazards

A vessel safety case may specify a clear operational boundary that excludes activities involving working in close proximity to a facility conducting drilling operations. Hydrocarbon hazards associated with drilling can therefore be excluded from further assessment within the FSA.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

Further guidance is available in the NOPSEMA guidance note:

"Hazard Identification"

4.2.2. Direct hydrocarbon hazards – vessels activities

A vessel facility working adjacent to, or over, a production facility (or part thereof) can induce a loss of containment event. The FSA should identify these types of hazards, which may include:

- vessel facility loss of position leading to a collision with the hydrocarbon facility
- vessel facility loss of position leading to excessive loading of hydrocarbon infrastructure from equipment dragging across infrastructure or being directly connected to infrastructure
- subsea intervention activities, e.g. incorrect valve operations
- dropped objects onto hydrocarbon containing infrastructure, e.g. wellheads or pipelines
- Storage of chemicals and/or hydrocarbons, e.g. low flash point flammable liquids for use in the intended activities.

Should the vessel facility induce a hydrocarbon release through loss of position, the risk from a subsequent jet or sea fire may increase given the vessel's proximity to the source facility and potential inability to move away.

4.2.3. Indirect hydrocarbon hazards – other facilities activities

A production or drilling facility may have a loss of containment event while a vessel facility is operating in close proximity. This could occur when a vessel facility is working either adjacent to such facilities, or working over associated hydrocarbon containing infrastructure (e.g. pipes (including pipelines and flowlines) or wells).

The safety case therefore needs to identify all the types of loss of containment events that could occur and the hazards each type presents to the vessel facility and its proposed activities. Hazards that should be considered include:

- sea and jet fires
- hydrocarbon gas and vapour cloud explosions
- subsea gas releases that could affect the stability of the vessel
- exposure of personnel to poisonous gas.

Sea and jet fires

Vessel facilities would most likely be capable of moving away from either a jet or sea fire, assuming their propulsion system remains operational and undamaged from the fire. Emergency response time for these types of event should be shorter as any release would be readily visible.

Hydrocarbon gas and vapour cloud explosions

An unexpected large hydrocarbon gas release is typically a greater concern to a vessel facility. Vessel facilities are typically not designed to operate in potentially explosive gas environments and subsequently will likely have numerous external ignition sources. In addition, the powered ventilation systems and air intakes for the main or auxiliary engines and other equipment can also draw gas into the internal spaces within the vessel exposing explosive gas mixtures to numerous internal ignition sources and hot surfaces. An explosion within a confined internal space could be catastrophic.

Internal combustion engines being air aspirated draw air into machinery spaces, even in the absence of forced power ventilation. Gas ingress into these spaces can result in diesel engine runaway, which can lead to engine over-speed, excessive high temperatures, destruction, and fire and explosion. Unlike MODUs, most conventional vessel engines are not routinely fitted with air shut-off valves (such as rigsaver or chalwyn valves) which act to prevent engine runaway.

Subsea gas releases that could affect the stability of the vessel

Substantial subsea gas releases can result in a large gas plume, which, depending on water depth water may have the potential to cause a rapid loss of vessel buoyancy and stability, potentially leading to capsizing or sinking, particularly when a vessel is positioned directly above the gas plume and is connected to the seabed. This loss of buoyancy can restrict/limit the tendency for the vessel to be pushed away from the gas plume by the localised surface lateral currents generated by the plume.

Exposure of personnel to poisonous gas

Exposure to poisonous gas (including H2S or smoke, or sufficient gas to exclude oxygen and cause asphyxiation) should also be considered, including the potential for it to be drawn into the accommodation by the ventilation system.

4.3. Risk assessment

Level of detail requirement:

Reg 2.5(2) ***The safety case for the facility must also contain a detailed description*** *of the formal safety assessment for the facility, being an assessment, or series of assessments, conducted by the operator that:*

(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.

For vessel facilities subject to external hydrocarbon hazards, a ‘detailed and systematic’ risk assessment means ensuring all hydrocarbon-related hazards with MAE potential are included and all aspects of risk for each of the potential MAEs is addressed (including nature, likelihood, consequence, etc.). In conducting this risk assessment, the operator should employ a logical, transparent and reproducible process, which enables comparison of a range of undesirable events and the identification of those that are the most important contributors to the overall risk profile of the facility.

The limitations of the risk assessment for external hydrocarbon-related hazards need to be clearly defined. The risk assessment should be aligned with, and based on, the activities proposed within the vessel facility safety case.

A generic scope safety case, which includes the potential for exposure to external hydrocarbon hazards, would need to cover a wide a wide range of scenarios and risk assess the worst case consequences for operating in close proximity to any production or drilling facility, unless clearly specified activity limitations are identified.

The composition and inventories of hydrocarbons for project-specific safety cases are more easily determined, as are the equipment, layout and structures; making the risk assessment process for a project-specific safety case easier than for a generic type. Known compositions can allow certain hazards to be easily discounted. For example, a project-specific safety case that proposes work on an oil pipeline facility with no associated gas, could exclude any hydrocarbon gas related hazards from the risk assessment, depending on volatility of the hydrocarbon. Detailed assessments and modelling, for example gas plume or oil spill modelling, can further demonstrate limitations of potential consequences of any hydrocarbon release for a project-specific safety case.

Further guidance is available in the NOPSEMA guidance note:

"Risk Assessment"

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

4.4. Control measures and ALARP

Level of detail requirement

Reg 2.5(2) **The safety case for the facility must also contain a detailed description** of the formal safety assessment for the facility, being an assessment, or series of assessments, conducted by the operator that:

(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.

Operators should consider a number of factors when identifying control measures necessary to reduce risks to ALARP; these may include:

- hierarchy of controls – elimination, substitution, isolation, engineering, administration and personal protective equipment
- types of control – technical or other (e.g. policy/procedural controls)
- common mode failures between controls
- layers of protection – adequate redundancy in controls
- operating circumstances – the control's effectiveness for all circumstances
- focus of control measure – scrutinise important and vulnerable controls
- effectiveness – establishing the functionality, availability, reliability and survivability.

Effectively identifying control measures necessary to reduce that risk to a level that is ALARP can be particularly challenging. Vessel facilities are typically involved in completing project-related activities that may include site-specific conditions or circumstances. These types of activities will therefore have a level of risk uncertainty involved in their execution. To demonstrate that the project risks have been reduced to a level that is ALARP on a general basis, a more precautionary approach in control measure selection may be warranted. In other words, additional controls to that which would normally be required in a project-specific safety case, may be necessary in order to demonstrate risks have been reduced to a level that is ALARP.

Any control measures identified should be clearly linked to the associated hazards and outcomes in which they control the risk. One useful way to represent the relationships between hazards, outcomes and control measures pictorially is a bowtie diagram (also called a cause-consequence diagram).

It is a common failure for vessel facility safety cases to focus on controls lower in the hierarchy of controls (e.g. administrative). Consideration should always be given to any potential controls that provide a greater risk reduction. On this basis shutting in and blowing down a production facility (elimination) prior to a vessel facility working in close proximity would be the preferred option, wherever practicable.

Example – ALARP controls for generic safety cases

A vessel facility safety case includes a generic hydrocarbon activity scope and commits to undertaking a project-specific hazard assessment prior to undertaking such work. The safety case states that the project-specific hazard assessment will include consideration of isolation, blowdown and shutdown controls. No further information is provided within the safety case to describe under what circumstances these controls will be implemented and hence the safety case does not appropriately identify controls measures necessary to reduce risks to a level that is ALARP.

Further guidance is available in the NOPSEMA guidance note:

"Control Measures and Performance Standards"

Further guidance is available in the NOPSEMA guidance note:

"ALARP"

4.5. Supporting studies

There are many types of risk studies that can be carried out in support of a safety case

(e.g. survivability studies, human factors, dropped objects, marine operations, etc.) however both a fire and explosion risk analysis (FERA), and an evacuation, escape and rescue analysis (EERA) are specifically required by the Safety Regulations. Operators should not simply include copies of these analyses within the safety case, but rather should provide a detailed description of these analyses, including key outcomes and linkages to other sections of the safety case e.g. facility description and SMS description. As noted in the Safety Regulations, to the extent that both of these prescribed studies address MAEs, they form a part of the formal safety assessment.

4.5.1. Fire and explosion risk analysis

Content requirement:

Reg 2.17(1) The safety case for a facility must contain a detailed description of a fire and explosion analysis.

Reg 2.17(2) **The fire and explosion risk analysis must**:

(a) identify the types of fires and explosions that could occur at the facility.

(b) consider a range of measures for detecting those fires and explosions in the event that they do occur; and

(c) consider a range of measures for eliminating those potential fires and explosions, or for otherwise reducing the risk arising from fires and explosions; and

(d) consider the incorporation into the facility of both automatic and manual systems for the detection, control and extinguishment of:

(i) outbreaks of fire; and

(ii) leaks or escapes of petroleum; and

(iii) leaks or escapes of flammable greenhouse gas; and

(e) consider a range of means of isolating and safely storing hazardous substances, such as fuel, explosives and chemicals, that are used or stored at the facility.

(f) consider the evacuation, escape and rescue analysis, in so far as it relates to fires and explosions.

(g) identify, as a result of the above considerations, the 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.

It is important that the FERA description in the safety case provides enough information to provide assurance to NOPSEMA that all the requirements of the FERA, as listed in subregulation 2.17(2) of the Safety Regulations, have been met. The FERA should identify the vessel facility's vulnerabilities to hydrocarbon fires and explosions, and demonstrate that these risks are reduced to a level that is ALARP. Particular focus should be on the vessel facility's vulnerabilities to smoke and gas ingress, given that as-built inherent safety controls will typically not be place for these hazards.

The FERA should:

- contain details of the hydrocarbon fluids, composition, volume and pressures that could potentially be released
- consider the inventory and storage of chemicals and/or hydrocarbons (including received well fluids), for example low flash point flammable liquids intended for use in the intended activities
- consider a range of hydrocarbon fires and explosions that could occur, including:
  - jet fires from an adjacent production facility
  - sea fires

  - pool fires on the vessel facility
  - gas and vapour cloud explosions at an adjacent facility
  - sas and vapour cloud explosions at the vessel facility (including any possible gas ingress)
- consider the escalation potential for hydrocarbon releases, including:
  - impact on existing escape, evacuation and rescue controls
  - impact on other safety-critical systems
  - ingress of smoke or gas into interior areas of the vessel facility
- consider a range of pre-ignition and post-ignition controls, including:
  - subsea lifting, deployment and recovery procedures and safety zones
  - isolation, shutdown and depressurisation controls
  - vessel positioning to allow for 'drift-off'
  - ignition controls, including Ex-rated equipment, isolation, shutdowns, disconnect and ventilation damper closing
  - safe working procedural controls (field entry checklist, activity specific operating guidelines, permit to work, lift plans, simultaneous operations plans, etc.)
  - provision of fixed gas detection at key locations
  - provision of portable gas detection equipment
  - pill containment for embarked chemicals and/or hydrocarbons (including received well fluids)
  - ESD and procedures for external hydrocarbon hazards with consideration to:
    - what equipment needs shutdown?
    - how it is shut down?
    - where can it be shut down from?
    - who is responsible for the initiation of the shut down?
    - when should it be shut down?
  - provision of active and passive fire and explosion protection systems
  - external hydrocarbon facility related controls and any necessary assurance controls
  - provision of hydrocarbon fire and explosion escape, evacuation and rescue controls
  - personnel protection requirements, including decontamination facilities
- demonstrate that the chosen controls reduce the risk to a level that is ALARP.

4.5.2. Evacuation, escape and rescue analysis

Content requirement

Reg 2.16(1) *The safety case for a facility must contain a detailed description of an evacuation, escape and rescue analysis.*

Reg 2.16(2) ***The evacuation, escape and rescue analysis must:***

- *(a) Identify the types of emergency that could arise at the facility; and*
- *(b) consider a range of routes for evacuation and escape of persons at the facility in the event of an emergency; and*
- *(c) consider alternative routes for evacuation and escape if a primary route is not freely passable; and*
- *(d) consider different possible procedures for managing evacuation, escape and rescue in the event of an emergency; and*
- *(e) consider a range of means of, and equipment for, evacuation, escape and rescue; and*
- *(f) consider a range of amenities and means of emergency communication to be provided in a temporary refuge; and*
- *(g) consider a range of life saving equipment, including:*
  - *(i) life rafts to accommodate safely the maximum number of persons that are likely to be at the facility at any time; and*
  - *(ii) equipment to enable that number of persons to obtain access to the life rafts after launching and deployment; and*
  - *(iii) in the case of a floating facility — suitable equipment to provide a float-free capability and a means of launching.*
- *(h) identify as a result of the above considerations, the technical and other controls measures necessary to reduce risk to associated with emergencies to a level that is as low as reasonably practicable.*

It is important that the description in the safety case provides enough information to provide assurance to NOPSEMA that all the requirements of the EERA, as listed in OPGGS(S) subregulation 2.16(2), have been met for external hydrocarbon-related hazards. The information must be appropriate to the facility and its proposed activities and address all identified external hydrocarbon-related potential major accident events.

Operators proposing to have vessels working next to hydrocarbons (surface or subsea) should consider the suitability and impact on any existing evacuation, escape and rescue controls that an external hydrocarbon event may cause, including:

- suitability of muster arrangements for external hydrocarbon releases
- consideration of personnel unable to immediately retreat to the designated muster area (e.g. crane operator, or the dive supervisor and standby diver during air diving activities)
- ability for the emergency systems to function safely

- suitability of emergency power systems for operation during external hydrocarbon releases
- impact on passive and active protection effectiveness
- suitability of escape equipment, for example, the ability of a TEMPSC to function in gas release and sea fire scenarios.

Example - EERA

A vessel facility safety case describes the mustering stations to be outside the accommodation in close proximity to the lifeboats. The vessel's activities include working in close proximity to a production facility. The description of the EERA does not consider the provision of an alternative muster station/area within the accommodation which may avoid exposure of personnel to hydrocarbon gas. The EERA would therefore be unlikely to meet the requirements of regulation 2.16(2) as it does not consider a range of means of evacuation and escape, and does not assess their suitability.

Further guidance is available in the NOPSEMA guidance note:

"Supporting Safety Studies"

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

4.5.3. Survivability studies

Level of detail requirement:

Reg 2.14(1) **The safety case for a facility must specify the equipment** required on the facility (including process equipment, machinery and electrical and instrumentation systems) that related to, or may affect, the safety of the facility.

Reg 2.14(2) **The safety case must demonstrate that:**

(a) the equipment is fit for its function or use in normal operating conditions; and

(b) to the extent that the equipment is intended to function, or to be used, in an emergency – the equipment is fit for its function or use in the emergency.

Additional to the FERA and EERA, the safety case needs to demonstrate the equipment control measures identified in the FSA will be fit for their function in an emergency. This can be achieved by a description of any emergency systems survivability analysis (ESSA) that may have been conducted to determine the vulnerability of equipment against the identified MAEs. It is expected that external hydrocarbon-related risks are carefully considered for vessel facilities as typically these types of risks would normally not be taken into account at the time of a vessel's construction. Operators can provide suitable descriptions of any survivability studies for their identified key safety equipment to provide evidence that the requirements of regulation 2.14(2) are met. This may include:

- emergency lighting considerations such as:
    - loss of main and emergency power
    - emergency switchboard supplied (vulnerable to LoC) or ships battery supplied or internal battery supplied.
- crane MOPS such as:
    - loss of main and emergency power
    - MOPS redundancy to crane power failure.
- diver power such as:
    - loss of main and emergency power
    - divers independent emergency survival systems (gas, communications and heating) and positioning of bell or dive stages above any subsea infrastructure, to ensure these will not hang up on any subsea infrastructure, if main and emergency power is lost during a LoC event.

Further guidance is available in the NOPSEMA guidance note:

"Supporting Safety Studies"

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

Further guidance is available in the NOPSEMA guidance note:

"ALARP"

5. Safety management system description

The content requirements of the safety management system (SMS) are contained in section 5 of the Safety Case Content and Level of Detail guidance note. This guidance note provides additional advice on compliance with several specific SMS content requirements related to vessel facilities exposed to external hydrocarbon hazards. The guidance note does not repeat any SMS content requirements and should be used in conjunction with the Content and Level of Detail guidance.

Further guidance is available in the NOPSEMA guidance note:

"Safety Case Content and Level of Detail"

5.1. Inspection testing and maintenance of control measures

Inspection, testing and maintenance:

Reg 2.5(3) The safety case for the facility must also contain a detailed description of the safety management system that:

(f) provides for inspection, testing and maintenance of the equipment and hardware that are the physical control measures for those risks.

The description of the SMS must provide details of planned arrangements (policies, procedures etc.) for inspection, testing and maintenance. The SMS should describe any additional inspection, testing and maintenance processes required for the additional equipment and hardware controls measures identified for vessel facilities working in close proximity to hydrocarbons.

In certain circumstances the vessel facility operator may not directly manage all of the equipment and hardware identified as the physical control measures for hydrocarbon risks. For example, any shutdown, blowdown and isolation requirements on an adjacent hydrocarbon facility would typically be managed by the adjacent facility. A process to verify the inspection, testing and maintenance of the external control measures relied upon would need to be described within the vessel facility safety case.

Example – Provision for inspection, testing and maintenance of hydrocarbon physical control measures

An operator of a vessel facility proposes to undertake riserless well intervention activities. The well intervention equipment is hired from a service company, which provides the equipment inspection, testing and maintenance. The vessels SMS does not describe the inspection testing and maintenance of the well intervention equipment and does not describe any assurance/verification process of the supplier's inspection, testing and maintenance system. The SMS description is therefore unlikely to meet the requirements of regulation 2.5(3) as it does not contain a detailed description that provides for inspection, testing and maintenance of the equipment and hardware.

5.2. Command structure

Content requirement:

Reg 2.8(1) *For a facility that is manned,* ***the safety case must specify****:*

(a) an office or position at the facility, the occupant of which is in command of the facility and responsible for its safe operation when on duty; and

(b) an office or position at the facility, the occupant of which is responsible for implementing and supervising procedures in the event of an emergency at the facility; and

(c) the command structure that will apply in the event of an emergency at the facility.

Note: *The same person may occupy both of the offices or positions mentioned in paragraph 1 (a) and (b).*

Emergency response involves numerous people working together, in a coordinated manner, to perform a range of tasks in an unstable, changing environment. A vessel operating in close proximity to a hydrocarbon facility provides additional complexity to any emergency response requirements.

It is critical that the command structure, roles and responsibilities of personnel are clear to all personnel on the vessel facility and any related hydrocarbon facility response team. A description of this command structure needs to be provided within the safety case. The description may also be accompanied by an organisation chart to enable clear identification of the decision-making hierarchy.

Further guidance is available in section 3.4.2 'Command Structure' in the NOPSEMA guidance note: ***"Safety Case Content and Level of Detail"***

Further guidance is available in section 3.1 'Command Structure' in the NOPSEMA guidance note: ***"Emergency Planning"***

5.3. Workforce competency

Members of the workforce must be competent:

Reg 2.9 *The safety case for a facility must describe the means by which the operator will ensure that each member of the workforce at the facility has the necessary skills, training and ability:*

(a)(ii) to undertake routine and non-routine tasks that might reasonably be given to him or her in abnormal ***or emergency conditions****; and*

(b) to respond and react appropriately, and at the level that might be reasonably required of him or her, ***during an emergency****.*

The regulation requires that the workforce must be competent and specifically includes the requirement that the workforce has the required skills, training and ability to undertake routine and non-routine tasks and respond and react appropriately in emergencies. With respect to the emergency management for hydrocarbon release, particularly hydrocarbon gas release, the following items may need to be considered:

- understanding of project hydrocarbon release risks
- gas alarm response
- equipment isolation and ignition controls
- equipment emergency release operation
- gas alarm mustering.

The operator must describe the means by which competency requirements are ensured for all activities including hydrocarbon-related activities within the safety case. A training matrix for safety critical training is a useful component in a safety case.

*Further guidance is available in section 5.2.2 'Command Structure' in the NOPSEMA guidance note: **"Safety Case Content and Level of Detail"***

*Further guidance is available in section 3.2 'Workforce competency' in the NOPSEMA guidance note: **"Emergency Planning"***

5.4. Permit to work system for safe performance of various activities

Content requirement:

Reg 2.10 (1) **The safety case for a facility must provide for** the operator of the facility to establish and maintain a documented system of coordinating and controlling the safe performance of all work activities of members of the workforce at the facility, including in particular:

(a) welding and other hot work; and
(b) cold work (including physical isolation); and
(c) electrical work (including electrical isolation); and
(d) entry into, and working in a confined space; and
(e) procedures for working over water; and
(f) diving operations.

Level of detail requirement:

Reg 2.10(2) The system must:

(a) form part of the SMS described in the safety case in force for the facility; and

(b) identify the persons having responsibility to authorise and supervise work; and

(c) ensure that members of the workforce are competent in the application of the permit to work system.

The SMS should provide descriptions of the planned arrangements (policies, procedures etc.) for the permit to work system. The arrangements in place on the vessel facility to control the safe performance of all work activities are likely to change when working in close proximity to a hydrocarbon facility. Two, or possibly more, operator safety managements systems may be involved in the work activities.

A vessel facility safety case will need to describe the interactions between the various parties and describe how work activities are effectively coordinated and controlled. This is typically accomplished through the creation of bridging documents (such as project plans or project SIMOPS plans) to clearly outline how the separate systems will interact with one another. It is not expected that these documents form part of the safety case, however it is expected that the safety case will contain a description of the systems with a sufficient detail to gain an appreciation of how the operator proposes to control the safe performance of all inter-related work activities.

Example – Hydrocarbon hazard related PTW processes

A vessel facility proposes to undertake construction activities in close proximity to an operating production facility. PTW-related processes applied include:

- field entry permits (including DP arrivals test, ARPA switched off, No open red hot work permits)
- isolation permits (handover permits) for well and pipelines.

*Further guidance is available in section 5.2.3 'Permit to work system for safe performance of various activities' in the NOPSEMA guidance note: **"Safety Case Content and Level of Detail"***

5.5. Emergency communication systems

Content requirement:

Reg 2.18 (1) **The safety case for a facility must provide for** communications systems that, in the event of an emergency in connection with the facility, are adequate for communication:

(a) within the facility; and

(b) between the facility and:

(i) appropriate on-shore installations; and

(ii) appropriate vessels and aircraft; and

(iii) other appropriate facilities.

Reg 2.18 (2) In particular, the safety case must provide for the communications systems of the facility to be:

(a) adequate to handle:

(i) a likely emergency on or relating to the facility; and

(ii) the operation requirements of the facility; and

(b) protected so as to be capable of operation in an emergency to the extent specified by the Formal Safety Assessment relating to the facility.

Communications systems within the facility (e.g. primary and secondary communications between bridge/dive control/ECR/mess muster station(s)/crane cabin/ROV control/gangway operator/ launch and recovery system (standby diver)) between the vessel facility and that of the hydrocarbon facility must be described. The vessel facility safety case needs to demonstrate that the communications systems in place are adequate for both emergencies and normal operational requirements for hydrocarbon hazard-related activities.

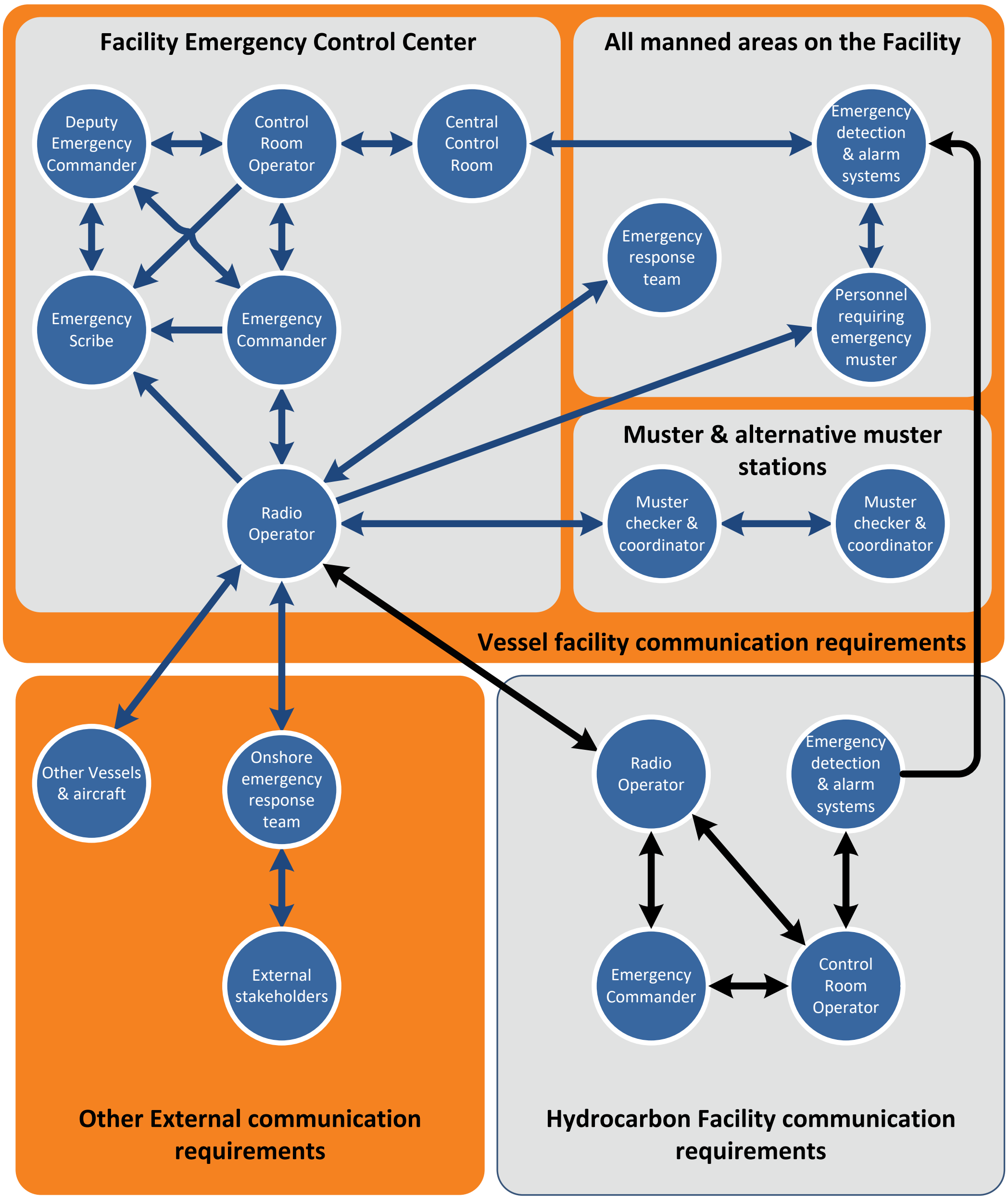
Operators need to consider the following factors in determining suitable means of communication for hydrocarbon-related activities:

- what information needs shared during routine activities and emergencies?
- who needs the information and why?
- how will this information be effectively transmitted?

Figure 2 below uses a Social Network Analysis (SNA) technique to identify communications paths (indicated in black) that may be required between a hydrocarbon facility and a vessel working in close proximity it. The SNA identifies communication paths by the use of arrows and their associated direction, which may be necessary.

In this SNA, the radio/communications operator would be relied upon for communication during an emergency between the hydrocarbon facility and the vessel. As an added precaution the detection and alarms system on the hydrocarbon facility is shown to be directly linked to the vessels alarm system, to provide an additional communication path to the vessel of any arising emergency. For working above a pipeline, communications may be required with an onshore plant or an offshore facility depending on the location of the control room.

Figure 2: Emergency communication example for a vessel in close proximity to a hydrocarbon facility



Further guidance is available in the NOPSEMA guidance note:

"Emergency Planning"

5.6. Emergency planning

Content requirement:

Reg 2.20(1) The safety case for a facility must:

(a) **describe** a response plan designed to address possible emergencies, the risk of which has been identified in the formal safety assessment for the facility; and

(b) **provide for** the implementation of that plan.

Level of detail requirement:

Reg 2.20(2) The plan must:

(a) **specify** all reasonably practicable steps to ensure the facility is safe and without risk to the health of persons likely to be on the facility at the time of the emergency; and

(b) **specify** the performance standards that it applies.

The operator must ensure that the description of emergency response plan (ERP) contains the documents, organisation structure and arrangements in place for dealing with hydrocarbon-related emergencies on the vessel facility. Detailed guidance on the content requirements of an ERP is contained in section 5 of the Emergency Planning guidance note and is not repeated within this guidance note.

5.6.1. The hydrocarbon emergency/contingency procedures

For vessels working in close proximity to hydrocarbons, the following considerations should be taken into account when developing an ERP and should be adequately described within the safety case:

- ensure all possible hydrocarbon-related emergencies, which are identified within the FSA, are addressed in the ERP
- development of emergency decision-making flowcharts/processes for the various types of hydrocarbon emergency that could occur
- development of roles and responsibilities
- development of hydrocarbon emergency checklists (e.g. checklists to facilitate power ventilation shutdown, mustering, deck load shutdown and emergency disconnect tasks)
- establish clear initiation points for emergency response. At what point in time does the emergency response commence? (e.g. failure of the DP system to meet the ASOG, activation of vessels gas alarms or emergency shutdown and blowdown of platform)
- development of tiered gas release response process (e.g. ESD hierarchy)
- hydrocarbon release communication protocols between host facility and the vessel

- incorporation of any new equipment and/or procedures into the ERP (e.g. modification of the fire and safety plan to incorporate additional fire fighting and/or lifesaving appliances such as gas detection)
- consider updating the vessel station bill to include gas alarms and gas emergency actions
- setting performance standards for hydrocarbon response.

Figure 3 below provides a simplified outline of a hydrocarbon gas release emergency response hierarchy that may be in place for gas release emergencies on a vessel facility operating in close proximity to hydrocarbon hazards. The figure illustrates a tiered response dependent on the number of detectors activated and gas levels detected. Given that vessel facility design, activities conducted and measures implemented may vary significantly from vessel to vessel, operators should carefully consider the response to ensure it is appropriate for their specific vessel facility and its activities.

Figure 3 – Example of a simplified hydrocarbon emergency response hierarchy

Tier	Gas detection system status and shutdown guideline	Action by
Level 4	**Any low or high level alarm from anywhere on the adjacent hydrocarbon facility**	
	Make public address (PA) advising of gas alarm on adjacent facility instructing an immediate stop to ALL work being performed under a permit.	Master
	Communicate with adjacent hydrocarbon facility to ascertain alarm status.	Master
	Monitor sea surface for surface fountain/gas cloud/mist associated with a subsea hydrocarbon release and/or communicate with adjacent hydrocarbon.	Bridge Crew
	Manually shutdown AHU to accommodation areas, including the galley.	Master
	If gas presence on adjacent facility is not confirmed, make PA advising that gas presence is not confirmed and that work can recommence.	Master
	If gas presence on adjacent facility is confirmed, then follow Level 2 response.	
Level 3	**Single low level alarm from any gas detector on vessel facility**	
	Make PA that gas alarm has sounded, cause is being investigated and instructing an immediate stop to ALL work being performed under a permit. Advise adjacent hydrocarbon facility	Master
	Monitor sea surface for surface fountain/gas cloud/mist associated with a subsea hydrocarbon release and/or communicate with adjacent hydrocarbon facility.	Bridge Crew
	Verify alarm using portable gas detector.	Chief Eng
	If gas presence is not verified, then silence alarm and make PA advising that gas presence is not verified and that work can recommence.	Master
	If gas presence is verified, then follow Level 2 response.	
Level 2	**One or more high level alarms/multiple low level alarms other than at ER intakes**	
	Initiate general alarm (for gas).	Master
	Make PA advising presence of gas instructing an immediate stop to ALL work and that muster will take place in temporary refuge (TR). Advise adjacent hydrocarbon facility if working nearby.	Master
	Monitor sea surface for surface fountain/gas cloud/mist associated with a subsea hydrocarbon release and/or communicate with adjacent hydrocarbon facility if working nearby.	Bridge Crew
	Manually shutdown AHU to accommodation areas, including the galley.	Master
	Shutdown powered ventilation units to the machinery and engine room spaces.	Master
	Activate emergency shutdown to isolate non-essential un-manned systems on the back deck	Chief Eng
	Shutdown ROV, leave ROV at depth and do NOT recover.	ROV Super
	Active crane emergency shutdown button and Brake Release button (MOPS) if attached to subsea load.	Crane Op
	Initiate movements to remove the vessel to a location both Upwind and Up Current.	Master

Level 1	Any high level alarm at ER intakes	
	Initiate general alarm (for gas).	Master
	Make PA advising presence of gas instructing an immediate stop to ALL work and that muster will take place in TR. Advise adjacent hydrocarbon facility if working nearby.	Master
	Manually shutdown AHU to accommodation areas, including the galley (if not already done automatically).	Chief Eng
	Manually shutdown powered ventilation to machinery and engine room spaces.	Chief Eng
	Deactivate the emergency generator automatic start up.	Master
	Shutdown main engines and associated machinery.	Chief Eng
	Activate emergency shutdown to isolate non-essential un-manned systems on the back deck	Chief Eng
	Shutdown ROV, leave ROV at depth and do NOT recover.	ROV Super
	Active crane emergency shutdown button and brake release button (MOPS) if attached to subsea load.	Crane Op
	Engines may be restarted once detector readings drop below the low alarm threshold at all detectors	Master

5.6.2. Hydrocarbon emergency drills and exercises

Content requirement:

Reg 2.20(3) **The safety case must make adequate provision** for escape drill exercises and fire drill exercise by persons on the facility.

Level of detail requiremet:

Reg 2.20(4) In particular, those exercises must ensure that those persons will be trained to function in the event of emergency with an adequate degree of knowledge, preparedness and confidence concerning the relevant emergency procedures.

The ERP must provide for a means for undertaking escape drill exercises and fire drill exercises for hydrocarbon-related emergencies. The drills and exercises (including desktop or simulated drills) should be based on the possible hydrocarbon emergency response scenarios, which are identified in the formal safety assessment.

The emergency planning arrangements for hydrocarbon-related hazards may vary from project to project. It may therefore not be appropriate to specify only a recurring frequency commitment for hydrocarbon-related drills and exercises to be completed. This may be an issue for a short duration project, in which the project could commence and be completed between a predetermined drill schedule. In order to demonstrate that relevant personnel have adequate knowledge, preparedness and confidence for hydrocarbon emergency response, the operator may need to commit to undertaking pre-project drills and exercises prior to project prior to commencement.

For example, drills related hydrocarbons on the vessel facility may include the following:

- loss of DP in close proximity to a hydrocarbon facility
- emergency drive off /drift off drills due to a hydrocarbon release
- collision with or snagging on hydrocarbon infrastructure during lifting operations
- loss of containment during various construction activities (including subsea crane operations)
- loss of containment during well servicing activities
- loss of containment during diving activities.

This will generally include actions to initiate under different gas alarms / ESD levels.

*Further guidance on drills and exercises is available in section 5.3 in the NOPSEMA guidance note **"Emergency Planning"***

6. Critical factors for acceptable safety cases

NOPSEMA will expect safety cases to address at least the following:

- safety case content that is consistent with the Safety Regulations
- a description with an appropriate level of detail that accurately explains the physical characteristics of the facility, its operating envelope, the activities that take place at or in connection with the facility and its technical safety-related control systems
- a consistent, integrated overall structure to the safety case such that there is a logical flow through the assessment process with links between the causes and consequences of MAEs, their associated risks, the selection of strategies and measures to control the risks, and the performance required from specific measures to maintain risk levels to ALARP
- a description with an appropriate level of detail that identifies all of the hazards which could cause or contribute to an MAE, the associated consequences, and the assessment of risk associated with those hazards
- a description with an appropriate level of detail that explains the means by which the operator ensures adequacy of the design, construction, installation, operation, maintenance or modification of the facility
- a transparent and robust argument to show that the adopted control measures reduce risk to a level that is ALARP
- a transparent and robust provision of evidence that the SMS provides for reduction of risk to a level that is ALARP, and that it is comprehensive and integrated
- a description of the processes by which the workforce are consulted and involved in preparation or revision of the safety case
- consideration for interrelatedness of the information being presented

- implementation of appropriate referencing techniques for both SMS documents and external material the case relies on (e.g. standards, codes, data, etc.).

7. References, acknowledgments and notes

DNVGL-RU-OU-0101 Rules for Classification of Offshore Units, Offshore Drilling and Supporting Units, Section 3 Supplementary Requirements for Service Notation Well Intervention Unit 1 (well intervention without introducing well fluids / hydrocarbons on board)

ABS Rules for Building and Classing Offshore Support Vessels 2016 – Part 5 Specialized Services, Chapter 10 Well Intervention (limited to Riserless Well Intervention (RWI) Systems)

All regulatory references contained within this Guidance Note are from the Commonwealth Offshore Petroleum and Greenhouse Gas Storage Act 2006 and the associated Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009. For facilities located in designated coastal waters, please refer to the relevant state or Northern Territory legislation.

For more information regarding this guidance note, contact the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA):

Telephone: +61 (08) 6188-8700, or e-mail: safetycaseguidance@nopsema.gov.au