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VERMILION OIL & GAS AUSTRALIA

WANDOO FACILITY ENVIRONMENT PLAN SUMMARY

WPA-7000-RH-0023

Revision 3

Revision	Date	Description	Originator	Checker	Approver
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Revision history

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Abbreviations and definitions

ALARP	As Low as Reasonably Practicable
AMOSC	Australian Maritime Oil Spill Centre
AMSA	Australian Maritime Safety Authority
CALM	Catenary Anchor Leg Mooring
CGS	Concrete Gravity Structure
DEC	Department of Environment and Conservation (Now DPaW)
DMP	Department of Mines and Petroleum
DoT	Department of Transport
DPaW	Department of Parks and Wildlife
EP	Environment Plan
KEF	Key Ecological Feature
MoU	Memorandum of Understanding
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OPGGS (E) Regulations	Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009
OSCP	Oil Spill Contingency Plan
VOGA	Vermilion Oil and Gas Australia Pty Ltd
WA	Western Australia
WHA	World Heritage Area
WPF	Wandoo Production Facility
ZPI	Zone of Potential Impact

1 Introduction

Vermilion Oil and Gas Australia Pty Ltd (VOGA) is the licensed permit holder of production licence area WA-14L, which contains the Wandoo Production Facility (WPF). VOGA has been operating in the Permit Area since 2005. The WPF processes subsea well fluids, oil is produced at Wandoo (unmanned monopod) and piped to the Wandoo B platform for processing. Oil is stored in a Concrete Gravity Structure (CGS) prior to export.

The Wandoo Facility Environment Plan (EP) (WPA-7000-YH-0007) has been prepared in accordance with requirements of the Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS [E] Regulations) and is a revision of an existing EP that the WPF had been operating under, previously accepted by the Western Australian (WA) Department of Mines and Petroleum (DMP) (WPA-7000-YH-0007). The EP is written to allow for the continuation of production at the WPF for a period of five years from the date of its acceptance by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). This EP summary has been prepared as per the requirements of Regulation 11(3) and (4) of the OPGGS (E) Regulations.

2 Location

The Permit Area (WA-14-L) is located in Commonwealth waters in the Carnarvon Basin off the northwest coast of WA, approximately 80 km northwest of Dampier and 110 km northeast of Barrow Island. The Wandoo facilities, including the Wandoo A Monopod, Wandoo B Platform, Catenary Anchor Leg Mooring (CALM) Buoy and anchorage are located within the Permit Area in water depths of approximately 54 m (Figure 2-1).

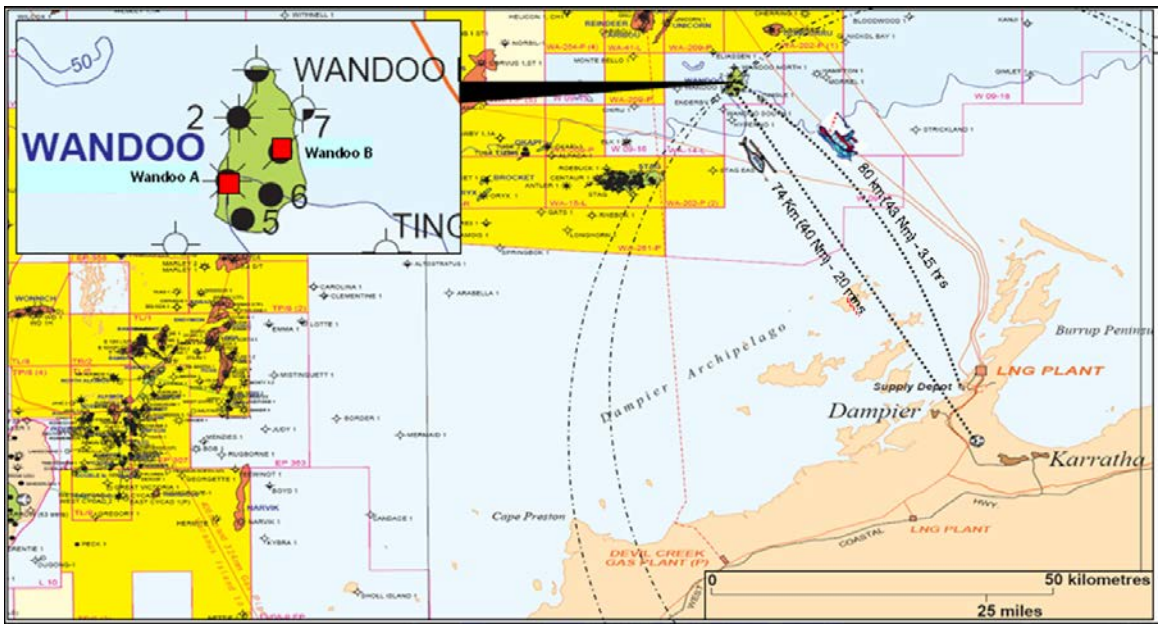

Figure 2-1: Location of the WA-14-L Permit Area and WPF

Geographical coordinates of Wandoo production's various facilities are provided in Table 2-1.

Table 2-1: Coordinates of the WPF

Facility	Latitude	Longitude
Wandoo A	20°08' 20" S	116°25' 17.5" E
Wandoo B	20°07' 43" S	116°26' 04" E
Anchorage	20°05' 00" S	116°23' 48" E
CALM Buoy	20°07' 02" S	116°26' 02" E

3 Description of the environment

This section describes the environment conditions in and around the Permit Area, as well as within the wider Zone of Potential Impact (ZPI). The ZPI is the area that could be impacted from both planned and unplanned events that may result from the operations. The description of the environment within the Permit Area covers both Wandoo A and Wandoo B, as they are within close proximity of each other.

The ZPI is based on the worst credible environmental hazard: a 0-5% probability of sea-surface exposure (reported to 1 µm) from an 80 day spill based on the unlikely event of an instantaneous release of Wandoo crude from the CGS tank. The 1 µm threshold is conservative in terms of environmental effects on marine fauna, however is more indicative of the perceived area of a spill that may trigger socio-economic impacts as a precautionary measure (APASA, 2014). The ZPI is based on the cumulative trajectory modelling (50 spills) of a spill of Wandoo crude oil during summer, transitional and winter wind and current conditions as this presents the maximum area. Environmentally sensitive areas are predominantly located at the shoreline and in near-shore/ coastal waters. Further details of potential impacts on these sensitivities from the worst credible oil spill scenario are provided in Section 6 below.

3.1 Physical environment

The Permit Area is situated in the middle/outer shelf waters of the North West Shelf. Circulation of seawater in the Permit Area is influenced by the Indonesian Throughflow from the western Pacific and Leeuwin Current which continues the transport of warm water further south. Sediments in the Permit Area are typically comprised of unconsolidated fine to coarse sands dominated by carbonates. Areas closer to shore may have a larger component of terrigenous sediments, particularly around inputs such as rivers and creeks. Sediment quality and water quality in the region is generally considered to be high, with low levels of metals and other contaminants (Fandry et al., 2006).

Currents in the continental shelf region around the Permit Area, and much of the offshore ZPI, are typically tidal currents influenced by wind-driven surface currents. Water movement is predominantly south easterly during flood tides and north westerly during ebb tides. Winter swells are typically in the range of 1 m to 2 m, but occasionally reach 3 m in the presence of severe cold fronts. In summer the swell is smaller, more variable and tends westerly. Swells generated by tropical cyclones in summer may range between 8 m and 10 m.

Winds vary seasonally, with a tendency for westerly winds in summer (October to April) and southerly winds in winter (May to September). During winter months (June to August), the winds are typically more variable, but mostly from the east.

3.2 Biological environment

Benthic habitats within the Permit Area comprise soft sediments and associated benthic fauna. The infaunal community of these soft sediments is essentially similar to that found at other locations throughout the region with low numbers of species and low abundance, with no particular areas of significant value. Hard corals (Order *Scleractinia*) are not likely to be present within the Permit Area due to water depths being too great to support zooxanthellae and a lack of hard substrate. Soft corals (Order *Alcyonacea*) are also unlikely to be present in the Permit Area as they have similar habitat requirements to hard corals.

Coral reefs, seagrasses, mangroves and macroalgae are widespread throughout the shallower areas of the ZPI. Significant areas of these sensitive habitats located within vicinity of the Permit Area include: the waters of the Dampier Archipelago, around offshore island groups such as the Montebello Island Group and the Barrow and Thevenard Islands. At the outer extent, sensitive habitats include the Scott, Cartier and Ashmore reefs, the south coasts of the southern islands of Indonesia from Timor in the east to central Java in the west. To the far west, the Christmas Islands and associated reefs as well as the isolated Cocos (Keeling) Islands and associated reefs and marine habitats could also be potentially affected. These areas contain habitats that are recognised as an important resource for a diverse range of fauna species providing breeding, calving, feeding/foraging and migratory areas.

An EPBC Act Protected Matters Search (DotE, 2014) of the ZPI, identified a total of 72 fauna species listed as migratory and/or threatened under the EPBC Act, including 39 bird, 14 mammal, nine reptile and 10 shark/ray species. Fourteen marine mammals that are listed as threatened and/or migratory under the EPBC Act include 12 cetaceans, one dugong, and one pinniped (sea lion). These EPBC Act protected fauna may potentially occur in the ZPI, though many of them are seasonal visitors or transit the area.

3.3 Social and economic environment

There are no Commonwealth Heritage or National Heritage sites in the Permit Area, although nine places within the ZPI are listed on the National Heritage list. These are:

- The Ningaloo Coast;
- Shark Bay;
- The West Kimberley;
- Barrow Island and the Montebello Islands Marine Conservation Reserve;
- Beekeepers-Lesueur-Coomallo Are and Namburg National Park;
- Dampier Archipelago;
- Dirk Hartog Landing Site 1616 – Cape Inscription Area;
- HMAS Sydney II and HSK Kormoran Shipwreck Sites; and
- Batavia Shipwreck Site and Survivor Camps 1629 – Houtman Abrolhos.

The Ningaloo Marine Area (Commonwealth waters) and the HMAS Sydney II and JSK Kormoran and Mermaid Reef – Rowley Shoals are also listed on the Commonwealth Heritage List. Historic shipwrecks of National and State heritage value are legally protected under the *Historic*

Shipwrecks Act 1976 (Commonwealth) and *Maritime Archaeology Act 1973* (WA). There are no known shipwrecks within the Permit Area, but there are an extensive number within the ZPI.

Several Commonwealth and State managed fisheries occur within the ZPI, some of which overlap the Permit Area. However, fishing activity is unlikely to occur within the permit area due to safety exclusion zones. Five federally managed and 15 state managed fisheries are potentially active within the ZPI, in addition to considerable commercial aquaculture. The closest known aquaculture facility to the Permit Area being at Dampier Archipelago (approximately 40 km from the Permit Area) and Montebello Islands (approximately 90 km from the Permit Area).

Under the Memorandum of Understanding (MOU) between Australia and Indonesia, fishers using traditional fishing methods only are permitted to operate in an area of Australian waters in the Timor Sea. The peak fishing season is between August and October with fishers departing the region at the onset of the northwest monsoon season. The MOU represents an area of 200 nm within the Australian Fishing Zone encompassing Scott Reef and associated reefs including Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Reef and various banks.

The region supports significant commercial shipping activity, the majority of which is associated with the WA oil and gas and mining industries, with a high density of vessel traffic in waters surrounding the Permit Area. There are no military related uses within the Permit Area; however the ZPI encompasses the military installations near Exmouth, including a naval communication station and pier facility.

The petroleum exploration and production industry is a significant stakeholder in the region. The Permit Area is directly surrounding by at least five other permits. There is also extensive existing and proposed LNG infrastructure within the ZPI and broader region.

No tourist activities take place within the Permit Area, although tourist activities do occur within the ZPI and tourism plays a significant role in the region. Tourism related activities include fishing and diving charters, shore-based activities and seasonal whale/whale shark watching, with activity often associated with marine protected areas or other coastal nature reserves. Major tourism precincts within the ZPI include the Ningaloo Coast, the Exmouth Gulf and Broome. Tourism is also one of the main economic activities on Christmas Island and the Cocos (Keeling) Islands.

3.4 Areas of environmental significance

There are three World Heritage Areas (WHAs) within the ZPI; Ningaloo Coast, Shark Bay WHA and the Komodo National Park WHA.

There are two gazetted Commonwealth Marine Protected Areas within the ZPI and ten Commonwealth Marine Reserves which were managed under transitional arrangements until they come into effect in July 2014. In addition, there are seven gazetted and two proposed WA State Marine Protected Areas within (or partially within) the ZPI. While there are no Commonwealth National Parks within the Permit Area; there are two National Parks that lie within the ZPI. There are currently six declared RAMSAR wetlands that lie within the ZPI. There are also two Indonesian National Parks containing protected marine areas. These protected areas provide important habitats, including foraging/feeding, nesting, calving and resting areas for a number of protected and species. These areas are particularly important for turtles (green, hawksbill, flatback and loggerhead), humpback whales, whale sharks, dugongs, Australian sea lions and migratory birds.

Key Ecological Features (KEFs) have been identified through the marine bioregional planning process and are described as those parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of a Commonwealth Marine Area (DEWHA, 2008). Within the ZPI, nineteen KEFs have been identified.

4 Description of the activity

4.1 Process description

Extraction of crude oil from the Wandoo Field commenced in 1993 from a single unmanned monopod wellhead platform (Wandoo A) supporting a helideck and five production wells. In 1997, the Wandoo B production platform, which is a CGS, was installed and connected to Wandoo A by a subsea pipeline.

The oil produced from Wandoo A is piped to the Wandoo B platform. Oil is stored in the CGS supporting the Wandoo B processing facilities, and then offloaded through flexible pipelines to a CALM Buoy located 1.2 km north from the Wandoo B platform (Figure 4-1). A floating hose is used to transfer the oil from the CALM Buoy to export tankers situated at a mooring facility. Export tankers are chartered to offload the oil.

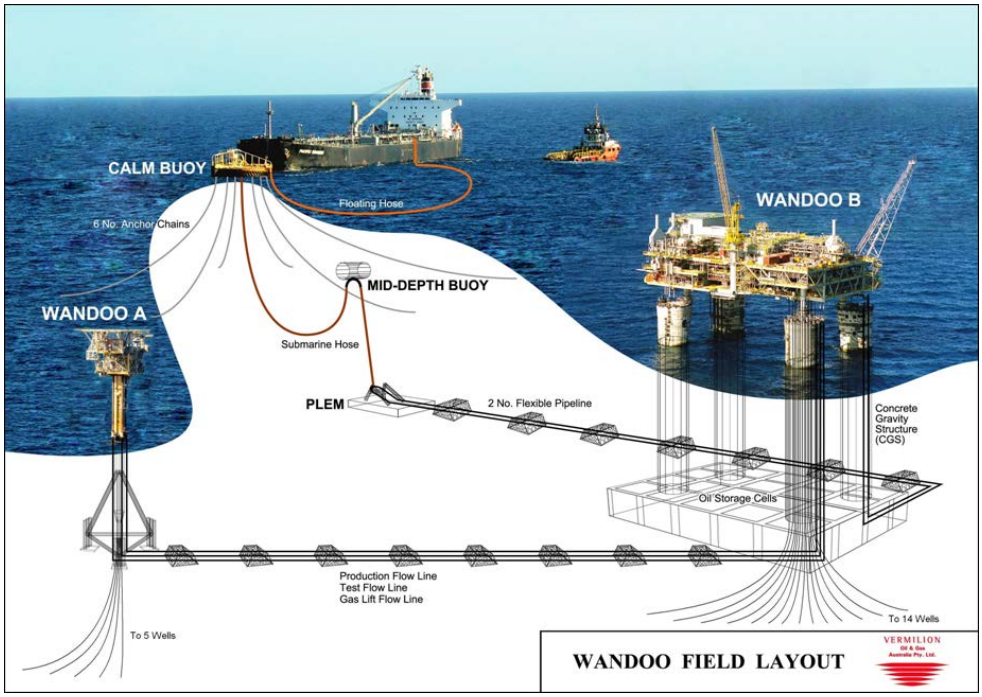

Figure 4-1: The WPF field layout

The platform is capable of processing in excess of 24,600 m^3 of well stream fluids per day. The Wandoo facility operates 24 hours per day, 365 days per year with the end of field life currently modelled to be 2030.

4.2 Field infrastructure

The Wandoo A platform is a 'Normally Not-manned' wellhead platform that consists of a fixed structure without processing equipment. The substructure is a piled shell unit consisting of two pieces forming one unit. The Wandoo A platform is equipped with the following facilities:

- five slots for production wells;
- production and gas lift manifolds;
- chemical injection;
- wellhead and Subsea Safety Valve control panel complete with telemetry system;
- piping and manifold system to deliver fluids to the marine riser as well as receive gas;
- monitoring and control system;
- process safety and shutdown system;
- radio telemetry system;
- navigation aids;
- instrument gas system with nitrogen backup;
- a caisson that includes four risers and a conductor;
- 3G cellular phone system;
- helideck;
- deck crane and work space;
- poor weather refuge and store; and
- Wandoo A power supply (direct current generator, solar panel and batteries).

The central oil production process and storage platform Wandoo B, consists of a single integrated three level deck supported on a CGS. This supports 13 production wells capable of being converted into water injection wells and one gas reinjection well, all with dry trees. The topsides comprise processing facilities, oil storage within CGS, utilities, accommodation and a helipad; it also contains an integrated deck structure with approximate overall deck dimensions of:

- 69 m long;
- 40 m wide; and
- the height of the integrated deck structure is 10 m from top of steel at Cellar Deck level (lowest deck level) to top of steel of Main Deck level (highest deck level).

The Wandoo B platform contains two accommodation modules with combined capacity for up to 48 persons.

4.3 Support activities

Support vessels will supply food and transport equipment required for operational activities. They will also back-load materials and wastes, to return onshore for disposal. Vessel related activities within the Operational Area will comply with the Platform Operations Manual (VOG-7000-MN-

0001). Vessels supporting the Wandoo facility when outside the Operational area will comply with applicable maritime regulations.

Principal access to the Wandoo A and Wandoo B platforms is by helicopter. Helicopter related activities are in accordance with the Wandoo Work Management Manual (WPA-7000-YG-00121). Seven helicopter movements to the Wandoo B facility take place each week, along with one trip per week to the Wandoo A facility. Helicopter transport is also used on occasion for small items requiring urgent delivery.

Other support activities include refuelling, waste management and the management of hazardous substances, which is undertaken in accordance with the relevant management procedures.

4.4 Facility maintenance activities

Maintenance activities such as deck cleaning, pigging, welding, cutting, spray painting and abrasive blasting is undertaken as required on the facility in accordance with Platform Operations Manual (VOG-7000-MN-0001) and the Wandoo Work Management Manual (WPA 7000-YG-00121).

4.5 Subsea surveys maintenance and inspection activities

Various subsea surveys will be undertaken as required including; metrology surveys, sidescan sonar surveys, sub-bottom profiling surveys, metocean surveys and remotely operated vehicle surveys.

Maintenance activities including: subsea welding and cutting, cleaning and marine growth removal, repair and replacement of subsea assets will be undertaken as required. Commercial divers often undertake maintenance activities.

5 Major environmental hazards and controls

VOGA held an environmental hazard workshop to identify and then evaluate the potential environmental risks associated with the operation of the Wandoo facilities. This process enables the development of elimination, mitigation and contingency strategies to ensure that, for those risks not eliminated, the residual risk is reduced to as low as reasonably practicable (ALARP). The assessment was undertaken in accordance with Australian/New Zealand Standard AS NZS ISO 31000-2009 Risk Management – Principles and Guidelines and the VOGA Risk Management Manual VOG-2000-MN-0001 and the VOGA risk assessment procedure. The VOGA risk assessment matrices shown below were used, taking into account the consequence and probability of 23 identified sources of potential environmental impact.

Table 5-1: Risk level and action

	High (H) Risk:	Intolerable – Stop activities unless risk controls that will reduce the risk are implemented
	Upper Medium (UM) Risk:	Tolerable (higher region) on demonstration of ALARP
	Lower Medium (LM) Risk:	Tolerable on demonstration of ALARP
	Low (L) Risk:	Acceptable

The risk assessment workshop found that there were no high or upper-medium risks, 15 lower-medium and eight low risks. A list of the risks and their residual risk ranking is provided in Table 5-2.

Table 5-2: Environmental risks from operational activities and their residual risk ranking

VOGA EP Risk No.	Hazard	Residual Risk Ranking
EP-OP-R01	Liquid hydrocarbon release from wells	LM
EP-OP-R02	Liquid hydrocarbon release from export equipment, submarine hose, floating hose, export flow lines, subsea pipelines	LM
EP-OP-R03	Crude oil spill from CGS	LM
EP-OP-R04	Environmental impacts of oil spill response activities	LM
EP-OP-R05	Diesel spill to sea	LM
EP-OP-R06	Discharge of PFW and ballast water from WPF	LM
EP-OP-R07	Noise	LM
EP-OP-R08	Atmospheric emissions	LM
EP-OP-R09	Artificial light	LM
EP-OP-R10	Discharge of cooling water from WPF	LM
EP-OP-R11	Vessel and WPF deck drainage and vessel bilge water discharge	LM
EP-OP-R12	Discharge of sewage, grey water and putrescible waste from the WPF and vessels	LM
EP-OP-R13	Discharge of desalination brine	LM
EP-OP-R14	Non-hazardous and hazardous waste	LM
EP-OP-R15	Use and discharge of chemicals for maintenance and inspection activities	LM
EP-OP-R17	Disturbance of marine fauna and seabirds	L
EP-OP-R18	Liquid hydrocarbon release in topsides process	L
EP-OP-R19	Ancillary hydrocarbon or chemical spills	L
EP-OP-R20	Physical presence of infrastructure	L
EP-OP-R21	Seabed disturbance	L
EP-OP-R22	Discharge of ballast water from vessel	L
EP-OP-R23	Liquid hydrocarbon release from flow lines and risers	L

The impacts outlined above have been considered in terms of the regional environment and the local marine ecosystem. VOGAs systems, practices and procedures ensure that its operation activities meet the defined performance objectives and standards and all relevant legislative requirements. The commitments associated with these objectives and standards contribute to ensuring that the residual environmental risk associated with operations of the WPF is reduced to ALARP.

To ensure the potential environmental impacts identified through the risk assessment are managed appropriately, VOGA has developed a range of performance standards (controls) that will be implemented throughout the life of the WPF. The environmental hazards listed in Table

5-2 are summarised in Appendix A ; including details on the environmental impacts and associated prevention and mitigation controls.

6 Ongoing monitoring of environmental performance

The operations of the WPF will be managed in compliance with the Wandoo Facility EP, under the OPGGS (E) Regulations.

The objective of the EP is to ensure that any potentially adverse impacts on the environment associated with the operation of the WPF are identified and managed, and that in instances where the residual risk associated with any activity is not eliminated, it is reduced to ALARP.

The EP details the proposed performance objectives, standards and measurement criteria, and identifies the preventative and recovery controls (where appropriate) in place for each potential impact. The overall level of residual risk is evaluated based on the assumption that these measures have been implemented.

VOGA has prepared a series of environmental performance standards for all risks, analogous to the safety performance standards prepared within Safety Case documents for managing safety critical equipment and systems. These performance standards detail the objectives, requirements, assurance processes and criteria by which environmentally significant equipment and systems shall be maintained.

The implementation strategy detailed in the EP identifies the management systems in place, communications network, required training and competencies and key roles and responsibilities of all personnel in relation to implementing controls, managing non-conformance, monitoring and auditing of operations and emergency response including the implementation of oil spill response activities. The reporting requirements for recordable and reportable incidents and reporting requirements on overall compliance of the activities are described within the EP.

7 Response arrangements

An Oil Spill Contingency Plan (OSCP) for the WPF detailing the arrangements in place for dealing with any potential spills and minimising the potential effects of a spill on the environment has been developed and approved by NOPSEMA. The OSCP details the roles and responsibilities of all involved and includes interfaces with third parties who may be affected by or involved in responding to a spill, for example, by supplying response equipment, such as the Australian Marine Oil Spill Centre (AMOSC).

The OSCP has been developed in consultation with State and Federal Statutory Agencies including the WA Department of Transport (DoT) and Australian Maritime Safety Authority (AMSA). The OSCP outlines:

- VOGA's incident response structure and function and interfaces with external response agencies;
- the incident notification requirements for the relevant State and Federal agencies;

- the potential spill scenarios, trajectory modelling and zones of potential impact;
- the response options, including net environmental benefit analysis, response constraints and logistics arrangements; and
- the testing and monitoring arrangements to ensure the performance standards for the plan and equipment are maintained.

In the event of a spill, immediate notifications will be made as detailed in the Wandoo Field OSCP [WAN-2000-RD-0001]. All resources for the spill category will be activated as per the OSCP. In the event of a spill, the incident action planning formally documents and communicates the:

- incident objectives;
- effectiveness of the response strategies;
- status of assets;
- operational period objectives; and
- response strategies defined by the Incident Commander during response planning.

The Incident Command Team will evaluate the response strategies provided in the OSCP based on the actual circumstances of the spill to ensure the response is appropriate to the nature and scale of the risks and to demonstrate that the risks are reduced to ALARP. The Incident Command Team will use monitoring and evaluation data to understand the behaviour and likely trajectory of the oil spill to evaluate the appropriate spill response strategy. To ensure the spill strategy is achieving the desired environmental outcomes, performance measures are established to support the assessment of the response strategy. If the review process determines that a strategy is not 'effective', the incident action planning process provides the flexibility to adjust the response strategy or reallocate resources if necessary.

Feasible oil spill response strategies include:

- source control;
- monitoring and evaluation;
- chemical dispersion;
- containment and recovery;
- mechanical dispersion;
- protection and deflection; and
- shoreline clean-up.

The potential impacts of each spill response strategy have been assessed to demonstrate the strategies are acceptable and reduce the consequences of the spill to ALARP. Equipment and capability requirements were also defined and reviewed to ensure that spill response resources were supporting the management of the spill risks to ALARP. The results are documented in the Oil Spill Capability Review [VOG-2000-RY-0037] and a summary of the capability is provided in the form of a resource list in the Wandoo Field OSCP [WAN-2000-RD-0001].

8 Consultation

VOGA continues to consult with a range of stakeholders to meet the following objectives:

- initiate and maintain open communications between stakeholders and VOGA;
- ensure stakeholders are kept informed of VOGAs activities;
- provide stakeholders with an opportunity to provide feedback on VOGAs activities;
- establish an open and transparent process for engagement;
- manage any concerns raised by stakeholders regarding VOGAs activities; and
- provide a means for recording all communication and/or consultation, issues raised and responses.

During the period November 2013 to July 2014, VOGA engaged with the key stakeholders by telephone and email, and held briefing meetings (when necessary) to present an overview of its current and planned operations, the OSCP and spill modelling and to seek feedback and comment. No objections or issues were received.

Stakeholders engaged during the development of the EP and OSCP are listed in Table 8-1.

Table 8-1: Summary of stakeholders

Group	Stakeholders
Relevant Government Regulators/Agencies	Australian Fisheries Management Authority
	AMSA
	AMOSC
	Dampier Port Authority
	WA DMP
	WA DoT
	Department of Fisheries
	WA Department of Parks and Wildlife (DPaW)
	City of Karratha (formerly Shire of Roebourne)
	State Emergency Service - Karratha
Interested Agencies	WA Fishing Industry Council
	Australian Petroleum Production and Exploration Association
Interested Fisheries	Recfishwest
	Mackerel Managed Fishery
	Onslow Prawn Managed Fishery
	Pilbara Trawl/Trap/Line Managed Fisheries
	Pearl Oyster Managed Fishery
	Bech de Mer Fishery
	Marine Aquarium Managed Fishery
	Specimen Shell Managed Fishery
	Pearl Oyster Managed Fishery

VOGA remains committed to ongoing two-way consultation with interested parties in relation to the progress of its EP and with respect to the company's broader commitment to thorough stakeholder engagement around its production operations in the Wandoo field.

In addition to external project stakeholders, VOGA has also engaged a number of consultants and subject experts to provide professional advice during the development of the EP and other relevant project documentation e.g. AMOSC.

VOGA will review all responses obtained from stakeholders during the ongoing consultation process and consider the implications for Wandoo Facility operations, making changes and revising the EP as appropriate.

As the modelled dispersion area for the worst case credible spill scenario and the identified sensitive resources boundary crosses into State waters, additional stakeholders were identified as requiring consultation. This included DPaW, DMP and DoT.

A dedicated email address and contact number will be made available to interested parties wishing to contact the company. This will provide the opportunity for stakeholders and interested parties to raise any questions they may have with respect to VOGAs activities in the Permit Area. All enquiries will be captured in the VOGAs stakeholder management system and VOGA will endeavour to respond to all incoming inquiries promptly and thoroughly.

9 Contact details

For further information about the Wandoo Facility Environment Plan (WPA-7000-YH-0007), please contact:

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APPENDIX

Appendix A. Environmental impacts and risks

Table 0-1: Summary of environmental hazards, potential impacts and preventative and mitigation measures

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
Liquid hydrocarbon release from wells	Toxic effects on marine organisms and decline in water quality.	Wellhead pressure control equipment (e.g. BOP) installed on well.	Isolation of wells as part of the facility Emergency Shutdown (ESD).
		Contractor evaluation and selection process.	BOP.
		Wellhead valves and seals are designed to API standard.	Subsurface shutdown valve (SSSV).
		Detailed program for each well activity to communicate the intended work scope and the well barriers to be in place during the campaign.	Wandoo Emergency Response Plan/ Wandoo Field OSCP.
		Maintenance of wellhead valves and seals.	
		Annual leak off test on wellhead valves and seals.	
		Annulus integrity monitoring/ Down-hole sand control.	
		Well designed with erosion tolerances/corrosion monitoring/ Corrosion inhibition treatment/ Sacrificial anodic protection/ NDT inspection.	
		Asset integrity management system to maintain performance to relevant codes and standards as per facilities basis of design.	
		Independent design validation/verification for life extension.	
		Platform location published in Notice to Mariners and Marine Charts/500 m exclusion zone.	
		Marine Operations Manual [WNB-1000-YV-0001].	
Liquid hydrocarbon release from export equipment, submarine hose, floating hose, export flow lines, subsea pipelines	Toxic effects on marine organisms and decline in water quality.	Breakaway coupling on floating export hose.	Monitoring and reconciliation (between tanker and platform off-take metering) on export volume transferred.
		Tanker position controlled by support vessel.	ESD.
		Marine export facility is designed to hold tanker of maximum 100,000 DWT with maximum bow to centre manifold distance 130 m.	Wandoo Emergency Response Plan/ Wandoo Field OSCP.
		Export/CALM Buoy terminal location published in Notice to Mariners and Marine Charts, and the AMSA is notified of the location of the Facility.	

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
		Cautionary zones around the subsea production systems are marked on field navigational charts.	
Crude oil spill from CGS	Toxic effects on marine organisms and decline in water quality.	Basis of design includes weather criteria, corrosion allowance, impact energy, and fatigue life.	Wandoo Emergency Response Plan/ Wandoo Field OSCP.
		Platform life extension to operate beyond Basis of Design life.	
		Platform location published in Notice to Mariners and Marine Charts/500m exclusion zone.	
		Permission required for field entry, CALM Buoy approach and mooring-up and departure.	
		SIMOPS matrix defines controls to be implemented when multiple vessels are in field.	
		Attending vessel maintains tanker position so that it cannot maintain position in the southern quadrant of the CALM Buoy.	
		Tanker engines are place in standby when winds above 25 knots from the north.	
Environmental impact from oil spill response activities	Increased entrained fraction of hydrocarbons in the water column after adding dispersants. Toxicity effects on marine fauna from dispersant. Disturbance to benthic habitat, adjacent vegetation and other environmentally sensitive areas. Scouring of sediments. Waste generation, disposal and management.	NEBA of response strategies outlined in IAP.	Environmental monitoring of impact of the spill and response strategies.
		Application of dispersant in accordance with dispersant application zones/ Dispersant selection.	
		Mechanical dispersion zones.	
		Placement of containment and recovery equipment and protection and deflection booms.	
		Prioritisation of protection and deflection measures to minimise the need to access shoreline breeding/nesting and other sensitive areas.	
		Shoreline assessment/ Use of appropriate shoreline clean-up techniques.	
		No anchoring within sensitive benthic receptors (coral reef and seagrass meadows) unless NEBA demonstrates a net environmental benefit.	
		Implement oiled wildlife response in accordance with OSCP.	
Diesel spill to sea	Toxic effects on marine organisms and decline in water quality.	Breakaway coupling along hose to prevent spill due to vessel loss of position.	SOPEP for vessels addresses potential spill response.

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
		Permission required for field entry, CALM Buoy approach and mooring-up and departure.	Wandoo Emergency Response Plan/ Wandoo Field OSCP
		Pressure rating of the diesel hose exceeds the maximum pressure from the vessel pump.	
		Refuelling is undertaken only during periods of calm weather and in daylight hours or at night time using artificial lighting to allow full hose to be visible and leaks to be detected.	
Discharge of PFW and ballast water from Facility	Toxicity effects to marine organisms from OIW and chemicals (biocide, corrosion inhibitor, water clarifier, scale inhibitor, O_2 scavenger) in PFW and ballast water. Decline in water quality associated with lowered dissolved oxygen concentrations as a result of elevated water temperature.	PFW is treated in the Produced Formation Water Treatment Plant (PFWTP) to minimise the OIW concentration, and OIW concentration is monitored.	No suitable controls identified.
		Maintain the PFW daily discharge flow rates within maximum limits during normal production conditions.	
		Environmental monitoring of PFW/Ballast water discharge is conducted to ensure ZPI doesn't increase.	
		Appropriate dosing ratios of chemicals are confirmed by continuous metering and weekly stock taking of all production chemicals.	
		Biociding is performed only while PFW is diverted inboard until the THPS test indicates background levels.	
		Only chemicals selected in accordance with the VOGA chemical assessment process are used.	
		Continuous OIW monitoring with low and high level OIW alarms.	
Noise	Injury to hearing or other organs of marine fauna. Masking or interfering with biologically important sounds. Disturbance leading to behavioural changes or displacement of fauna.	No management measures identified for facility since: • Firewater pumps only run for critical function testing for a short time or for firefighting; and • Cooling water pumps will have minimal impact since pump motors are located on deck.	No suitable controls identified.
		Within the field support vessels avoid (where practicable): • Approaching closer than 100 m of a cetacean or whale shark known to be in the area. • Changing course or speed if a dolphin approaches the vessel or comes within 100 m.	

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
		For geophysical and hydrographic surveys, if cetacean comes within 100 m of the survey vessel, the survey will be postponed.	
Atmospheric emissions	A localised reduction in air quality due to contribution to global greenhouse gases. A localised reduction in air quality due to particulate matter from diesel combustion.	Detection to confirm both pilot burners are functioning with alarm if they go out.	No suitable controls identified.
		Low sulphur diesel is used for vessels re-fuelling in Dampier, in accordance with MARPOL 73/78 Annex VI requirements to minimise SOx emissions.	
		Use of HFO is not permitted within the Field (except tankers).	
		Emissions associated with power generation are eliminated on Wandoo A and CALM Buoy by utilising renewable energy.	
		Low sulphur diesel is used for power generation, in accordance with MARPOL 73/78 Annex VI requirements to minimise SO_x emissions.	
		Low sulphur diesel is used for diesel powered equipment on Wandoo A and B.	
Artificial light	Disorientation, attraction or repulsion of marine fauna and birds. Altered foraging and breeding behaviours.	No suitable controls identified.	No suitable controls identified.
Discharge of cooling water from WPF	Minor thermal impacts to marine organisms. Localised reduction water quality.	No suitable controls identified.	No suitable controls identified.
Vessel and Facility deck drainage and vessel bilge water discharge	Reduction in water quality. Toxicity effects to marine organisms in the immediate vicinity of the discharge.	Biodegradable detergents used during wash-down activities.	No suitable controls identified.
		All designated chemical storage areas, wellhead and manifold areas are bunded.	
		Drip trays or temporary bunds are used where required to contain potential residual spills.	
		Drainage from production areas is collected through the open drain system and stored in the open drain tank, from where it is transferred to a waste isocontainer.	
		All designated chemical storage areas and hydrocarbon process areas are bunded.	
		Drainage from decks in hazardous areas is collected through and open hazardous and open non-hazardous drain system. The oil is transferred to the CGS and water discharged overboard.	
		No bilge discharge within the exclusion zone.	

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
Discharge of sewage, greywater and putrescible waste from Facility and vessels	Nutrient enrichment and increased biological demand of surrounding waters. Low level contamination of organisms caused by ingestion of waste materials. Increase in scavenging behaviour of marine fauna and seabirds.	Sewage effluent from the Wandoo B Platform is macerated to pass through a 25mm mesh (as required under MARPOL).	No suitable controls identified.
		Food waste from the Wandoo B Platform is macerated to pass through a 25mm mesh (as required under MARPOL).	
		Biodegradable, low phosphate detergents will be used in laundry.	
		Vessel> 400T or certified for >15 persons must comply with MARPOL 73/78 (Regulation 11 Annex IV) including: • Equipped with either a sewage treatment plant or sewage comminuting and disinfecting system or a sewage holding tank; • Wastes shall be macerated to <25mm prior to discharge; and • Untreated sewage will be stored on-board in suitable holding tanks and disposed of onshore at a reception facility or to a carrier licensed to receive the waste, or discharged at a distance of more than 12 nautical miles from the nearest land.	
Discharge of desalination brine	Localised elevation in seawater salinity. Localised reduction in water quality.	No suitable controls identified.	No suitable controls identified.
Non-hazardous and hazardous waste	Marine pollution (litter). Injury and entanglement of marine fauna and seabirds. Potential toxicity effects to marine fauna. Land and onshore groundwater contamination.	Recyclable wastes will be segregated on the Facility prior to being sent onshore for recycling by a waste contractor.	No suitable controls identified.
		Inert solid wastes will be sent onshore for collection by a licensed waste contractor for disposal in the Karratha Landfill.	
		"Not readily biodegradable" putrescible galley waste is to be bagged in the galley for disposal in the Karratha Landfill. Putrescible solids generated on the Facility will be discharged to the ocean following maceration or treatment.	
		Solid low-level hazardous waste is collected in general hazardous waste bins before being sent to a licensed waste contractor for disposal.	
		Filters are placed in the flammable filter skip before being sent to a licensed waste contractor for disposal.	

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
		Waste oils and contaminated water and put into drums. Content is recycled for oil separation and drums are recycled by a licensed waste contractor	
		Greases are collected in drums and sent to a licensed waste contractor for disposal.	
		Miscellaneous chemical waste (including laboratory waste, corrosion inhibitor, acids, alkalis, biocides adhesives), is collected in waste drums and sent to a licensed contractor.	
		Flammable liquid wastes, production sand and process sludge are collected in drums and sent to a licensed waste contractor for disposal.	
		Medical waste is collected in dedicated bins and sent to third party medical facility.	
		Skips storing loose solid material either have lids or are covered by tarps. Liquid containers are closed for transport.	
Use and discharge of chemicals for maintenance and inspection activities	Reduced water quality. Toxicity effects to marine organisms.	All hazardous liquid chemicals are stored in bunded areas/chemical cradles.	No suitable controls identified.
		Only chemicals selected in accordance with the VOGA chemical assessment process are used.	
		A THPS test is undertaken to ensure the biocide has depleted to sufficiently low activity prior to discharge to the sea, in accordance with the Wandoo Platform Operations Manual [VOG-7000-MN-0001].	
		Pigging/hydrotesting/flushing procedures are developed on the case-by-case basis to minimise potential hazardous waste release and impact assessed.	
		Sulphamic acid is neutralised with caustic soda prior to discharge.	
Disturbance with marine fauna and seabirds (from logistics activities)	Potential injury/death and/or temporary and localised displacement of marine fauna or seabirds.	Within the Field, support vessels avoid (where practicable): • Approaching closer than 100m of a cetacean or whale shark known to be in the area; and • Changing course or speed if a dolphin approaches the vessel or comes within 100m.	No suitable controls identified.
Liquid hydrocarbon release from topsides process	Hydrocarbon release of up to 100 m^3 of oil to sea.	Facility Basis of Design includes AS1210.	Platform ESD.
		Pressure safety valves.	Topsides hazardous drains and bunding.
		Bursting disc (Wandoo B only).	ERP/OSCP.
		Automated process shutdown when process pressure exceeds specified value.	

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
		Isolation controls to ensure drainage, venting and positive isolation prior to performing a process break-in.	
Ancillary hydrocarbon or chemical spills	Hydrocarbon/chemical loss to sea causing environmental damage	Intermediate Bulk Containers (IBCs) are transferred to/from vessel using a chemical cradle.	Hydrocarbon and chemical spill containment and clean-up material.
		IBCs, including lifting lugs, are certified.	Wandoo Emergency Response Plan/ Wandoo Field OSCP.
		All chemicals are stored in bunded areas.	
		All liquid waste containers will be closed to prevent loss overboard.	
		Only chemicals selected in accordance with the VOGA chemical assessment process are used.	
Physical presence of infrastructure	Disturbance to marine fauna including marine mammals, reptiles and birds. Interaction with commercial and recreational fishing and shipping. Provision of an artificial habitat for benthic and pelagic organisms. Changes to visual amenity. Seabed scour	Functional communication equipment on board Facility to communicate with vessels in the vicinity of the Facility.	No suitable controls identified.
		Consultation/notification with relevant stakeholders including AusCoast/AMSA notification as required.	
		Wandoo facilities gazetted on navigational charts.	
		Bird deterrents are used on Wandoo A.	
Seabed disturbance	Seabed scour. Increase in turbidity of the water column/reduction light penetration. Localised smothering of benthos. Localised reduction in benthic productivity.	Presence of scour protection around CGS.	No suitable controls identified.
Discharge of ballast water from vessels	Changes to habitat structure. Predation of native species. Potential introduction of invasive marine species.	Vessels from outside Australian waters are required to meet AQIS Guidelines including those on ballast water exchange, pest management, bio-fouling, human health (on-board), quarantine waste and previous cargoes.	No suitable controls identified.
		Vessels must have a quarantine inspection certificate and antifouling coatings that complies with the requirements of Annex 1 of the International Convention on the Control of Harmful Antifouling Systems on Ships.	

Source of Risk (Hazard)	Potential Environmental Impact	Preventative Control Measures	Mitigation Control Measures
		Bio-fouling on vessels will be managed as per the National Bio-fouling Management Guidance for the Petroleum Production and Exploration Industry (2009).	
Liquid hydrocarbon release from flow lines and risers	Liquid hydrocarbon release to environment, i.e. 0.8 m^3 of oil to sea.	Down-hole sand control.	Platform ESD will close riser shutdown valve.
		Marine Operations Manual.	Wandoo Emergency Response Plan/ Wandoo Field OSCP.
		Pigging procedure specifies correct valve sequence.	
		Codes and standards as per facilities' Basis of Design.	
		Platform life extension - Fitness for service assessments for continued service.	
		Platform location published in Notice to Mariners and Marine Charts/500 m exclusion zone.	