

## **Nganhurra FPSO Environment Plan Summary**

### **Operations Overview**

Woodside Energy Ltd. (Woodside) is part owner and operator of production licence WA-28-L (previously part of exploration permit WA-271-P). Woodside has made a number of hydrocarbon discoveries within the WA-271-P permit and has constructed the Nganhurra Floating Production Storage and Offloading (FPSO) facility to produce from the wells in the Enfield area. The Nganhurra FPSO is approximately 38 km off the coast, about 2 km to the east of the Enfield reservoir and is in water depth of approximately 400 m. The coordinates of the FPSO are 189 895 mE, 621 658mN GDA94.

The Nganhurra FPSO is a standard Suezmax of double hulled construction with a cargo storage capacity of approximately 143,000 m<sup>3</sup> (900,000 barrels) and it is equipped with a disconnectable mooring and its own propulsion system to allow evasion of tropical cyclones. In normal 24 hour operations, an offshore crew averaging 29 personnel is accommodated onboard. The topsides processing facilities consists of oil/water/gas separation systems, water injection and gas compression equipment.

Reserves are extracted using subsea wells with flowlines tied back to the Nganhurra FPSO. Gas-lifted wells are used to produce the Enfield fluids. Water injection wells are required for the disposal of produced water supplemented by injection of seawater to provide reservoir support for Enfield. Excess gas is reinjected into the reservoir.

### **Environment**

Prevailing winds in the region are from the southern and south-western quadrants during summer (October-March) and from the eastern, south-eastern and southern quadrants during winter (May-August). During the transition months of April and September, both summer and winter air flows may be expected. Cyclones in the area most frequently occur between January and March, but they have been recorded from November to May. Local currents flow predominately towards the southern and western quadrants from August to April, with the exception to this being October, when a significant portion of the currents move towards the northern and eastern quadrants. During May-July there is a more variable pattern with significant current flows towards the northern and eastern quadrants as well as strong southern and western flows.

WA-28-L is situated in an area with water depths ranging between 100 m and 2,000 m, and consequently it contains no inter-tidal or supratidal environments. The seabed in this area is dominated by a north-south trending scarp and several east-west trending submarine canyons. The majority of the seabed in the area is generally featureless and consists of fine to medium sediment (silts and sands). Biological seabed surveys conducted across the licence area have indicated that benthic communities across the shelf and slope are typical of the north western Australian region. Abundance and diversity of benthic organisms in the area generally decreases with depth, with the greatest abundance and diversity of biota observed on the continental shelf, in depths to 150 m. Biota are generally more abundant and diverse around areas of complex seabed topography or coarse sediments.

Surface waters around the FPSO location typically contain a sparsely distributed and ocean-travelling marine life, including whales and whale sharks and other pelagic fish such as mackerel, tuna, marlin and sailfish. Humpback whales migrate through the area between June and December, while pygmy blue whales have been recorded in low numbers in offshore waters of the region throughout the year. Seabirds also occur offshore, where they may raft on the water surface. Resources of ecological significance in the offshore waters of the licence area are thus typically mobile species mostly occurring in low numbers and widely dispersed.

### **Community**

There are several commercial fisheries operating within the region including the Western Tuna and Billfish Fishery (Commonwealth) and Commonwealth wetline Fishery and Deepwater Trawl Fishery. The Exmouth Gulf Prawn Fishery, the Pilbara finfish area and the Pilbara Trawl Fishery operate in coastal waters to the south east and north east of the licence area. A number of small pelagic long

liners also operate out of Exmouth Marina. The licence area falls within Zone 1 of the Pearl Fishery, though no activity takes place in the deep waters of the licence area.

Recreational and game fishing is also common in the region, and is mainly concentrated in coastal and inshore areas. Tourism is one of the major industries in the region and contributes significantly to the local economy in terms of both income and employment, and generally includes nature-based activities such as snorkelling and scuba activities, whale shark encounters and whale watching. The main tourism season is between April and October. The licence area does not impinge on any existing or proposed marine parks or nature reserves, with the FPSO located approximately 21 km from the northern boundary of the Ningaloo Marine Park (Commonwealth Waters).

There are no defined shipping lanes in the North West Cape Region, however, there are general shipping routes running in a due north-south direction up the coast which turn in a north to easterly direction north of Exmouth. Shipping vessels keep outside the Ningaloo Reef and some therefore pass directly through licence area.

There are no known sites of Aboriginal or European cultural significance within the licence area.

### **Stakeholder Consultation**

Woodside undertakes significant consultation with the community and government departments as part of the approval process for the construction and operation of its production facilities and related support activities. There have been a number of meetings between Woodside and the DoIR and the Department of the Environment and Heritage throughout the development of the Enfield oil project. Community Reference Groups (CRG) have been in place since 2002 in Perth and Exmouth to provide a forum inform and update stakeholders on current and future activities. CRG meetings have been conducted on a regularly basis, with participants including government and non-government organisations, industry associations and community groups such as:

- Dept. of Conservation and Land Management
- Dept. of Fisheries
- Australian Marine Conservation Society of WA
- Conservation Council of WA
- APPEA
- North West Cape Exmouth Aboriginal Corporation
- Dept. of Industry and Resources
- Marine and Coastal Community Network
- Cape Conservation Group
- Exmouth Shire Council
- Gascoyne Development Commission
- Exmouth Charter Boat Operators Association

Woodside also has in place an external communication strategy which is described in “Receiving, documenting and responding to External Queries” and also in the Woodside’s External Affairs Management System.

The Nganhurra Operations Manager, General Manager – Operations, Woodside General Manager - Environment and the Operations Environmental Advisor also communicate regularly with DoIR to discuss various operational aspects. This includes regular quarterly meetings between Woodside and the DoIR, which provide a forum to overview and discuss ongoing plans and operational issues with regard to legislative requirements, and to provide feedback on environmental performance against environmental commitments.

### **Management of the Nganhurra**

The Nganhurra FPSO will be managed in accordance with the Woodside Management System (WMS) framework. The WMS outlines the way in which business risks, including health, safety and environment (HSE) risks, are managed using the operations, HSE, human resources and other business processes. The HSE Business Process component of the WMS provides a systematic means for identifying hazards and managing risks in order to protect people, plant and the environment. Implementing and complying with the WMS and the associated business process requirements is the direct responsibility of everyone associated with the Nganhurra FPSO.

The WMS and Woodside business processes are continuously improved through a modified plan-do-check-adjust management continuum which includes:

- Plan – Objectives & Leadership Commitment, Capability, Risk Management and Planning & Processes;
- Do – Planning & Processes and Management of Change;
- Measure & Improve – Management Reviews & Audits; and
- Learn & Share – Learning & Knowledge Sharing.

The major environmental hazards on the Nganhurra FPSO as identified via the Environmental Risk Assessment process include:

- Fuel Consumption and Exhaust Emissions;
- Loss of Large Quantities of Hydrocarbons;
- Commissioning Flaring; and
- Operational Flaring.

A summary of the controls and mitigation measures in place to manage these major hazards and to ensure that the risks levels are both tolerable and as low as reasonable practicable (ALARP) is provided in the table below.

Major Hazard	Controls and Mitigation Measures
Fuel Consumption and Exhaust Emissions	<p><u>Design</u></p> <ul style="list-style-type: none"> <li>• Control and protection systems on the fuel treatment system (eg. liquid knockout and dewpoint control).</li> <li>• A waste heat recovery system is incorporated into the power generation units, with waste heat used for process heating.</li> <li>• Use of an N+1 philosophy, where the “+1” is offline and allows for maintenance, and N best matches load.</li> <li>• Hot and cold process streams interchange heat in the process design.</li> <li>• Each turbine and prime mover has its own flow meter and control system.</li> </ul> <p><u>Operations</u></p> <ul style="list-style-type: none"> <li>• Daily monitoring of equipment performance during operator daily rounds.</li> <li>• Daily recording of fuel gas usage.</li> <li>• Scheduled maintenance routines on equipment including instrument calibrations.</li> <li>• Piping and valving configuration allows each gas turbine to be worked on, and operated independently.</li> <li>• The Solar power generation turbines are overhauled approx. every 30,000 hrs (5 yrs) with new or refurbished equipment.</li> <li>• Monitoring and reporting of fuel gas usage as a KPI – including daily reports, monthly production summary, monthly HSE Performance reports, NPI reporting, and Greenhouse Challenge reporting.</li> </ul>
Loss of Large Quantities of Hydrocarbons	<p><u>Design</u></p> <ul style="list-style-type: none"> <li>• Wellhead valve design and configuration allows safe operation and control of the well (open water trees)</li> <li>• Design and certification of drilling equipment, including completion tubing and wellhead.</li> <li>• Wells are provided with a sub surface safety valve (SSSV) which automatically shut the well in if surface pressure control is lost.</li> <li>• Wells have an ESD system and can be shutdown automatically or manually to prevent excursions or limit a failure.</li> <li>• Cathodic protection and anti-fouling treatment provided to prevent corrosion and fouling growth.</li> <li>• Subsea and surface valves are provided to isolate flowlines from the facility and vice versa.</li> <li>• Ability to shut-in and depressurise flowlines.</li> <li>• Shutdown systems – automatic and manual.</li> <li>• Both diesel and cargo storage tanks are double hull protected.</li> <li>• Steel bulkhead is provided between the engine room and the diesel storage tanks.</li> <li>• Offloading hose is stored on hose reel rather than being left in the water in between offtakes.</li> <li>• Breakaway coupling used on diesel bunkering and offtake hoses.</li> <li>• Safety features built into design such as shutdown system, blowdown system, fire and gas detection system, fire protection system, emergency disconnect system, flare system.</li> <li>• Control features built into the design such as drainage systems, including slops tanks, process control system.</li> <li>• Scupper plugs in place on FPSO decks.</li> <li>• Fish plate around deck.</li> <li>• Passing vessel detection, including AIS, ARPA, RACON, navigational lights, fog signal.</li> </ul> <p><u>Operations</u></p> <ul style="list-style-type: none"> <li>• Specific controls for work-over or re-entry operations, including: use of lubricator downhole plugs / oblique barriers and horizontal completions.</li> </ul>

	<ul style="list-style-type: none"> <li>• Operating wells within technical envelope.</li> <li>• When drilling – overbalanced drilling and optimised mud weight selection based on expected pore pressure, in-situ stress constraints and fracture gradients.</li> <li>• Inspection and monitoring of flowlines and other subsea equipment under the ROV programme.</li> <li>• Exclusion zone around facility and all wellheads and flowlines with no anchoring in exclusion area.</li> <li>• Wellheads are included on navigational charts.</li> <li>• Watching brief for operators; indication of silvery sheen may indicate leak.</li> <li>• Monitoring of pressure, temperature, flowrate, etc.</li> <li>• Both diesel and cargo storage tanks are double hull protected.</li> <li>• Steel bulkhead is provided between the engine room and the diesel storage tanks.</li> <li>• Offloading hose is stored on hose reel rather than being left in the water in between offtakes.</li> <li>• Breakaway coupling used on diesel bunkering and offtake hoses.</li> <li>• Safety features built into design such as shutdown system, blowdown system, fire and gas detection system, fire protection system, emergency disconnect system, flare system.</li> <li>• Control features built into the design such as drainage systems, including slops tanks, process control system.</li> <li>• Scupper plugs in place on FPSO decks.</li> <li>• Fish plate around deck.</li> <li>• Passing vessel detection, including AIS, ARPA, RACON, navigational lights, fog signal.</li> <li>• Well bore stability modelling for reservoir and overburden formations.</li> <li>• Well shut in testing is conducted to ensure that in the event of a spill well can be shut in to prevent escalation of the incident.</li> <li>• Flow rates and sand production is monitored to provide information for management of the reservoir and to mitigate erosion effects.</li> <li>• All spills &gt;1 litre (contained and uncontained) are reported internally.</li> <li>• Training of FPSO and supply vessel crew is undertaken for operational and emergency roles, including AMOSC Spill Response Training.</li> <li>• 24 hr standby oil spill modelling capability.</li> </ul>
<p>Commissioning Flaring</p>	<p><u>Design</u></p> <ul style="list-style-type: none"> <li>• Onshore commissioning of gas compressor.</li> <li>• Early start-up of the gas compression and fuel gas systems.</li> <li>• Vessel, piping and control systems designed to avoid lifting PSV.</li> <li>• Knockout vessels and piping slopes to prevent liquids carry over.</li> <li>• Flare tip specified/designed for base load flaring and emergency flaring.</li> <li>• Logic used in the Cause and Effects.</li> <li>• Blowdown valves provided with limit switches to indicate they may have failed open. Shutdown valves also have limit switches to advise if failed to close.</li> </ul> <p><u>Operations</u></p> <ul style="list-style-type: none"> <li>• Operators monitor the process in the control room on a continuous basis.</li> <li>• No process start up until flare pilots are ignited.</li> <li>• Leak testing after maintenance to avoid leaks resulting in an ESD.</li> <li>• Routine PSV change out and inspection.</li> <li>• Operational checks performed on SDV, BDV, etc.</li> <li>• Trip review process.</li> <li>• Inspections of flare system and scheduled physical inspections.</li> <li>• Alarms to CCR – eg BDV fails open, SDV fails to close.</li> <li>• Auto shutdown, and total depressurisation of system under emergency circumstances.</li> <li>• Depressurisation of flowlines and shut in of wells undertaken as a safety response to an emergency shutdown.</li> <li>• Routine inspections by operators for noise, condensation, or icing downstream of valves to indicate leaking valves.</li> <li>• Acoustic leak detectors can be used downstream of suspect valves.</li> <li>• Monitoring by camera.</li> <li>• HP/LP flare gas flow meters to monitor volumes flared.</li> <li>• Monitoring and reporting of volume of gas flared as a KPI – including daily reports, monthly production summary, monthly HSE Performance reports, NPI reporting, and Greenhouse Challenge reporting.</li> </ul>
<p>Operational Flaring</p>	<p><u>Design</u></p> <ul style="list-style-type: none"> <li>• Reinjection of surplus gas.</li> <li>• Dry gas seals on compressors.</li> <li>• Insulated flowlines to allow faster restarts and minimise flaring.</li> <li>• Facility equipment and control system design and shutdown logic.</li> <li>• Vessel, piping and control systems designed to avoid lifting PSV.</li> <li>• Knockout vessels and piping slopes to prevent liquids carry over.</li> <li>• Flare tip specified/designed for base load flaring and emergency flaring.</li> <li>• Logic used in the Cause and Effects.</li> <li>• Blowdown valves provided with limit switches to indicate they may have failed open. Shutdown valves also</li> </ul>

	<p>have limit switches to advise if failed to close.</p> <p><u>Operations</u></p> <ul style="list-style-type: none"><li>• Re-pressuring of the production system undertaken in a controlled manner to provide progressive test of systems and assurances of integrity prior to resumption of production.</li><li>• No process start up until flare pilots are ignited.</li><li>• Leak testing after maintenance to avoid leaks resulting in an ESD.</li><li>• Routine PSV change out and inspection.</li><li>• Operational checks performed on SDV, BDV, etc.</li><li>• Trip review process.</li><li>• Inspections of flare system and scheduled physical inspections.</li><li>• Alarms to CCR – eg BDV fails open, SDV fails to close.</li><li>• Auto shutdown, and total depressurisation of system under emergency circumstances.</li><li>• Depressurisation of flowlines and shut in of wells undertaken as a safety response to an emergency shutdown.</li><li>• HP/LP flare gas flow meters to monitor volumes flared.</li><li>• Routine inspections by operators for noise, condensation, or icing downstream of valves to indicate leaking valves.</li><li>• Acoustic leak detectors can be used downstream of suspect valves.</li><li>• Monitoring by camera.</li><li>• Monitoring of performance against Annual HSE Plan objectives.</li><li>• Monitoring and reporting of volume of gas flared as a KPI – including daily reports, monthly production summary, monthly HSE Performance reports, NPI reporting, and Greenhouse Challenge reporting</li></ul>
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**Further Information**

For further information about Woodside’s Enfield oil operations or related activities off North West Cape please contact:

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