An overview of the offshore petroleum lifecycle

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The National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) is the regulator for health and safety, well integrity and environmental management for offshore petroleum activities in Commonwealth waters and in coastal waters where regulatory powers and functions have been conferred.

NOPSEMA

nopsema.gov.au

Legislative framework

Offshore acreage release

The Australian Government facilitates investment in, and development of, Australia's offshore petroleum resources. Each year offshore areas, or 'acreage', with petroleum potential are opened up to bids from companies interested in exploring for oil and/or gas.

Prior to this annual acreage release, the Department of Industry, Innovation and Science (DIIS) consults with state and Northern Territory (NT) government agencies with direct responsibilities for managing the marine environment. The proposed release areas are also made available for public comment to ensure persons with an interest in a specific area may provide feedback.

Following consultation and public comment, the proposed release areas are provided to the Joint Authority (JA) for consideration. The JA is comprised of the relevant Commonwealth, state or NT resources ministers (or their delegates). The JA provides final approval of the offshore areas that comprise the annual acreage release. Companies are then invited to bid on the release areas which, ordinarily, comprise a work program of proposing exploration activities such as seismic surveys and the drilling of wells.

Granting of a petroleum title

Bids on the annual acreage release are assessed by the National Offshore Petroleum Titles Administrator (NOPTA). It is NOPTA's role to provide advice to the JA based on their assessment so that the JA may make the final decision as to the winning bids.

On behalf of the JA, NOPTA grants the company or companies of a winning bid an exploration permit. An exploration permit is a type of petroleum title that provides its holder (titleholder) with the exclusive right to undertake exploration activities within the title's offshore area. Once a permit is granted, the titleholder is required to undertake the activities proposed in their work program within a specified timeframe.

If a titleholder's exploration activities discover oil and/or gas, then it may decide to apply to the JA for a production license if the discovery is viable or a retention lease if it is not yet viable.

The granting of a petroleum title does not provide its titleholder with the necessary approval to begin an offshore petroleum activity. To begin an activity, a titleholder must have relevant risk management plans assessed and accepted by NOPSEMA. A titleholder may submit an unlimited number of risk management plans to NOPSEMA for assessment over the life of a petroleum title. Each risk management plan attracts a levy, even where the plan is ultimately rejected.

Assessment of risk management plans

Before an activity can commence, and dependent on the type of activity proposed, one or more risk management plans must be assessed and accepted by NOPSEMA. Relevant risk management plans may include a safety case, well operations management plan, diving safety management system, offshore project proposal and environment plan.

The purpose of risk management plans is to demonstrate to NOPSEMA how the activity will be undertaken in a way that reduces risks to the health and safety of the workforce and the integrity of drilled wells to a level that is as low as reasonably practicable (ALARP). Environmental risks and impacts must also be reduced to ALARP and also to an acceptable level.

NOPSEMA will only accept a risk management plan, and therefore approve an activity to commence, when it is satisfied the plan meets all legislative requirements.

For more information on the assessment and approval process of risk management plans see nopsema.gov.au.

PETROLEUM TITLE

Exploration, Short-term, Development/ Production, Infrastructure, Pipeline

RISK MANAGEMENT PLAN

- S Safety case
- W Well operations management plan
- D Diving safety management system
- O Offshore project proposal
- E Environment plan

Offshore petroleum lifecycle

Exploration and appraisal phase

Seismic surveys E

A titleholder may use seismic surveys to produce detailed images of the various rock types and their location beneath the Earth's surface to determine the location and size of an oil and/or gas reservoir. Typically, a seismic survey will involve a vessel towing a compressed air source and streamers holding acoustic sound receivers across an offshore area. The compressed air source produces sound waves that bounce off underground rock formations. The sound waves reflect back to the surface and are captured by the acoustic sound receivers. Collected data is then processed and analysed by geophysicists. To increase the accuracy of the data interpretation, the geophysicists will compare the results of their analysis with other data (such as rock samples, regional well/drilling results and known geology).

MARINE SEISMIC SURVEYS

A **two-dimensional (2D) survey** uses one seismic source and one receiver along a single line to produce an image of a single cross-section through the Earth along that line.

A **three-dimensional (3D) survey** uses one seismic source and multiple receivers to produce a highly detailed image of a specific area across multiple transects.

A **four dimensional survey (4D)** is a 3D survey repeated over the same location after some time has passed. Usually, the first survey is undertaken during the exploration phase and the second during production. Comparing the two surveys provides valuable insight into changes to the reservoir.

AN EXAMPLE OF A 3D SEISMIC SURVEY

Site surveys E

If the interpretation of seismic data identifies the potential presence of an oil and/or gas reservoir, a titleholder may choose to commence site surveys. These surveys are used to collect data on the characteristics of the various rock types beneath the Earth's surface to determine potential locations to drill wells and install subsea infrastructure. Site surveys typically involve geophysical and/or geotechnical surveys. A geophysical survey may use various methods (e.g. electromagnetic and gravity surveys) to produce a map or model of the subsurface geography, stratigraphy, rock distribution, and geological structure delineation. A geotechnical survey involves taking samples of the rock and sediment around the site location to determine its physical and chemical properties.

Drilling E S W

After collecting and analysing the information acquired through seismic and site surveys, a titleholder may choose to commence exploration drilling. This type of drilling seeks to confirm the presence of oil and/or gas in commercial quantities as well as other characteristics of the reservoir. If commercial quantities are confirmed, a titleholder may choose to commence appraisal drilling to determine the extent of the reservoir, possible flow or production rates, and other reservoir properties. Whilst exploration wells are typically plugged and abandoned, appraisal wells can become production wells, which can be suspended and re-entered at a later date.

AN EXAMPLE OF A DRILLING RIG

Design

A titleholder will typically use the information acquired through surveys and exploration and appraisal drilling to determine the optimum number and location of

wells needed to be drilled to extract all the oil and/or gas from the reservoir. When this is determined, the titleholder will then have enough information to begin the conceptual, front-end engineering, and detailed design work required to make an informed decision on whether or not to proceed to development and production. For example, this work would provide a titleholder with the technical data and definitive costs of proceeding, such as the type of production facility required to be contracted or constructed.

Development phase

Drilling and completion O E S W

A titleholder will commence drilling of a development well with the intention of it ultimately becoming a production well. Development wells can be drilled vertically, deviated or horizontally to access the oil and/or gas reservoir. If the drilling of the development well finds the reservoir then the titleholder will typically drill the well to completion (to become a production well). A titleholder may also suspend drilling of a development well with the intention of re-entering and evaluating the well at a later date. If a development well doesn't access the oil and/or gas reservoir then it is plugged and abandoned.

SUSPENDING AND ABANDONING A WELL

Suspending a well typically involves setting cement plugs that can be drilled out at a later date while abandoning a well typically involves setting permanent concrete plugs and removing infrastructure from the seafloor such as the wellhead.

Commissioning O E S W

When a titleholder has contracted or constructed a production facility then it is typically towed by a support vessel to the site of the oil and/or gas reservoir. Once the facility is onsite, the titleholder will then commence commissioning of the facility which is the process of assuring that all equipment and systems are designed, installed, tested, operated and maintained in accordance with operational requirements and the accepted risk management plans. Commissioning is generally undertaken for new projects but may be undertaken on existing equipment, systems and processes during expansion or renovation.

Production phase

O E S W

A titleholder will commence production, commonly referred to as 'operations and maintenance,' following commissioning of its production facility. This phase involves extracting oil and/or gas from the reservoir via the production well; separating the oil, gas and water; and then typically offloading the oil and/or gas for transport onshore by pipeline or tanker to be refined and marketed. Floating liquid natural gas facilities are able to refine the gas onsite and ship it directly to market. The duration and extent of the production phase is different for every project given the wide variety of oil and/or gas reservoirs and production facilities.

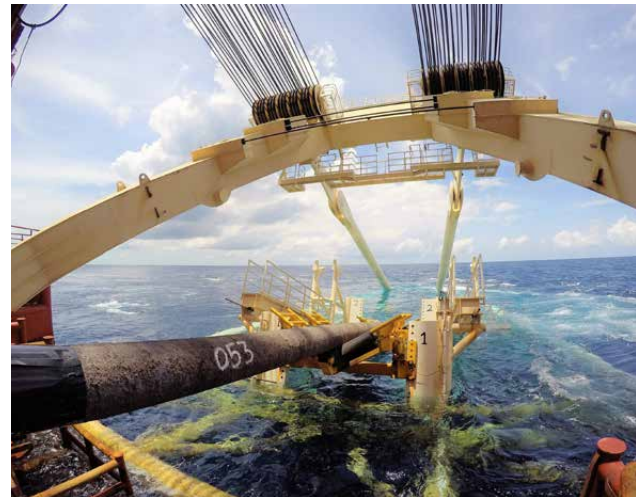
Production facilites S

The size, shape, and type of a production facility will depend on the size and composition of the oil and/or gas reservoir, the site's water depth and distance from shore. More than one production facility may be used in offshore fields with larger or multiple reservoirs. If multiple production facilities are used in the same offshore field, each requires its own safety case.

Pipelines S

All production facilities use pipelines either to join drilled wells to the facility, transport oil and/or gas between facilities and/or to onshore refineries. Pipelines may include either a single carbon steel pipeline or spiral-bound flexible lines that can range from 6–42 inches wide, and can be hundreds of kilometres long. Where a pipeline crosses into state waters and/or to an onshore refinery, relevant state approvals must be also gained.

AN EXAMPLE OF LAYING A PIPELINE



Diving operations D

Diving operations provide vital inspection, maintenance and repair support to offshore oil and gas exploration and production activities. This support can be provided for facility structures, wellheads, manifolds, risers, associated pipelines and mooring systems. Saturation divers work at great depths for prolonged periods of time. They live in a pressurised chamber on a diving support vessel, travelling to and from their worksite on the seabed in a similarly pressurised chamber called a diving bell. Before returning to normal atmospheric pressure, divers must first decompress slowly to eliminate inert gasses from their bodies or they risk decompression sickness and even death.

Modifications E S W

Throughout the offshore petroleum lifecycle, changes and modifications to an activity may occur. For example, a titleholder may choose to expand an existing activity by drilling more wells or the operator of a facility may propose to modify existing equipment, systems and processes or make changes to existing management systems. Where changes and modifications occur, revisions to risk management plans may be required.

Decommissioning phase

O E S W

When a facility reaches the end of its economic life and will no longer be used to extract oil and/or gas then the facility must be decommissioned. Decommissioning involves removing, or otherwise satisfactorily dealing with, infrastructure previously used to support the production phase of a project. Decommissioning must be undertaken in a manner that is safe and environmentally responsible and could involve removing all equipment from the offshore area, or partially removing equipment if arrangements are in place that ensures any remaining equipment meets all legislative requirements.

To date, only a few small facilities have been decommissioned in Commonwealth waters. NOPSEMA expects this to change significantly over the next two decades as production facilities that have been producing oil and/or gas for many years reach the end of their life.

NOPSEMA

Further information

NOPSEMA publishes fact sheets, brochures, reports and regulatory guidance on its website at nopsema.gov.au.

For more information about the acreage release process, visit petroleum-acreage.gov.au.

For more information about NOPTA and petroleum titles see nopta.gov.au.

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Key Legislation

Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)

OPGGS (Safety) Regulations 2009

OPGGS (Environment) Regulations 2009

OPGGS (Resource Management and Administration) Regulations 2011