4. Description of Operation and Decommissioning Phases

4.1 Offshore Field Operation - OLNG Scenario

4.1.1 Project and Reservoir Lifespans

Field life has been forecast using a minimum production rate of 150 MMscf/d raw gas production. At this point the typical average production rate of a well still producing is some 10 MMscf/d.

The resulting field life ranges from 30 to 75 years. Production declines below the plateau rate during the latter third of field life. It is assumed that gas sales contracts can be extended and managed through the decline phase of the field.

While it is recognised that the full field life ranges from 30 to 75 years, no specific design allowance has been made for extended facilities life beyond a nominal 30 years. Instead, the facilities would be managed and maintained to achieve the life required.

4.1.2 Processes

Figure 4-1 shows that the offshore production facilities are designed to deliver two products; natural gas and condensate. There will be two process trains each having a capacity of 50 percent, known as a 2×50% configuration.

The well production from the wellhead platform and the subsea wells will be manifolded on the wellhead platform and routed across the bridge to the PCUQ platform. All risers, and subsea flowlines (3) and export stabilised condensate to the FSO, will be located on the wellhead platform.

The compression and processing systems will process all wellstream fluids flowing from the field. Processing equipment will include:

- Primary separation;
- First stage gas compression;
- Gas dehydration;
- Hydrocarbon dewpoint control;
- Export gas compression;
- Condensate stabilisation and pumping;
- Produced water treatment; and
- Fuel gas systems.

Compression comprises 5×25%, two-stage centrifugal compressors.

Products include:

- Export gas routed to export gas pipeline;
- Condensate product routed to FSO; and
- Produced water.

FSO Condensate Transfer and Storage

Condensate is transported from the process facilities located on the PCUQ platform to the FSO via a 2 km long 8 inch pipeline. The barge-design FSO will be permanently moored, will weathervane about the forward turret, and will be designed to be on location throughout the field life.

The FSO will be a new build construction and designed to store 750,000 bbl of condensate. The FSO will have export cargo pumping to allow filling of shuttle tankers within 24 hours and inert gas arrangements for this capacity. Offloading will be via stern mounted floating offloading hose to shuttle tanker. Condensate will be offloaded to trading tankers on a routine basis so as not to impact on the production facilities on Sunrise, approximately once every 17 days.

Service Carriers
During operation of the offshore facility a number of support vessels and helicopters will be required. Helicopters will be employed for crew change and delivery of light and urgently needed provisions and equipment. A supply boat will operate between the onshore base and the Sunrise Platforms and FSO on a regular basis.

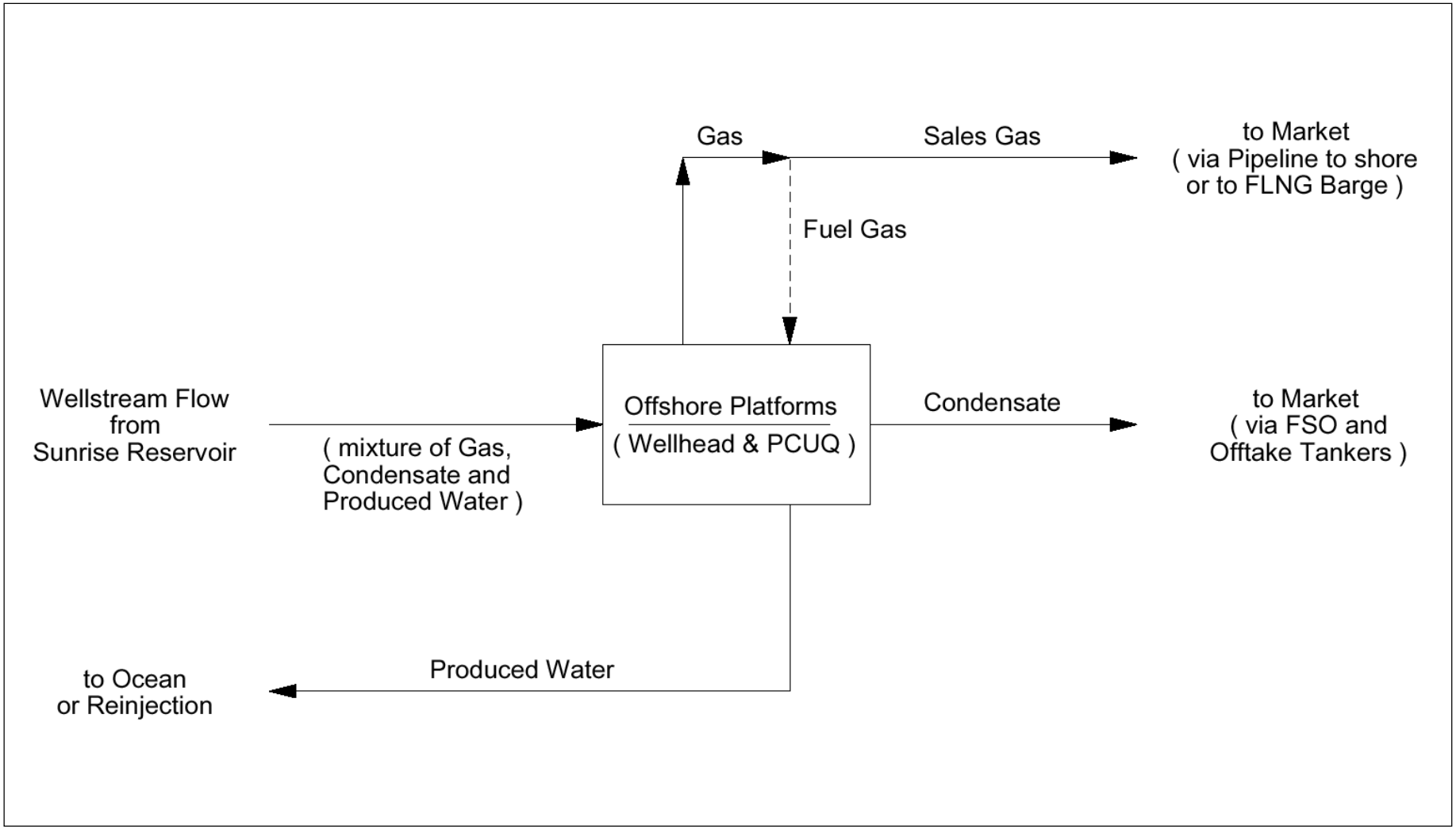
During FSO offloading, an 'offtake support' vessel will be necessary for mooring, hose connection and transport between the FSO and shuttle tanker.

4.1.3 Infrastructure and Utilities

PCUQ
As well as process and compression systems the PCUQ platform includes utility systems, living quarters, support, control and safety systems, flare tower, workshops, switchrooms and temporary refuge. Service vessels can be accessed by the pedestal crane and lay down areas are provided. The 60–100 m long trafficable bridge-link with the wellhead platform will support utility piping as well as electrical and instrumentation requirements.

The living quarters, with structurally integrated helideck is designated as the living, control and administrative centre of the platform, providing facilities for a planned 80 persons. The PCUQ will produce all required utilities, which will then be reticulated to the wellhead platform. Utilities will include:

- *Waste Heat Recovery/Heating Medium Systems*: Waste heat recovery units on the power generation turbines will supply all heating loads via a circulating heating oil circuit;
- *Cooling Water System*: A tempered water cooling system will be provided with the Sea Water (SW) Lift Pumps, seawater filtration equipment, Sea Water/Tempered Water Exchangers and Tempered Water Pumps. Completely segregated Seawater and Firewater Systems will be adopted;
- *Firewater Pump*: Two diesel engine driven firewater pumps (2x100%) will be provided;
- *Fuel*: Fuel gas, taken from downstream of glycol dehydration will undergo pressure letdown and will be superheated before use. Treated fuel gas will be supplied for use in the power generation dual fuel turbines. (Diesel can be used as an alternative fuel during start-up);
- *Power Generation*: Power will be provided from the PCUQ platform for all electrical consumers where it is reticulated to the wellhead platform. Maximum diversified power generation demand of around 12 MW will be supplied by turbo-generators arranged in a 3 x 50% configuration using dual fuel turbines. A diesel engine driven generator will be provided for emergency power and for use during black-start;
- *Fuel*: Aviation fuel storage and heli-fueling facilities;
- *Air*: Air, instrument and plant air;
- *Nitrogen System*; for line purging
- *Closed and Open Drains:* Water from the drain systems will be cleaned and discharged to sea.
- *Produced water:* Will be cleaned to statutory requirements and discharged to sea or reinjected;
- *Sewage System*: With macerator to comminute particulate material from black and grey water;
- *Diesel System*; and
- *Accommodation:* For 80 personnel – galley, office and recreational facilities.



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Overview of Offshore Process Systems

Figure 4-1
Project No.: DE2090.100
Figure prepared by: T.Lee
Date Prepared: 16/10/01

Wellhead platform utilities will include:
- Closed and open drain systems;
- Diesel storage, treatment and distribution;
- Dedicated sewage system with macerator;
- Service water;
- Seawater will be used for the provision of washwater and fire water; and
- Power generation from dual-fuel generators.

FSO
Utility systems will be installed to allow operations including:
- Inert gas generation;
- Tank venting and tank cleaning facilities;
- Fuel systems;
- Power generation;
- Hydraulic power systems; and
- Firewater systems (2x100% pumps).

Accommodation and utility space will be of conventional stern location and will include sleeping for 10–20 personnel.

4.1.4 Dangerous Goods/Chemicals

As regards the handling, export, import, handling, disposal of dangerous goods and substances the following legislation may be applicable:
- *Northern Territory Explosives and Dangerous Goods Act 1980*
- *Northern Territory Port By-laws 198*
- *Australian Standard AS 3846-98 Handling of Dangerous Goods in Port Areas*
- *The Industrial Chemicals (Notification and Assessment) Act 1990 and Regulations 1990*
- *Northern Territory Marine Act 1981:*
- *Navigation Act 1912 (Cth)*
- *Marine Orders, Part 41 (Dangerous Cargoes) Order No. 15 of 1998 (Cth)*; and
- *Marine Orders, Part 92 (Powers of intervention - Noxious substances) Order No 11 of 1995 (Cth) Marine Orders, Part 93 (Marine Pollution Prevention - Noxious Liquid Substances) Order No 11 of 1999 (Cth)*.
- *Marine Pollution Act 1999*

The types and quantities of process, utility and operational related chemicals is not yet known but such products may include some of the following:
- Diesel;
- Cementing fluid chemicals (cement, surfactants, defoamers, inorganic salts, bentonite, barite);
- Drilling Fluids (**Refer to Section 8.2.2.2**);
- Helifuel;
- Methyl Ethyl Glycol (MEG)
- Lube oil;
- Methanol; and
- Other chemicals to be used for potable water treatment, corrosion inhibitors and scale inhibitors, etc.

Depending on the drilling fluid properties required, there may be a need for bacterial control, corrosion inhibition, viscosity, weighting and fluid loss control chemicals to be added to the drilling fluid. Drilling fluid additives will be screened on both their technical requirements and environmental performance. Where technically practicable, the most environmentally acceptable options will be preferentially selected.

All chemicals will be screened on both their technical requirements and environmental performance and the most environmentally acceptable options will be preferentially selected. The HSE Safety Case will review the health, safety and environmental implications of such inventories further. Platform, FSO and supply boat management systems will include:

- Material safety data sheets;
- Labelling;
- Segregated and contained storage areas for different classes of substances; and
- Handling procedures for transfer of materials.

All storage facilities and handling equipment will be required to be in good order and designed and constructed in such a way as to prevent and contain any spills. The type of facilities will be decided during the detailed design phase.

All waste and products will be stored and transported with consideration for dangerous goods segregation and onshore and offshore handling and disposal requirements. The Projects' Waste Management Plans will address these aspects.

4.1.5 NPI Substances

The annual throughput of National Pollutant Inventory (NPI) substances has not yet been quantified. The *National Environment Protection Measure for the National Pollutant Inventory National Environment Protection Act 1994* (Commonwealth), concerned with the reporting of solid, liquid, and gaseous emissions, states that:

- Facility operators are required to report to the National Environment Protection Council if any emissions of a substance from the facility exceed the reporting threshold for that substance in a reporting year;
- Schedule A of the measure made pursuant to s.14 (1) *National Environment Protection Act 1994* provides a list of substances (with thresholds) for which a report is required if the threshold for that substance is exceeded in a reporting year;
- In providing emissions estimates the relevant industry handbook technique must be used. If there is no such technique then a technique that the State Environmental Protection Authority approves must be used; and
- If the required information is not supplied, the State Regulator will take enforcement action.

Typical NPI substances that may be NPI reportable for the Sunrise Project include:

- NO_X;
- CO;
- SO_2;
- Particulates; and
- Benzene.

4.1.6 Maintenance & Upgrade Requirements

Approximately every 4 years a shutdown programme will be initiated for inspection, maintenance and upgrading of the offshore facilities.

Operating costs have been included for periodic refurbishment of both wells and surface facilities, and percentages of construction capital costs have been allowed for abandonment of each asset.

The wellhead platform will contain four spare slots for future well requirements. Contingency plans will include capability to retro-fit additional risers or daisy chain risers to tie back additional subsea wells.

The PCUQ platform has the capability to retro-fit additional modules (3,000 ton) on top of legs once the production jack up is installed.

Floating Hose Inspection will take place annually.

4.1.7 Offshore Workforce

Working hours on board the platform will typically comprise 12 hour shifts for the 24 hour operation. Shifts will follow either a 2 week on/off or a 3 week on/off pattern. Accommodation will cater for approximately 80 shift personnel plus a limited number of guests at any given time on the PCUQ platform. 10–20 personnel will be accommodated on the FSO.

Transport to and from the platform will be by means of helicopter or fast ferry.

4.2 Export Pipeline

The subsea export pipeline will operate at 191 bara and transport gas at appropriate flow rates from the field to meet downstream customer demands.

In the event of an emergency a shutdown may be implemented. The shutdown procedure will be based on measurements of pressure and rates of change of pressure at each end of the pipeline. In addition leak detection will be carried out by comparing time integrated inlet and outlet flow rates to provide a system mass balance.

The pipeline condition will be monitored by Remote Operated Vehicle (ROV) equipped with TV/video and an instrumented pipeline inspection tool on a regular basis – possibly every 5 years. The pipeline will be pigged to the Wye piece or landfall and maintenance operations introduced when required. With the subsea pipeline consisting of a 36 inch steel pipeline covered with concrete coating, it is anticipated that maintenance, if and when required, will primarily focus on prevention of freespans and replenishment of rock dump material.

DNV OS F101 states that:
'*as a minimum monitoring/inspection frequency should be such that the pipeline system will not be endangered due to any realistic degradation/deterioration that may occur between two consecutive inspection intervals….'*

The Code goes on to state that:
'Instrumentation of the pipeline system may be required when visual inspection or simple measurements are not considered practical or reliable, and available design methods and previous experience are not sufficient for a reliable prediction of the performance of the system'.

The export pipeline will be subject to a formal hazard identification study (HAZID) in which events, which may influence the pipeline, are systematically examined and their consequences assessed. A Quantitative risk assessment (QRA) will then be made of these hazards and where appropriate, risks will be mitigated by engineering and operational solutions.

4.3 Sunrise Gas Field Operation - FLNG Scenario

If this scenario proceeds, the gas field development and operation will take place within the project scope described above; the most significant difference is the operation of the FLNG barge itself, which is being pursued under a separate approvals process and therefore not considered here. In this scenario, a combination of subsea and well head platform wells are required, with gas and condensate exported to a FLNG facility via a series of flowlines and risers, which have been described in the preceding sections. Under this scenario Produced Formation Water including production chemicals, may be transferred from the FLNG back to the field for re-injection.

4.4 Decommissioning

4.4.1 Offshore

Overview

The future aim will be to decommission production facilities and abandon operating areas so as to leave them as near as practicable to their original environmental condition.

Decommissioning guidelines are currently being prepared by NT Department of Business, Industries and Resource Development (formerly NTDME). These guidelines, or the guidance in place at the time of decommissioning will be followed by the Operator at the decommissioning phase.

Offshore Facility

In general decommissioning requirements are considered on a case-by-case basis at the discretion of the relevant regulatory authority at the expiration of the permit, licence or lease, having due regard to the protection of the area's natural resources and IMO guidelines (APPEA, 1996). Provisions include:

- Removal of structures which may snag or entangle fishing gear or anchors;
- Removal of structures which may present a collision hazard to shipping;
- Removal of all platform structures to at least 55 m below the sea surface;
- Complete removal of platform structures in less than 75 m of water;
- Removal to be performed in such a way as to minimise any adverse impacts on navigation or the marine environment;
- Ensuring maintenance plans are developed to maintain any structure that protrudes above sea level (if appropriate);
- Ensuring all structures not completely removed are notified to appropriate authorities to record on nautical charts;
- Pipelines to be purged, and protrusions removed where likely to snag or entangle fishing gear or anchors; and
- Documenting and maintaining in a permanent file all procedures and well work records.

In accordance with APPEA Guidelines (1996) considerations at decommissioning will include:

- Taking account of the needs and views of other maritime/resource users, natural resource managers and affected community groups;
- Current and likely future values and users of the area;
- Disposal or reuse of structures and equipment; and
- Safe decommissioning of wells.

The APPEA Code of Environmental Practice (1996) also identifies several decommissioning procedures stating:
'Equipment and facilities no longer required for production operations must be decommissioned safely taking into account:

- *Wells are to be cased, plugged, sealed and abandoned in accordance with industry standards and regulatory requirements; and*
- *All waste materials and equipment generated from decommissioning and decommissioning activities should be managed in accordance with a structured waste management plan'.*

Wells
Well decommissioning and suspension are specifically regulated via

- Section 107 of the P (SL)A-1967; and
- *P(SL)A Schedule of Specific Requirements as to Offshore Petroleum Exploration and Production.*

Decommissioning of wells will be planned to achieve the following objectives in accordance with the APPEA Guidelines for *Well Suspension and Decommissioning Offshore (1999):*

- To isolate formation fluids from each other;
- To isolate formation fluids from the surface; and
- To clear the seabed or reinstate land areas.

Wells will be decommissioned in accordance with the guidelines in place at the time and standard industry practice.

Platforms & FSO
Options for removal of the wellhead platform include:

- Complete removal of jacket;
- Toppling of jacket on side and leaving as an artificial reef;
- Cutting of the jacket at seabed and towing to deep water for disposal as an artificial reef; and
- Removing of the top bays of the jacket.

The production jack up may be removed from site at the end of operations for use elsewhere by reversing the installation technique. The FSO and all mooring systems above the seabed will be completely removed with only anchor piles remaining.

Intrafield Pipelines & Risers
Intrafield pipelines will be cleared of hydrocarbons, depressurised, cleaned and left in place. Risers will be cleaned and removed.

4.4.2 Subsea Export Pipeline

Options for decommissioning which have been considered include, leave in place, full removal, partial removal, deep burial; or a combination of these. At this stage no decision has been made as to the abandonment policy. However, Woodside and any future operator recognise that opinion changes in relation to the best approach to such issues and will fully comply with the regulations and follow industry practice in force at the time of abandonment.

At present the *Petroleum (Submerged Lands) Act 1982* does not stipulate any procedures with regard to abandonment of subsea pipelines. Similarly, DNV OS F-101 does not provide any guidelines.