

8.1 INTRODUCTION

At the end of the production life, the project will be decommissioned and abandoned to restore the site to a safe condition that minimises potential residual environmental impact and permits reinstatement of activities such as fishing and unimpeded navigation at the site.

8.2 REGULATIONS AND AUTHORITY

The overriding legislation covering oil and gas developments within Ghana is the *Petroleum (Exploration and Production) Law (Act 84 of 1984)*. In relation to decommissioning, this Act requires that all operations remove infrastructure no longer required for petroleum production, including the closing of abandoned wells. The Act further states that all works undertaken for decommissioning must meet good international practices in comparable circumstances (ie deepwater FPSO projects).

The Jubilee Field Unitisation and Unit Operating Agreement (UUOA), to which GNPC is a co-signatory, and was approved by the State, also stipulates how the field will be developed and operated. The decommissioning process for the Jubilee Field is included in this agreement and states that it will be decommissioned in accordance with international oil field practices and procedures, such as those used in the North Sea and Gulf of Mexico.

International conventions pertaining to the decommissioning of oil and gas projects cover both the removal of installations (eg navigation and fishery hazards) and disposal of wastes (ie pollution prevention). They include:

- The United Nations Convention on the Law of the Seas, 1982, permits the partial removal of structures provided that International Maritime Organisation (IMO) criteria are met.
- The 1989 IMO guidelines on decommissioning require the complete removal of all structures weighing less than 4,000 tonnes when located in water depths of 100 m or less. Those in deeper waters can be partially removed, leaving a minimum 55 m of clear water for the safety of navigation.
- The Oslo and Paris Convention for the Protection of the Marine Environment supercedes a number of the 1989 IMO guidelines. Although Ghana is not a signatory, it does provide guidance for the Jubilee Project for International practices in comparable circumstances as required by Ghanaian law.

It should be noted that there are no international guidelines on the decommissioning of disused pipelines and so good industry practice such as that followed in the Gulf of Mexico and North Sea will be applied.

The Jubilee Project shall be decommissioned in accordance with the national regulations, international standards and licence requirements prevailing at the time. These currently include:

- Government of Ghana, including GNPC requirements;
- Jubilee Field Phase 1 Plan of Development requirements;
- Industry good practice standards; and
- International laws and conventions to which Ghana is a signatory such as the Bamako Convention and the Basel Convention

Ghana marine and environmental laws and regulations will also be adhered to including those concerned with prevention of pollution of waters, disposal of waste and navigation safety at sea.

8.3

APPROVAL PROCESS

The UUOA requires a detailed decommissioning plan to be developed early in the project life. The decommissioning plan will be updated over the life of project to incorporate:

- changes in the field development (eg additional wells);
- new decommissioning techniques developed by the industry; and
- changes to regulatory requirements.

The GNPC, EPA, GMA and Fisheries Department will be consulted by Tullow when developing the detailed plan. Updates to the decommissioning plan over the life of the project will be provided on a regular basis and be included in the Environmental Management Plan.

As required by the UUOA, the decommissioning plan will be used as the basis for assessing funding requirements to decommission the Jubilee Field. The UUOA stipulates that a Decommissioning Trust Fund will be set up by the Joint Venture partners with contributions made over an agreed period to cover the full decommissioning costs of the project.

At the completion of oil production, the project will seek approval from GNPC and Ministry of Energy to decommission the facilities and abandon the field. The approval request will include all relevant data required to demonstrate that all practical and economic extraction of oil from the field has been achieved.

Once approval for decommissioning is granted, the project will implement the detailed plan for facility decommissioning and abandonment. The plan will include details on all aspects of facility and well decommissioning and abandonment. The plan will also address issues identified by a health and

safety risk assessment of the decommissioning itself and the abandonment phase. Potential environmental and social risks will be addressed. The plan will include environmental monitoring, including a post abandonment environmental survey, to ensure that procedures were properly followed and that they were effective. The final plan will be submitted to GNPC and Ministry of Energy for review and approval prior to commencing decommissioning activities.

8.4 ABANDONMENT METHODS

8.4.1 General Approach

At the time that of abandonment, the Jubilee Field, as defined in Phase 1, is likely to consist of the following infrastructure:

- FPSO vessel;
- nine mooring legs from the FPSO (these consist of chain, rope and suction piles);
- 17 subsea wells;
- about 30 km of 12" (30 cm) diameter flowlines;
- 10 flexible risers (total length circa 30 km);
- 35 km of control umbilicals;
- eight manifolds (5 with suction piles); and
- two riser bases (with suction piles).

The above Phase 1 infrastructure may have been added to by subsequent development phases by the time of decommissioning and any scope increase would be included in the regularly updated detailed decommissioning plan.

The project will dismantle and remove as much of the infrastructure as practicable given the deepwater location. As is typical in deepwater environments, it is likely that the seabed flowlines, manifolds, wellheads (if they cannot be cut off below the seabed) and the suction piles (protruding 1 m maximum above the seabed) will be flushed clean where relevant and then abandoned in place. The approach and techniques for abandonment shall consider industry good practice, which is continuously being developed, as well as prevailing regulations at the time.

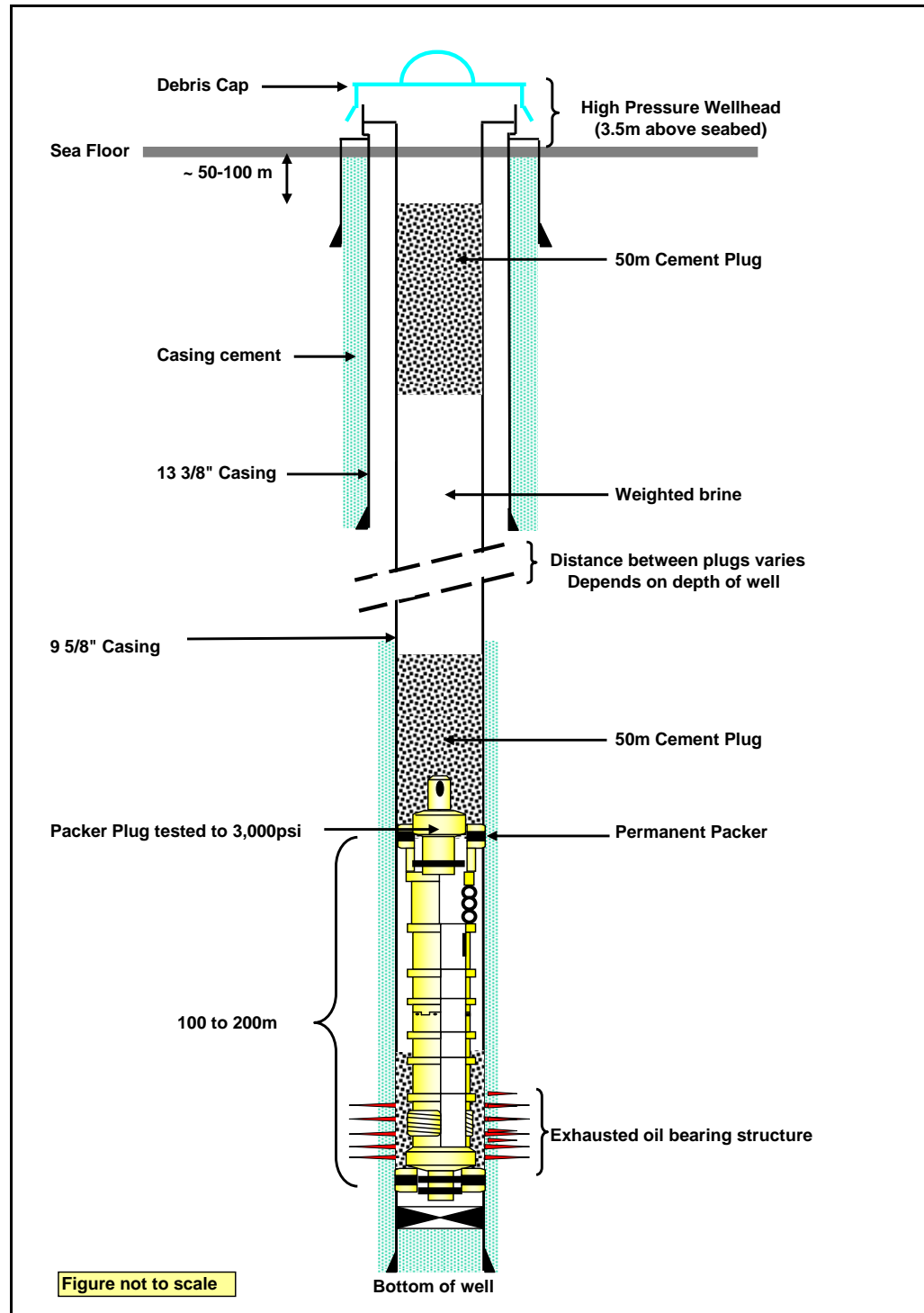
8.4.2 Production and Injection Wells

The downhole equipment such as tubing in the wells will be removed and the perforated parts of the wellbore across the reservoir cleaned of sediment, scale and other debris. Residual hydrocarbons in production wells will be displaced with a high density fluid (ie weighted brine) and wells will be mechanically and/or cement plugged to prevent fluid migration within the wellbore to the seabed or overlying formations. The subsea trees will be removed and the top of the wellheads will be approximately 3.5 m above the seabed. The wellheads will be in water depths between 1,150 m and 1,550 m

and will not pose a hindrance to future fishing or navigation. *Figure 8.1* illustrates how these methods may be applied to well decommissioning to prevent any potential fluid migration after abandonment. The exact decommissioning requirements will vary for each well and will be identified in the detailed decommissioning plan.

The wells will be individually abandoned using a drilling rig or well service vessel. Well abandonment will take approximately 16 days for each well including two days to flush any residual hydrocarbons back to the FPSO.

Figure 8.1 *Cross-section of Typical Decommissioned Well*



Source: Tullow Ghana Ltd 2009

8.4.3 *Floating Production, Storage and Offloading Facility*

At abandonment, the FPSO will be disconnected from the risers and the production system isolated from the subsea wells. The topsides equipment will be decommissioned offshore. The production system will be flushed from the FPSO end using seawater to displace any residual oil and production fluids. The flushing water will be returned to the FPSO for treatment. Any residual hazardous waste will be taken to shore and treated at appropriate approved waste treatment facilities as required by the Waste Management Plan. Once the production system has been flushed and confirmed clean, the FPSO will be released from the mooring system for removal.

The ultimate disposition of the FPSO will depend upon its condition at the end of the production life and upon the options available for further use. If the decision is made to decommission the FPSO, it will be towed from the site to where it will be dismantled/scrapped in accordance with the appropriate international conventions. Depending on the condition of the FPSO it could be refurbished and re-used at another location worldwide

From the mooring system, lines and chains will be recovered. The nine steel suction piles will be abandoned in place. The piles will protrude approximately 1 m above the seabed in waters approximately 1,000 m deep.

8.4.4 *Subsea Facilities*

Subsea facilities above the seafloor will be purged. The flexible risers up to the FPSO will be detached from the riser bases and recovered by reeling onto a lay vessel. The umbilicals will be recovered to the surface as well as the termination boxes and other subsea control equipment. The subsea manifolds, production and wellhead jumpers may be recovered to surface after flushing whilst any steel piles installed to hold the this subsea equipment in place would remain in-situ and protrude a maximum of approximately 1 to 3 m above the seabed in waters between 1,150 m and 1,550 m deep.

The internal field pipelines are likely to have been partially buried in the sea bed sediment over time. These will be flushed until hydrocarbon levels are undetectable and left in place. In some cases the pipe may be recovered as scrap though this is considered unlikely.

8.4.5 *Discharges and Waste*

Discharges that occur during the decommissioning phase, such as produced water and sewerage, will meet the same discharge criteria that applied to the operational phase of the project (see *Chapter 2: Table 2.4*).

Waste generated during the decommissioning phase will be managed as per the project Waste Management Plan, which will be updated through the life of the project. Specific requirements covering the FPSO will be developed closer

to the decommissioning phase once the fate of the vessel (ie scrap or re-use elsewhere) is decided.

8.4.6 *Post-decommissioning Survey*

Following abandonment of all wells and subsea facilities a seabed environmental survey will be undertaken to check that the abandonment process has been carried out correctly. If required, additional surveys will be undertaken to monitor recovery of the site. A report will be submitted to the GNPC, EPA, GMA and Fisheries Department showing the results of the environmental survey once the Jubilee Field has been decommissioned and abandoned.