



OTC 19919

Agbami Field Development—Subsea Equipment Systems, Trees, Manifolds and Controls

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This paper was prepared for presentation at the 2009 Offshore Technology Conference held in Houston, Texas, USA, 4–7 May 2009.

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Abstract

This paper describes the subsea facilities designed and built for the AGBAMI field development as defined by the Subsea Equipment Vendor (SEV) contract issued to FMC Technologies by Star Deep Water Petroleum Limited – an affiliate of the Chevron Corporation in partnership with Texaco Nigeria Outer Shelf Inc, Petroleo Brasileiro Nigeria Limited, Statoil Nigeria Limited, Famfa Oil Limited and the Nigerian National Petroleum Corp. The history of the design, manufacturing, testing and project logistics are described along with useful lessons learned.

The Agbami field is located offshore from the central Niger Delta in water depths ranging from 4,200 to 5,400 feet of water, graphically illustrated in Figures 1 & 2. The physical size of the field can be visualized as fitting tightly within interstate (Loop) 610 which girdles the city of Houston as illustrated in figure 3. The field is being developed using 100% subsea completions tied-back to an FPSO and tanker mooring system. The subsea completion system includes 16 production trees, 6 Gas Injection Trees, 10 Water Injection Trees which will be tied back to 6 production manifolds, 2 gas injection manifolds and 4 water injection manifolds. The SEV contract covers this equipment as well as all flowline and jumper connector kits, electrical flying leads (EFL's) and Hydraulic (Steel) Flying Leads (SFL's), topsides Multiplex (MUX) controls system and installation tooling. The remainder of the subsea kit was supplied by the Subsea Installation Contractor, Technip, including the umbilicals, flexible flowlines, risers, flexible jumpers and subsea umbilical terminations.

Project success was dependent upon more than simple hardware delivery and installation. Included with the contract hardware deliverables were extensive requirements for documentation management, interface management, Nigerian manufacturing and engineering content, technology transfer for sustainable long term development in Nigeria and facilities logistics as well as field and technical personnel support in a location which has limited support facilities for offshore field developments and well as security challenges which had to be managed successfully.

Background

The field architecture was originally developed as base case scenario in the FEED design concept using a drill-center focused development approach shown in figure 4. The approach established a concept basis with options to allow for specific field needs while driving a standardized approach to the design of individual assemblies such as the manifolds and the trees. The vision of the FEED design concept was to repeat the base case system in designing the field development architecture. Adjustments to the base case system would be limited to the predetermined optional features designed into the base case system. Examples of options that can be included in the base case concept are to incorporate gas injection capacity within the drill center or to piggy back an outlying production drill center into the production system of the base concept. These features can be optionally included or left out without impacting the major systems level assemblies. The base case system is designed around a single umbilical which controls the drill center (and the optional piggy-backed drill center). The base case consists of a production manifold and an optional gas injection manifold. Both manifolds include dual headers with flowlines back to the FPSO to allow for round-trip pigging. The production manifolds include a retrievable pigging loop which can be removed and replaced with infield flowlines allowing for the addition of a piggybacked production manifold to an adjacent drill center without modifying the existing drill center production equipment or controls. The adjacent drill center would also