



OTC 18681

From P-34 to P-50: FPSO Evolution

C.C.D. Henriques and F.N. Brandão, Petrobras

Copyright 2007, Offshore Technology Conference

This paper was prepared for presentation at the 2007 Offshore Technology Conference held in Houston, Texas, U.S.A., 30 April–3 May 2007.

This paper was selected for presentation by an OTC Program Committee following review of information contained in an abstract submitted by the author(s). Contents of the paper, as presented, have not been reviewed by the Offshore Technology Conference and are subject to correction by the author(s). The material, as presented, does not necessarily reflect any position of the Offshore Technology Conference, its officers, or members. Papers presented at OTC are subject to publication review by Sponsor Society Committees of the Offshore Technology Conference. Electronic reproduction, distribution, or storage of any part of this paper for commercial purposes without the written consent of the Offshore Technology Conference is prohibited. Permission to reproduce in print is restricted to an abstract of not more than 300 words; illustrations may not be copied. The abstract must contain conspicuous acknowledgment of where and by whom the paper was presented. Write Librarian, OTC, P.O. Box 833836, Richardson, TX 75083-3836, U.S.A., fax 01-972-952-9435.

Abstract

PETROBRAS started to use ship-shaped processing and storage vessels (FPSOs) for offshore production in 1979, through the installation of a process plant over the deck of the P.P.Moraes oil tanker (later renamed to P-34). In April 2006, the P-50, PETROBRAS' latest and most complex FPSO, ever, started production in Albacora Leste Field.

In these last 25 years, the concept and design of our FPSOs suffered a large transformation, from the simplified production plants for up to 50,000 bpd used in the late 70s, through the large FPSOs converted in the mid-90s, up to the concept adopted in P-50 project.

In this project, the concepts of modularization and self-contained equipment packages allied to the life enhancement strategies adopted to guarantee an operational life in excess of 25 years, lead to a design that can be considered "top-of-class" for converted FPSOs.

In this paper it will be described how the design of PETROBRAS' FPSOs evolved highlighting the modifications made in the design of P-50 main systems.

Introduction

PETROBRAS has a long history of using ship-shaped production units in its offshore projects starting in the end of the 80's. Table 1 shows the list of our FPSOs in design, construction or operation and the FPSOs that were demobilized. At present, we have 11 FPSO/FSOs in operation, and we can divide the history of those Units into 3 phases, as can be graphically seen in figure 1 that shows the number of FPSO/FSOs that entered production in each year, since 1987:

- Phase I: In this period, from 1979 up to the beginning of the 90s, FPSOs were used mainly as Early Production Systems;
- Phase II: This period, up to the end of 90s, comprises the boom of FPSO construction and installation in the Campos Basin;

- Phase III: In this phase, the use of FPSOs was consolidated and a second generation of units was built, taking into account all the experience gathered in the first wave of FPSOs from the second phase.

Nowadays we can see that a new FPSO Phase is beginning, with the development of P-57 project, our first newbuilt designed FPSO.

Evolution of FPSO Concept in Brazil

Phase I:

In the Campos Basin, the first CALM buoy was installed in the Enchova Field, in 1978 in order to allow the mooring of an oil tanker to receive the production from a drilling rig in a pilot production system.

The first mono-hull floating production unit to operate in the Campos Basin (and one of the first FPSOs in the world) was the former tanker P.P.Moraes. This 33,000 dwt tanker was built in 1959, and, in 1975 it was jumboized to 54,000 dwt. Then, in 1979, a 60,000 bpd process plant was installed in P.P.Moraes to allow it to operate in the Garoupa field, moored by a tower-yoke system as can be seen in figure 2. In 1980, the tower failed from fatigue at the ballast tank, and a CALM buoy was then installed in the field, to moor the P.P.Moraes FPSO through a soft yoke (figure 3).

In 1987, P.P. Moraes received a rigid yoke to connect to the buoy and was relocated to the recently discovered Albacora deep water field. The unit operated as a Pilot System for the Albacora Field up to March of 1993, with no significant downtime and relatively low OPEX (Ref. 2, 3, 4).

During this period, floating production systems based on semi-submersible platforms were the typical solution adopted in the Campos Basin deep water fields. These FPU's exported the oil to Tankers from our fleet, permanently connected to loading buoys. The first main project of this kind was the Pilot System for the Marlim Field, in 1992, where the Aframax Tanker Horta Barbosa was moored in 625 m of water depth, breaking the world record of deepest moored CALM buoy, at that time. The first tandem offloading operation ever done in the Campos Basin was performed in the FSO Horta Barbosa, proving that this kind of operation could be done safely, with conventional shuttle tankers, under Campos Basin environmental conditions. In 1993, P.P.Moraes left the Albacora Field in order to begin its modification process for the future installation in the Barracuda Field. P.P.Moraes was replaced by a Semi-Submersible, the FPU P-24, which exported the Albacora oil to the Aframax Tanker Jurupema, moored in a CALM buoy.