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Roncador Field Development: Reservoir Aspects and Well Development Strategy

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Abstract

Roncador, a giant field located in deep-water Campos Basin, was discovered in 1996. Oil field development involves an area of 111 km² and water depths range from 1,500 to 1,900 m. Due to expressive oil in place volume, different types of oil and variations in geological characteristics, development strategy comprises 4 modules. The first module, Module 1A, will produce reservoirs in the Hanging wall of a large normal fault structure whereas the other three modules, Modules 2, 3 and 4, will produce reservoirs in the Foot wall Block.

Module 1A started production in 2002, through an FPSO unit (FPSO BRASIL) with 12 wells (9 producers and 3 injectors). At the end of 2007, the second phase of Module 1A and Module 2 started production through two new platforms, one Semi Submersible platform, P-52, and another FPSO, P-54, respectively. P-52 platform will be connected to 29 wells, 18 producers and 11 injectors. P54 platform will be connected to 17 long horizontal wells, 11 producers and 6 injectors.

Roncador main reservoirs are Upper Cretaceous turbidity sandstones with high net thickness (up to 240 m). The depositional model has been interpreted as a complex turbidity system, mainly represented by channels, lobes and over bank facies. Hangingwall Block has been characterized by high net thickness stratified sandstones, which was the main reason for development through vertical/deviated multiple completion wells in Module 1A area. Footwall Block has been characterized by high net thickness single sandstone, that was the main reason to development through horizontal wells, with horizontal extension between 500 (22 API area, Module 3) to 1,000 m (18 API area, Modules 2 and 4).

Intensive application of the following technologies was important to make field development technically and economically successful: (1) high quality 3D seismic; (2) real time LWD (logging while drilling); (3) long gravel-packed horizontal wells; (4) multiple frac packing wells; and (5) massive sea water injection for sweep, and reservoir pressure maintenance. In order to reduce risks of scaling and souring as a result of sea water injection, Sulphate Removal Units were installed in FPSO BRASIL, P-52 and P-54 FPSO, and will be installed also in P-55 and Module 4 platform.

This paper presents the key aspects of the reservoirs, the drainage modeling and design, as well as the strategy adopted during project implementation, in order to overcome main reservoir uncertainties, such as fluid type, connectivity, and net pay, resulting, at the end, in a successful implementation of the projects.

Introduction

The Roncador deep-water giant oil field is located on the northern part of Campos Basin, southeastern Brazil, distant about 125 km from the São Tomé Cape, Rio de Janeiro State coast, in water depths ranging from 1,500 to 2,000 m (Figure 1). Reservoir depths range from 2,900 to 3,600 m, referenced to sea level. Roncador reservoirs are high quality siliciclastic reservoirs from the Cretaceous age with average porosities of 25% and average absolute permeability of 800 mD. The field is divided into two great blocks separated by an expressive normal fault (Figure 2), with oil gravity varying from 18 to 22° API in Footwall Block and 28 to 30 °API in Hanging wall Block..

The field STOOIP volume is about 7.5 billions bbl. Estimated total recoveries for Roncador is of 3.7 billions bbl of oil equivalent, with proven reserves of 3.0 billions bbl of oil equivalent.

The Roncador Field was discovered in 1996. The expressive volume of oil, the good quality of the crude (28 API oil in Hanging wall Block), and the concurrent benefits for the downstream, together with the high economic results of the project, led Petrobras to choose a fast tracking development plan. Besides higher water depths, Hanging wall Block was selected to