



OTC 18198

## Application of Subsea Processing and Boosting in Campos Basin

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This paper was prepared for presentation at the 2006 Offshore Technology Conference held in Houston, Texas, U.S.A., 1-4 May 2006.

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### Abstract

Subsea processing and boosting techniques are being considered for application in both new developments and mature fields in Campos Basin. Production from offshore fields usually begins in an environment where there is lack of information of the actual behavior of the reservoir. Throughout the field's productive life, this situation evolves to a maturity status that allows the identification of new opportunities for subsea processing and boosting application.

This paper aims to give an overview of the systems developed and applied in Campos Basin during the last ten years, such as the Vertical Annular Gas-Liquid Separation (VASPS) and the Electrical Submersible Pumps in Subsea Wells (BCSS). It also reports, in some details, the present situation and future steps for the main technologies under development like Subsea Multiphase Pumping (SBMS 500), Subsea Raw Water Injection and Subsea Water Separation.

In addition to that, the paper also addresses the main drives for the adoption of subsea innovative solutions, which allow field production optimization and oil recovery enhancement, as alternatives to overcome the constraints on offshore floating facilities, which limit the feasible topside improvements on these production systems.

### Introduction

An important characteristic of exploitation of offshore oilfields is the significant initial investment in the beginning, to build the production units, to drill the wells and to install all the equipment necessary for the production. During this period, there is not a perfect understanding about the behavior of the reservoir, something that is calibrated during the productive life of the field. This context leads the operators to adopt a conservative solution, leaving little room for innovative technologies, although, in some fields, the reservoir characteristics show an upfront demand of some

unconventional production systems that are mandatory for profitability.

Most fields in Campos Basin, have no aquifer helping to keep the pressure in the reservoir during the fluid life. The main recovery mechanism for this kind of reservoirs, since the beginning of the production, is waterflooding. A typical curve of produced fluids starts with the predominance of oil, rising to the production plateau, until the water breakthrough occurs. At this point, the production presents increasing water content in the liquid stream.

All these aspects in combination with the typical (1) initial lack of information on reservoir behavior, (2) the need for massive water injection to keep reservoir pressure, (3) water cut increase and, (4) limitation of deck space at the production units create a scenario where subsea systems become an attractive solution that allows production optimization in the field's mature life.

Moreover, reservoirs that produce heavy and viscous oils, flow assurance issues related to the water production and improvement in the flexibility of the production system layout, frequently demand unconventional solutions for this mature phase of the fields.

Realizing, more than a decade ago, that most of the new fields in Campos Basin were in deep and ultra-deep waters, Petrobras created Technological Programs to support the development of these fields. Under these Programs, that align the resources available with the policies and production goals of the company, most of the initiatives of unconventional systems have been developed and others are being developed.

### Technology Development Management

Petrobras follows a robust process to evaluate project proposals and to periodically evaluate the development of the approved projects. This process aims to keep the projects aligned with the company's needs and to establish the priorities that will allow the resources allocation to the great number of projects being carried out at the same time.

In this circumstance, the Technological Programs play an important role, providing an additional forum for discussion and helping the management of resources for the projects that aim the same scenario. The most important boosting and subsea processing projects developed and under development for Campos Basin were included in these Programs, more specifically PROCAP (Deep Water Program), PRAVAP (Enhanced Recovery Program) and PROPES (Heavy Oils Program).

Projects hosted by a Technological Program, often have a defined scenario, which helps the development of the activities