

Minimum Production Riser System for Deepwater Application

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ABSTRACT

As oil companies progress in the exploration of deepwater reservoirs, they identify smaller, multiple oil bearing zones not necessarily connected with each other. Oil Companies knowledge of reservoirs improves continuously from the moment oil production begins. It is contractors' responsibility to provide riser solutions consistent with this continuous learning process. The minimum functions necessary for oil production can be achieved with two piggable looped production lines, and depending on the local conditions, possibly a water injection line, a gas injection or export line, and for the whole field, one oil export line. Acergy has designed and built the large bundled Hybrid Riser Towers (HRT) of Girassol and Greater Plutonio, and streamlined its design and fabrication methods. Its preferred bundled HRT architecture, as opposed to single HRTs (SLORs), embodies the lessons learned and, in this paper, is applied to a minimum risers system for oil production. The proposed system can be decommissioned and is reusable. It is particularly well suited to phased oil field developments, which is receiving more popularity in recent years.

KEY WORDS: deepwater; oil production; riser; Hybrid Riser Tower (HRT); Single Line Offset Riser (SLOR).

NOMENCLATURE

API American Petroleum Institute
bbl Barrel of Oil
DMA Dead Man Anchor
EPS Early Production System
ESP Electro-submersible pumps
FPSO Floating Production Storage Offloading
FPU Floating Production Unit
GOM Gulf of Mexico
GOR Gas to oil ratio
GSEF Glass Syntactic Epoxy Foam
GSPP Glass Syntactic Polypropylene
HDPE High Density Polyethylene
HRT Hybrid Riser Tower
MPHRT Minimum Production Hybrid Riser Tower
OHTC Overall Heat Transfer Coefficient
PLEM Pipe Line End Manifold
RBGL Riser Base Gaslift
scf Standard Cubic Foot
SCR Steel Catenary Riser
URTA Upper Riser Termination Assembly

INTRODUCTION

Detailed understanding of the properties of a reservoir comes only with production. Deepwater does not offer this wealth of information because of the limited history of the production, the connectivity or lack thereof of the various zones, as well as more recently in ultra deepwater¹: high pressure, high temperature and the presence of salt layers.

Making early decision involves large risks. The overall magnitude of the reservoir may be appreciated fairly well and from there the capacity of the Floating Production Unit (FPU), but the connectivity of the various areas of the reservoir may only become apparent during production. The proposed minimum production riser system aims at minimizing the oil company risk by tailoring its capacity to one identified area of the reservoir. Additional production riser systems are added by increment as more production is required to maintain the production plateau of the FPU. Standardization can be achieved because the riser system has only a few components.

This paper successively deals with: field architecture, the definition of a minimum riser system, the design, fabrication and installation of such a system.

OIL PRODUCTION FIELD DEVELOPMENT

Because wet tree based developments are prevailing in many areas of the world including more recently in the Gulf of Mexico (GOM), the remainder of this paper will be devoted to wet tree based fields².

Flow assurance is the main drive of field developments and it depends on the properties of the wellfluid (low or high GOR) and the water depth (deepwater or ultra deepwater).

For illustration purposes two cases are described:

- deepwater case at 1500m (5000ft) with a GOR of 3000 scf/bbl and a reservoir located 1500m below sea level

¹ According to API 17D, ultra deepwater is below 1830m (8000 ft).

² It is recognized that the high drilling cost of ultra deepwater may initially favor dry tree solutions, at least until the most cost-effective completions have been identified.