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The Future for Flexible Pipe Riser Technology in Deepwater: Case Study

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Abstract

Unbonded flexible pipe has been an enabler for deepwater (<3,300ft) and ultra deepwater (>3,300ft) developments for over 15 years. The technology has enabled the industry to initially produce in deepwater in the early 90's and then into ultra deepwater up to 6,500ft in the late 90's. Water depths greater than 6,500ft push the envelope where typical free hanging riser configurations can operate. High tension loads from free hanging pipe weight coupled with high pressure loads creates a challenge for any riser system.

The purpose of this paper is to demonstrate the technical feasibility of unbonded flexible pipe risers in ultra deepwater greater than 6,500ft. A case study is presented herein for a flexible pipe riser: 6-inch internal diameter x 10,000ft water depth x 12,500psi design pressure. The key challenges for this water depth and internal pressure combination are:

- Top tension load
- Collapse load
- Birdcage load

The case study presented herein will quantify each of the key technical challenges and set forth methods for meeting each challenge. Methods for meeting the challenges include: unique riser configurations.

The results of the case study confirm the ability of unbonded flexible pipe to operate in ultra deepwater under high pressures. In addition to the operability of the risers, unbonded flexible pipe offers numerous other advantages in deepwater including:

- Increased flexibility in field architecture, particularly in congested developments
- Re-use as part of the economic assessment
- Pipe is fully tested before delivery – Factory Acceptance Testing
- Reduced operating costs due to minimal maintenance and inspection needs.
- Flexibility of installation methods and scenarios:
  - Pre-installation
  - Wet storage
  - Time saving installation campaigns
  - Low risk abandonment scenario

Future work to confirm the riser and system to allow field operation includes:

- Optimize riser solution for intended operating conditions.
- Evaluate qualification testing needs.
- Optimize buoyancy requirement
- Detail method of attaching/intrgating buoyancy in the riser system.

Introduction

Oil and gas production in deepwater and ultra deepwater continues to grow. For 2006 to 2010 deepwater and ultra deepwater E&P spend is estimated at $65 billion [1]. As the industry goes to water depths greater than 6,500ft, advances in unbonded flexible pipe capabilities and riser system solutions are required. This paper confirms the feasibility of unbonded flexible pipe meeting the ultra deepwater needs of the E&P industry. The key challenges for flexible risers in ultra deepwater are:

- Top tension load
- Collapse load
- And potentially birdcage load.

The case study presented herein will quantify each of the key technical challenges and set forth methods for meeting each challenge. Pipe design and riser configuration system optimizations are summarized and technical feasibility confirmed.

Flexible Pipe Riser Design

The flexible pipe riser is designed using proprietary design tools calibrated with test data. The flexible riser is designed for the parameters listed in Table 1.