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Flow Assurance Benchmarking—Bridging the Gap Between Initial Design and Ongoing Operations

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Abstract

A brief overview of the flow assurance benchmarking process is presented, followed by a discussion of typical flow assurance problems identified during benchmarking studies, a couple of examples showing how benchmarking adds value to field operations, and lessons learned that can be applied to flow assurance studies for ongoing operations and future projects. The types of computer models described in this paper could be used to track and interpret field data, evaluate and improve field performance, and to identify and mitigate potential flow assurance problems during subsea production operations.

Actual field data are incorporated into the two examples of flow assurance benchmarking. Specifically, the first example involves malfunction of a subsea tree choke valve during the first few months of production. The second example involves potential failure of flowline insulation or sensor malfunction. This paper adds to the current body of knowledge regarding the modeling of subsea production operations and provides guidance on improving models used in flow assurance analysis.

Introduction

The flow assurance challenges and mitigation strategies typically associated with deepwater projects have been discussed at length in multiple papers [1,2]. Production fluid behavior during steady-state and transient operations need to be understood adequately in order to maximize production, minimize costly downtime, and develop effective strategies to prevent flow assurance problems.

The flow assurance benchmarking process is a key step in bridging the gap between engineering design and successful field operations. The primary goal of this process is to develop an accurate and integrated quantitative model of the production fluid behavior within the constraints of the as-built field architecture and actual environment. With a reliable model, engineers and operators can better understand the actual operating limits, identify and monitor deviations from operating targets, anticipate and avoid operational problems, implement effective operating strategies and procedures, and plan for future operation and field development.

An overview of the benchmarking process is presented in this paper, together with a couple of examples demonstrating how effective benchmarking can be used to alert operators to potential equipment failure and avoid unexpected downtime.

Benchmarking process

A typical benchmarking process involves the following high-level steps:

1. Define the scope, objectives and acceptance criteria.
2. Gather required model input data, including operating data.
3. Develop thermal-hydraulic model (steady-state and/or transient).
4. Compare operating (measured) data to model-calculated values.
5. Revise model until acceptance criteria are met.

It is important to define clearly the scope and objectives of the benchmarking. For example, is the model intended to calculate the early-life steady-state liquid-hold-up in a production flowline-riser system during normal operation or to calculate late-life cooldown time of a shut-in well jumper? This step defines the individual tasks, input data, and analysis needed to develop the