Analysis on Flow Assurance and Dynamic Simulation of Deepwater Subsea Processing System

Kai Zhou, Peilin Liu, Hao Ni, Dong Wang, Feng Su, Feilong Liu
China Offshore Oil Engineering Co. Ltd.
Tianjin, China

ABSTRACT

The purpose of this paper is to investigate subsea processing system on how to impact on flow assurance, and to propose some design methods about subsea system. The paper discusses the subsea processing system on how to relieve the hydrate and decrease usage of hydrate inhibitor, to increase the tie-back distance, to improve production rates and increase total recovery.

The study analyzes the differences of effect on flow assurance whether with or without the subsea processing system. The design principle of subsea processing system is researched, such as, how to get the optimum location for the deepwater subsea processing system, boosting pump selection, subsea processing compared with topside processing, the efficiency of subsea processing system, process flow design of subsea processing system. In addition, the subsea processing system is simulated with dynamical flow software. The purpose of dynamic simulation is to determine the control strategy and operation philosophy of the subsea processing system. The flow is modeled with the dynamic multiphase flow simulator OLGA.

KEY WORDS: Subsea Processing System; Flow assurance; Dynamic Simulation; Subsea separator.

NOMENCLATURE

CAPEX Capital Expenditure
ESP Electrical Submersible Pump
GLCC Gas-Liquid Cylindrical Cyclonic
GLR Gas Liquid Ratio
GOR Gas Oil Ratio
GVF Gas Volume Fraction
MPP Multiphase Pump
NBP Normal Boiling Point
OHTC Overall Heat Transfer Coefficient
OIW Oil in water
OLGA Dynamic Multiphase Flow Simulator
PLEM Pipeline End Manifold

INTRODUCTION

Subsea processing system is an important component of the subsea production system in the offshore oil fields. It is a hardware solution type to flow assurance. Subsea separation technology is growing at an increased rate due to its huge potential to increase recoverable reserves and to accelerate production. Subsea processing systems encompasses all separation and pressure-boosting operations that are performed subsea. The paper successively includes relation of flow assurance and subsea processing system, design analysis of subsea processing system, dynamic simulation of subsea processing system. How the available technology of subsea processing system use in future field, especially in the deep water.

SUBSEA PROCESSING SYSTEM AND FLOW ASSURANCE

The Benefits

Subsea processing system is a hardware solution type to flow assurance. Subsea separation technology is growing at an increasing rate due to its huge potential to increase recoverable reserves and to accelerate production.

The benefits of subsea processing system:
- Increased recovery achieved by reducing back-pressure on wells;
- Reduced risk due to reservoir uncertainty versus multiphase pumping only;
- Improved flow assurance such as hydrates, wax, slugging, erosion, less chemical injection;
- Prevent solids dropout by allowing higher liquid-flow velocities;
- Eliminate fluid surges by use of single-phase pipelines;
- Reduced CAPEX on topside processing equipment and number of flowlines and insulation;
- Suited for Harsh Environments.

Deepwater and Long-distance Tiebacks

The current practice is to flow produced fluids from subsea wells directly back to a central surface processing facility in multiphase