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## A Simplified Subsea Separation and Pumping System

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### Abstract

Subsea gas/liquid separation and pumping is an effective means of providing artificial lift for enhanced oil production from subsea oilfield developments. Compared to multiphase pumping the energy efficiency may be improved by a factor of two to four, depending on the water depth. A subsea separation and pumping system is, however, more challenging to operate, as the liquid level in the separator needs to be controlled to ensure a stable liquid feed to the pump. The pump must also either be protected from gas surges or designed to be gas tolerant. For deepwater applications this becomes even more challenging, as compact separation solutions are required, due to the difficulty of manufacturing subsea separators to withstand the high hydrostatic pressure.

This paper describes conceptual design and model testing of a subsea separation and pumping system, using a gas tolerant, Hybrid Helicoaxial-Radial pump. The slug-handling characteristics of the system are discussed, and a control strategy capable of handling any realistic slug size and frequency is described. A key feature is that active subsea control valves are not required, reducing the complexity of the subsea facilities and control system.

The system design and control strategy was verified by model testing. A pressurized air water loop was used, with maximum liquid flow rate of 166 m<sup>3</sup>/h (25,000 bbl/d) with a gas volume fraction (GVF) at separator inlet of up to 70%. Pump suction pressures up to 30 Bar were used. The testing proved that overall control system response time of 1–2 s is required to handle typical slug frequencies, which is well within the capabilities of present subsea control systems and Variable Speed Drives.

### Introduction

Subsea gas liquid separation and pumping is an effective means of providing artificial lift for enhanced oil production from subsea oilfield developments. Compared to multiphase pumping the energy efficiency is improved by a factor of two to four, depending on the water depth. A subsea separation and pumping system is, however more challenging to develop and operate, as the liquid level in the separator needs to be controlled to ensure a stable liquid feed to the pump.

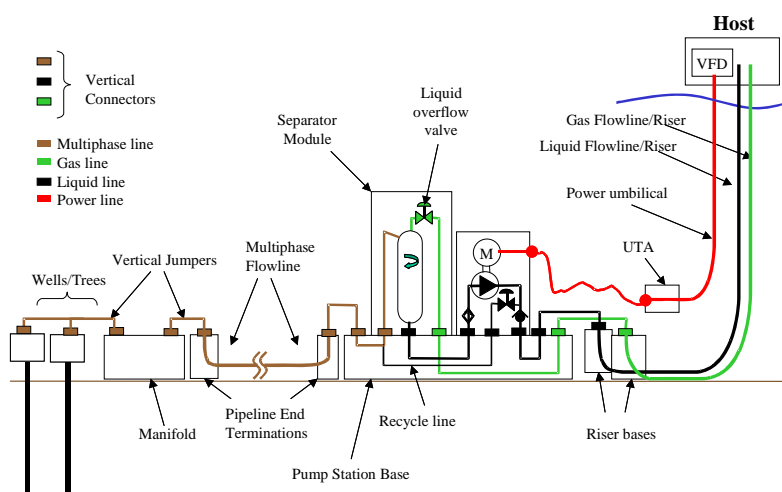


Figure 1 Subsea separation and pumping system