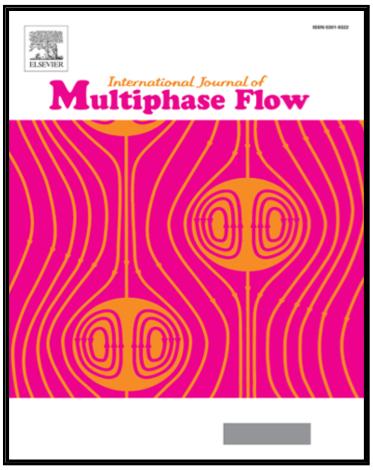
Accepted Manuscript



Challenges in slug modeling and control for offshore oil and gas productions: A review study

Simon Pedersen, Petar Durdevic, Zhenyu Yang

PII: S0301-9322(16)30067-2
DOI: 10.1016/j.ijmultiphaseflow.2016.07.018
Reference: IJMF 2464

To appear in: *International Journal of Multiphase Flow*

Received date: 15 February 2016
Revised date: 5 July 2016
Accepted date: 14 July 2016

Please cite this article as: Simon Pedersen, Petar Durdevic, Zhenyu Yang, Challenges in slug modeling and control for offshore oil and gas productions: A review study, *International Journal of Multiphase Flow* (2016), doi: 10.1016/j.ijmultiphaseflow.2016.07.018

Challenges in Slug Modeling and Control for Offshore Oil and Gas Productions: A Review Study

Simon Pedersen, Petar Durdevic, Zhenyu Yang
Department of Energy Technology
Aalborg University, Esbjerg Campus
Niels Bohrs Vej 8, 6700 Esbjerg, Denmark
spe@et.aau.dk, pdl@et.aau.dk, yang@et.aau.dk

Abstract

The upstream offshore multi-phase well-pipeline-riser installations are facing huge challenges related to slugging flow: An unstable flow regime where the flow rates, pressures and temperatures oscillate in the multi-phase pipelines. One typical severe slug is induced by vertical wells or risers causing the pressure to build up and hence originates the oscillating pressure and flow. There exist many negative consequences related to the severe slugging flow and thus lots of investments and effort have been put into reducing or completely eliminating the severe slug. This paper reviews in details the state-of-the-art related to analysis, detection, dynamical modeling and elimination of the slug within the offshore oil & gas Exploration and Production (E&P) processes. Modeling of slugging flow has been used to investigate the slug characteristics and for design of anti-slug control as well, however most models require specific facility and operating data which, unfortunately, often is not available from most offshore installations. Anti-slug control have been investigated for several decades in oil & gas industry, but many of these existing methods suffer the consequent risk of simultaneously reducing the oil & gas production. This paper concludes that slug is a well defined phenomenon, but even though it has been investigated for several decades the current anti-slug control methods still have problems related to robustness. It is predicted that slug-induced challenges will be even more severe as a consequence of the longer vertical risers caused by deep-water E&P in the future.

Keywords: Offshore, oil & gas, multi-phase flow, bifurcation, anti-slug, gas-lifting, riser slug, flow control, stabilization.

1. Introduction

In recent years the production optimization for offshore oil and gas Exploration & Production (E&P) facilities has been extensively investigated, as any potential enhanced fuel recovery can result in huge economic gains [1]. Figure 1 illustrates a typical well-pipeline-riser section at a typical offshore oil & gas field. This specific system consists of three connected subsections:

1. The production well section; where liquids, gases and solid compounds from the reservoir flow through a vertical well. Some production wells use artificial lifting techniques to help keep reasonable production rate from the reservoir. In some constructions the well head goes above sea level to a manifold platform, where the flows from several wells can join into one stream and further move forward into a single pipeline. In most cases topside choke valves located at the top of each well are available to regulate the flow through the tubing of the production well.
2. The subsea transport pipeline section, which consists of a transportation pipeline that follows the sea bed. This section consists of the majority of the complete pipeline length.
3. The vertical riser section; where the riser raises the well fluids from the subsea transport pipeline up to the topside platform above sea level, where a separation process separates the multi-phase (gas/oil/water) fluids. As with the well section, the riser sometimes uses artificial lifting at the riser base to improve the production rate [2]. A topside choke valve is often placed before a separator to regulate the flow fed into the separator.