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A System for Training Operators of Subsea Facilities

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Abstract

The safe operation of sub sea facilities requires trained operator who are familiar with the field installation and the operations to be conducted on the field. The training of operators may be performed using simple logic based facilities designed to allow the operator to identify features in the Master Control Station (MCS) and Distributed Control Station (DCS) screens. This may have been sufficient for simple operations, but as the operations begin to include complex and risky operations such as Water-Alternating-Gas (WAG) transitions, pump and process start-ups and shutdowns, the training systems need to be designed to include realistic responses of the complex behavior of modern deepwater production.

A proper simulation should include emulation of the MCS and sub sea logic systems, simulation of the wells and production network and all of the relevant topsides facilities. The simulation should also include features designed to easily emulate operational difficulties such as leakages, solids deposition, alarms, and other unplanned events. Because the sub sea network often includes multiple options for boosting or network operations, the training facility should also include features to allow for “what-if” training of operators and more importantly, the package must be designed to accommodate future production options as they are implemented in the field. It must also be designed for extreme reliability and robustness: the student and teacher will abandon the effort if the tools themselves fail.

This paper will describe the development of a configurable application designed to provide the simulation of the sub sea infrastructure as well as the interaction between it and the topsides facilities. We will describe the solution methodology chosen to allow the configurable simulation of most production operations and including maintenance and diagnostics of both multiphase- and virtual-flowmeter based allocation.

The features available to the Teacher include most expected production upsets, but also include the direct access to equipment status indicators. This allows the trainer to simulate “undetected” system failures and gives them the opportunity to gauge to competency of students as they try to fault detect the system.

The final product has not only provided a facility for operator training but also has been utilized in MCS and DCS SIT testing.

Introduction

As subsea production systems become more complex and increasingly advanced production solutions are being applied to the system, the control system has itself become more advanced. Operations in the subsea facility involve controlling in dynamic and unstable flow regimes, in turn causing complex interactions with the topsides facilities. These changes require that we place more emphasis on experienced operators and on training systems capable of creating experienced operators. The simulators are aimed at allowing the operators to:

- Work with conventional well and riser control
- Learn responses and actions to equipment failures or flow assurance related events
- Operate artificial lift control systems
- Work with and tune physical and virtual metering systems