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Subsurface Safety Valve Control System for Ultradeepwater Applications

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Abstract

The typical subsurface safety valve for deepwater high-pressure/high-temperature (HP/HT) subsea applications employs many operational techniques including pressure-balanced pistons using gas energy for assisted closure, hydraulic balance lines, or a heavy spring to ensure failsafe closure in the event of an emergency shutdown. Each of these techniques has an impact on the valve's characteristics, which can raise concerns about valve operation or reliability.

A solution is desired that minimizes valve opening pressures by balancing tubing pressure , yet allowing extreme valve setting depth capability without compromising operational characteristics such as high opening pressures or pressure-balanced pistons using long term valve gas charge storage.

This paper discusses a new surface-controlled subsurface safety valve (SCSSV) control system that uses the low opening pressures of a tubing-pressure-insensitive safety valve, without gas-charged assisted closure or dual control lines for balanced line applications. This system eliminates the need for pressure reversals across the valve's critical actuating piston seals, which increases valve reliability and sealing performance while maintaining tubing pressure insensitivity. This control system allows for deeper valve depth capabilities compared to the methods previously discussed, allowing the safety valve to overcome annulus pressure buildup scenarios not possible in current SCSSVs for the applications described.

This paper presents design considerations using an SCSSV control system allowing technological accomplishments not previously possible with existing SCSSV technology. Test results demonstrate the suitability of the new control system design for previously unattainable valve operating depths in aggressive well designs or annulus pressure buildup situations while enhancing valve reliability.

Introduction

Deepwater production and operations in the outer continental shelf (OCS) is defined by the United States Minerals and Management Service (MMS) as operations taking place in OCS water depths in excess of 1,000 feet or 305 meters[1]. Given that deepwater discoveries are considered higher-risk ventures with unique operational, environmental, health, and safety concerns, it is no surprise that the visibility and criticality of subsurface safety valve designs for these applications are taking center stage in critical field completions.

Many projects in the Gulf of Mexico are taking place in excess of 7,000 feet of water depth and new discoveries support the future of deepwater development as technically feasible and financially justifiable. Existing technologies for subsurface safety valves each pose unfavorable features or risk when exceeding the earlier noted depths. Recognizing the high costs associated for a deepwater well workover, every precaution must be taken to ensure optimum valve performance and reliability.

Recognizing that even deeper depths will be required in the future, it becomes necessary to develop a subsurface safety valve operating control system capable of standard operating pressures in extraordinary water depths