

SPE/IADC 92626: Modeling Ultra-Deepwater Blowouts and Dynamic Kills and the Resulting Blowout Control Best Practices Recommendations (2005)



SPE/IADC 92626

Modeling Ultra-Deepwater Blowouts and Dynamic Kills and the Resulting Blowout Control Best Practices Recommendations

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Abstract

The paper was prepared for presentation at the SPE/IADC Drilling Conference held in Houston, Texas, U.S.A., 20-21 November 2005.

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Abstract

In response to the drilling industry breaching new frontiers, specifically ultra-deep waters (5,000 ft or more of water depth), new blowout control measures are necessary. This paper outlines a study into the control of ultra-deepwater blowouts using the dynamic kill technique.

The study was conducted using a newly developed dynamic kill simulator, COMA-Sim, to model blowout control conditions and blowout control in simple wellbore geometries. The simulator was validated theoretically through wellbore examples.

The simulation runs first establish initial conditions analysis of the various blowout conditions for an array of well conditions. Next, the simulator was used to determine the dynamic kill requirements to control these blowouts based on a range of relief well parameters.

The results showed that ultra-deep waters definitely have an effect on the blowout conditions due to the increased hydrostatic pressure of the water. Initial conditions were also significantly affected by the length of openhole sections.

The dynamic kill requirements were adversely affected as the projected relief wells became longer. In addition to relief well parameters and blowout scenarios, the dynamic kill requirements were also related to the well without flowing status.

This study has highlighted several key trends and interesting future research topics in the area of ultra-deepwater blowouts and control of these blowouts.

Introduction

As the sector to find and produce hydrocarbons are depleted, the oil and gas industry must move into new areas to

continue supplying the world with hydrocarbons. Many of these frontiers are in what is considered ultra-deep waters, 5,000 feet or more of water depth. This is a unique environment that requires many new techniques and technologies to safely explore and produce. As the various areas of the oil and gas industry advance their ultra-deepwater technology, one area has had to remain at the forefront: drilling. Often these frontiers are harsh environments either downhole, on the surface or both. Ultra-deep water is a good example of a dangerous and unknown drilling environment. It is in these frontiers however that the advancement of technology is often dependent. While drilling as whole may be advancing to keep up with these environments, some parts lag behind. An area that has seen this stagnation and resulting call for change has been blowout control in deep and ultra-deep waters.

Blowouts have been a problem for the industry since its inception. However, in spite of the development of many safety measures such as BOPs, as well as numerous types of equipment and drilling procedures, blowouts still occur. In fact, since 1990 blowouts have occurred at a fairly stable rate. This rate has not changed even though blowout prevention equipment and procedures have drastically changed (Fig. 1).

As evidenced by Fig. 1 the number of blowouts per feet drilled on the Outer Continental Shelf of the Gulf of Mexico stayed relatively constant from 1990 to 1996. These numbers point to an inevitable conclusion: blowouts will always happen no matter how far technology and training advance.

It is important to remember that the data in Fig. 1 is taken from relatively shallow OCS wells. Ultra-deepwater wells will have similar well control issues but in an exaggerated manner mostly due to the increased hydrostatic pressure. Indicators and measurements of surface such as gas and pressure values will often be deceptively benign until the situation has escalated to the point that control of position will become a very complicated and dangerous task.

A significant difference between previously recorded blowouts and potential ultra-deepwater blowouts is the increased risk of underground blowouts high pore pressures and low fracture gradients in ultra-deep waters. Underground blowouts will increase the likelihood of surface equipment damage.

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Control of Blowouts. There are many ways offshore blowouts are controlled. These include:

- Capping
- Wellhead equipment installation/operation
- Cement/Gunk plug
- Bridging
- Depletion/flooding of reservoir
- Momentum kill/bullheading
- Dynamic kill

The majority of the listed blowout control methods have their origins in shallow water or land well applications. The working depth in ultra-deepwater wells limits the practicality of many of the methods. According Fig. 2, the relative majority of blowouts were controlled through bridging. If a blowout is to be controlled through bridging, this typically occurs in the first 24 hours. After this point the probability of passive control through bridging decreases. At this point, other options should be considered. In ultra-deepwater blowouts, active control methods will center on subsurface intervention techniques. Most subsurface techniques require a

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