Deepwater well control: The industry takes charge

SPE/IADC 52761

"Development of Deepwater Well Control Guidelines"

The **International Association of Drilling Contractors** and the **Offshore Operators Committee** co-sponsored a task force charged with developing guidelines on deepwater well control and identifying areasfor future work. An implicit objective of the Task Force was to share knowledge and experience between a broad range of participants, including operators large and small, contractors, service companies, academia, and government.

The Task Force was organized into a steering committee and 5 subcommittees dealing with well planning, procedures, equipment, emergency response, and training. The guidelines were published on schedule in late 1998

—M R Plaisance,
Diamond Offshore Drilling, et al

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"Deepwater Well Control—Circulate with Both C&K Lines?"

Floating drilling rig well control systems are equipped with two "choke and kill" (C&K) lines from the subsea BOP. The traditional reasons for two lines include redundancy and the ability to circulate down one line and back up the other prior to opening a suspended well. In deepwater, new purposes have arisen: (1) to sweep the BOP stack of 'trapped gas', (2) to use one of the lines as a static, pressure-sensing line to the BOP stack, and (3) to use both lines in parallel to reduce frictional pressure loss, and hence the back pressure on potentially weak downhole formations below shallow casing shoes. The decisions on how to use these lines during a well control circulation are based on a number of factors.

The paper will review the potential uses of both C&K lines in well control circulation and the associated advantages and disadvantages, with emphasis on deepwater. In addition to BOP pressure monitoring and frictional pressure drop issues, there is a largely unrecognized phenomenon in which the BOP stack acts as a separator. This 'BOP separator effect' has a surprising consequence that can reduce potential surface pressure fluctuations in gas kicks.

—S A Christman,
Exxon Upstream Development Co

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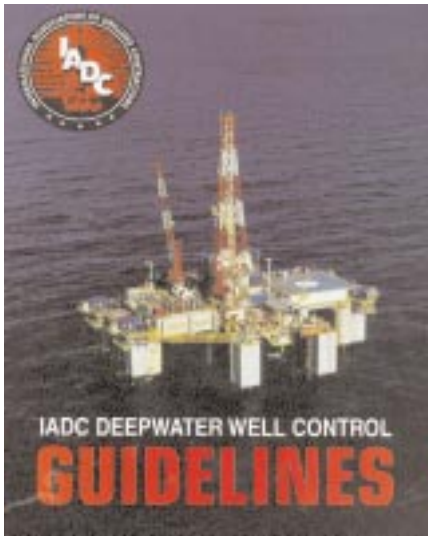
"Well Control Guidelines for Girassol"

The Girassol field, discovered in 1996, lies offshore Angola in water depths around 1,400 m. The development project calls for the drilling of 40 subsea wells which will target shallow oil bearing tertiary reservoirs constituted of highly permeable unconsolidated sand layers. Although pore pressure is hydrostatic, well control is an issue, as there is a high swab kick risk, mainly for the long horizontal wells.



SPE/IADC 52761: An IADC/Offshore Operators Committee task group developed the first set of guidelines on deepwater well control.

This paper reviews some essential particularities of West Africa deepwater drilling operations, which make well control challenging; the objective is to highlight key parameters related to well control situations in this environment such as low temperatures, very low frac gradient, problems induced by the risk of major lost circulation, and all the consequences of the BOP position at mudline, sometimes nearer to well TD than to surface.

A new theoretical control approach is proposed based on the classical Driller's method, offering an optimised choice of the slow circulating rate and some easy-to-follow control curves. Graphical synthesis associated with essential equations of the wellbore pressures at the different stages of the control operation will be detailed. This method intends to be fully efficient even in extreme situations such as a swab gas influx in a long horizontal drain with significant choke line pressure losses. Validation has been made by using an advanced kick simulator.

New operational well control guidelines combining essentially the experience gained while drilling Angola Bloc 17 exploration and appraisal wells, and the theoretical approach already introduced, are also presented in this paper.

—D Bertin, Elf Exploration Production
—J Lassus-Dessus, Elf Exploration Angola
—B Lopez, ENSPM Formation Industrie

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"Well Testing Challenges in Deepwater Wells"

After an encouraging exploration well discovery, there is an increasing trend to reduce the number of appraisal wells. Simultaneously, management teams need to begin early development studies which call for a reliable set of reservoir and fluids data.

This paper, which discusses the challenge of data acquisition in deep water or appraisal wells, is divided into three sections.

The first section is a review of the crucial data that must be acquired in order to enable preliminary studies by reservoir engineers, fluids analysis specialists and production teams. In addition, the operating procedures necessary to ensure good data quality are reviewed and potential risks to both data and safety are highlighted.

The second section of the paper presents field examples, taken from West Africa deepwater wells, indicating the limits of the testing operations, as well as the high level of preparation required.

The last section is focused on the necessary technical innovations in well testing technology and procedures. In this particular area, the partnership with service companies to meet operators' require-

ments and constraints, is discussed in detail.

—A Chassagne, Elf Exploration Production

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"MABOPP—A New Diagnostic for Deepwater Well Control"

The long choke lines extending from the subsea blowout preventer (BOP) to the surface complicate the procedural difficulties in removing gas as a result of a well control incident. One of the traditional indicators of the ability to circulate out a kick has been the Maximum Allowable Annular Surface Pressure (MAASP). The high chokeline friction losses when circulating and gas swap-out in the chokeline(s) mean that the use of a constant MAASP (usually based on the last leak-off test) is inappropriate. The use of a dynamic MAASP that can be modeled using a simulator has been suggested as one possible indicator that can allow for the complex interactions between the high frictional losses, gas swap-out, kick tolerance, riser margin and reduced fracture gradients. However, the large fluctuations in this parameter during the kill are such that interpretation can be difficult.

With the advent of instrumented BOPs many of the inherent complexities of the kill circulation can be understood by the use of a new diagnostic— the Maximum Allowable BOP Pressure (MABOPP). Although this is a dynamic quantity (as it changes during the kill) it avoids the large fluctuations of MAASP as it is isolated from the hydraulic and hydrostatic changes in the vertical choke line(s) and can thus be more easily interpreted.

The interpretation of MAASP and MAABOP both involve estimation of the difference between 2 curves, not easy if both are changing at the same time. We introduce a second diagnostic—Fracture Margin that dynamically tracks the difference between the curves and is a direct indicator of the safety pressure available at the shoe.

We illustrate the advantages of using MAABOP for deep water well control for kicks that necessitate circulation through both choke and kill lines and modifications to the pump pressure schedule during control.

—J P James, I M Rezmer-Cooper, Schlumberger Oilfield services

—S Kr Sorskar, Statoil

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"Deepwater Direct Intervention Blowout Control"

This paper will review current ROV capabilities to solve some types of blowout problems in deepwater. An example of a recent application to isolate a leak is reviewed. New ROVs of higher horsepower with multiple wet connect hydraulic tools are becoming more available. The paper will discuss possible additional tool developments to expand applicational range. Additional operational guidelines will be reviewed (surface sea state, currents, blowout plume, dive boat or MODU operational concerns).

—L H Flak, L Romo, Boots & Coots Intl Well Control Inc