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The K2 Project: A Drilling Engineer's Perspective

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Abstract

Several environmental, drilling and completion challenges were overcome to make the K2 development successful. These challenges included the following:

- Loop current
- Hurricanes (Lillie, Katrina and Rita)
- Shallow water flow zones
- Drilling through over 10,000 feet of salt
- Pore Pressure Profile / regressions in the well
- Formation evaluation
- Conventional Core Acquisition
- Low skin / long life completions
- Downhole Commingling

The following paper will discuss each challenge and will review how they were mitigated and overcome.

Currently, all three wells have been sidetracked and tied-back successfully. The subsea trees have been set utilizing an intervention vessel and one well has been completed. Initial production was over 17,000 boepd.

Introduction

The K2 development is an oil field located approximately 132 miles south of the Louisiana coastline, primarily within Green Canyon Blocks 562 in water depths ranging from 3800 feet to 4200 ft. Green Canyon Blocks 562 is jointly owned by Eni, Anadarko, ConocoPhillips and Chevron.

The K2 development features three (3) subsea wells in two (2) different clusters (Fig. 2). The K2 wells are non-TFL and have a 15,000 psi pressure rating. Production is processed at Anadarko's Marco Polo TLP in Green Canyon 608, 7 miles away.

Development History

Productive hydrocarbons were originally discovered in K2 by Conoco in 1999. Well 1 discovered hydrocarbons in the Reservoir 2 horizon. The well was sidetracked up dip where it encountered slight reservoir improvement. Eni (previously AGIP) established operatorship from BP in 2000 and subsequently drilled Wells 2 and 3. Both were successful. An additional exploration sidetrack and a bypass were drilled to further evaluate the development.

Development drilling began after project sanction in 2004. Operations included the following:

- Sidetracking of the 3 wells below the 9-7/8" production casing (approximately 22,000 feet) to TD (26,000 feet TVD).
- Running 7-3/4" production casing
- Running 9-7/8" production casing tie-back to the subsea well head.

The rig was released for a 1 well project. During this time, the subsea trees were run. The Vetco horizontal trees (15,000 psi rated) were set utilizing the Q4000 intervention vessel. All future work was performed through the horizontal trees.

The final campaign, Completion, commenced 3 months later and is currently ongoing.

Geologic / Reservoir Description & Challenges

The K2 field is located on the northwest edge of the Mississippi fan fold trend. The nearest discoveries within the Miocene fold trend are Mad Dog, 15 miles (24 km) south of K2, Atlantis, 20 miles (32 km.) to the southeast, Tahiti 30 miles (49 km) to the west and recently Shenzi 12 miles (20 km) to the southeast (Fig. 3). There are two (2) primary horizons, with the main target being below 25,000 feet TVD. Both targets are below a salt canopy which is over 10,000 feet thick (Fig. 4). Hydrocarbons are trapped subsalt in a 3-way fault closure against a deep salt root / weld zone. A crestal normal fault separates the field into north and south fault blocks.

The first geologic challenge is the presence of a shallow water flow approximately 2,000 feet below the mud line. Next, is the salt canopy itself. Top of salt is approximately 8,000 feet and thicknesses ranging between 10,000 and 12,000 feet.