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Innovative Operations Management and Flow Assurance Strategies Extend Field Life and Increase Ultimate Reserves of a Long Distance Subsea Tieback in Ultradeep Water

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Abstract

This paper discusses the operations and flow assurance challenges in deepwater subsea tiebacks during mid to late life of the field. Adequate planning for these challenges can extend field life and improve ultimate recovery of reserves.

By the 4th Quarter of 2004, (Gas Production Rates: 391 mmscfd; Water Production Rates: 840 bbls/day), the subsea fields comprising the Canyon Express System were declining and the water production rates were increasing. The depletion drive reservoirs were being severely affected due to natural decline and increasing liquids in the flow line. The water drive wells were being affected due to increased water production and limitations in methanol injection capacity. Wells had to be curtailed because of liquid handling limitations both subsea and topsides.

In order to stymie the fast decline and to extend the life of the field, various options like implementation of LDHI's[1], subsea compression, subsea separation, and re-configuration of the subsea architecture to isolate the dry depletion drive wells from the high water producing wells were evaluated.

The flow lines were reconfigured to separate the depletion drive wells from water drive wells. A real-time production management tool for enhanced production planning, monitoring and trouble shooting capabilities was implemented[2]. The flow line arrival pressures at the platform were reduced through restaging and optimization of the compressors. The field life was extended by over 1 year and the ultimate reserve recovery increased by an estimated 18 BCF.

Introduction

The Canyon Express transportation system consists of two 12-inch flow lines running parallel from Camden Hills through Aconcagua and Kings Peak to Canyon Station Platform. The three subsea fields: Camden Hills, Aconcagua, and Kings Peak, are in 6200 to 7250 ft. of water. Canyon Express subsea tieback, at 56 miles from Camden Hills to Canyon Station Platform, is one of the longest subsea tiebacks in the Gulf of Mexico. Production from the fields is predominantly gas with condensate and produced water. The wells are tied together via a “daisy-chain” arrangement. The Canyon Express field and liquid management have been described in previous papers[1,3,4]. Refer to the attached Canyon Express schematic and infrastructure figures (Figures 1 and 2).

During mid life operations, increasing water production from water drive reservoirs (Aconcagua AC1 & AC2, Camden Hills CH1 & CH2 and Kings Peak KP1 & KP2) and declining reservoir pressures of depletion drive reservoirs (Aconcagua AC3 & AC4) led to high liquid rates and lower gas rates. The declining depletion drive wells were being severely restricted by higher water rates and liquid hold-up in the flow lines. To optimize production during this period of increasing water rates and declining gas rates, several production options were considered: producing all wells through a single flow line, re-routing low-pressure wells through one flow line and high-pressure wells through the other flow line, gas re-cycling, subsea separation, subsea pumping, compressor optimization, flow line insulation (buried pipe), and drag reducers. Detailed flow assurance analysis was performed for each of the proposed options, and a recommended solution was reached based on clearly identified advantages and disadvantages for each operating scenario.

Flow assurance evaluations were used on a continuous basis for smart planning of operations to optimize and maintain production during this period.

Basis for Evaluation of Late Life Options

Various late life operation strategies were evaluated:

- Open pigging valve at AC1 and allow flow from each flow line to flow freely in one or both directions depending on the pressure in the system. Maintain same