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A Fieldwide Integrated Production Model and Asset Management System for the Mumbai High Field

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Abstract

To increase the profitability and field production an Integrated Asset Modeling project was initiated. A high fidelity, field-wide, Integrated Production Model (IPM), was developed for Oil and Natural Gas Corporation's (ONGC) giant offshore field of Mumbai High. The network based IPM enables superior engineering analysis and more efficient decision-making compared to classical single branch and nodal analysis approaches. This is done by capturing, in the model, the effect of all the network interactions that occur in the production network.

Such a model helps to quickly identify and accurately quantify bottlenecks and other opportunities to improve production. Production improvements can be made by making daily or weekly operational changes as in gas-lift-allocation, surface backpressures, pipeline lineup etc as flow conditions change in the field. The IPM model would also assist in reliably evaluating field operational and re-development plans, and thus expedite the engineering decision processes.

The project-plan also called for an Integrated Asset Model (IAM) by integrating the IPM to reservoir simulation models and to a suite of fit-for-purpose optimization tools. The IAM model will then enable model based field-wide future development projection studies and planning scenario studies over time. Network based optimization such as network-gas-lift optimization can be easily done to find the optimum operation set points that maximize production without violating user defined operational and capacity constraints.

The model will eventually evolve into an online IAM. Here the On-Line utilities will effortlessly update data from the application historian to the IAM with the latest or requested data set. The historian stores recurrent data from field-wide SCADA-DCS systems and other sources.

This paper describes the development of the IPM for ONGC's giant offshore Mumbai High field and the technical and project management challenges faced. The IPM includes the production, water-injection, gas-lift supply and transportation networks. The integrated model also includes simplified models of processing facilities at each process complex.

Work to extend the IPM to an IAM is ongoing. Factors that were found to be critical to the success of the project are identified and discussed in this paper. This will provide a better understanding and appreciation of the complex project implementation issues and challenges that need to be resolved.

Introduction

ONGC's Mumbai High field is located 160 Km W-NW offshore from Mumbai in the Western Coastal shelf of India, with an aerial extent of 1200 sq km (Figure 1). The field was discovered in 1974 and put on production in 1976; it is currently on a pressure maintenance scheme using water injection (since 1984). The field is currently in a decline phase with problems like high water cut and high GOR (gas oil ratio).

Mumbai High Field is divided into two major blocks, North and South. The field is a multi-layered reservoir with several exploitable zones of oil and some gas (Figure 2). At present oil and gas is being produced through 5 processing complexes, 98 unmanned wellhead platforms and 2900kms of pipeline network. There are about 650 oil and 40 gas producing strings, and 200 water injection wells in Mumbai High Field. The field is divided into two parts; Mumbai High North and Mumbai High South (fig 3a and 3b) More than 80% of the oil producers are on gas lift. Presently, around 250,000 bpd of crude oil and 15 MMSCMD of gas are produced from the Mumbai High Field (Figure 4).

The bulk production from unmanned wellhead platforms is transported to one of the 5 process complexes (BHS, SHP,