Optimizing Well Integrity Surveillance and Diagnostic for Gas Lift Wells in Mature Fields - Case History in Egypt

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Abstract

GUPCO is one of the major companies in Egypt using Gas Lift for operating more than 500 wells across Gulf of the Suez (GoS). To ensure that wells operate as designed for their assigned life with all risks as low as reasonably practicable, GUPCO initiated an in-house Well Integrity Management Policy (WIMP) with combination of well modeling to simulate the operating conditions. WIMP defines the operating standards for maintaining well integrity parameters, securing well potential availability and emphasizing on the problem prevention before happening. In addition, well modelling plays a vital role in such challenging mature fields that helps in decreasing Natural Flow Capability (NFC) physical test frequencies, especially for vast infrastructure.

Case A: a Shut-in well re-perforated due to formation damage and is classified as high risk according to WIMP due to NFC and communication between annulus and tubing. Based on reservoir performance, the well should stabilize at higher WC. Well modeling quantified the value to be self-killed and the plan changed from rig workover to producing the well for a month to monitor the WC with a temporary dispensation from WIMP for diagnostic. The well stabilized at higher WC and saved workover cost.Case B: a vessel collided with one of the GoS Platforms, which leads to structural failure, and physical NFC tests at zero Well Head Pressure (WHP) for the wells became impossible before toppling the P/F. Well modeling using PROSPER helped to identify wells potential, NFC of each well and choose the proper securing method.

Gas lift is one of the most common and efficient artificial lift techniques. Thereby, it has been widely recognized and successfully applied worldwide for increasing oil production. The objectives of this simulation study are to investigate effect of gas injection rate and injected gas composition on oil production to determine the optimum injection rate, effects of parameters such as water-cut, well-head pressure, and tubing roughness on oil production, reliability of used well test data, and model the field performance along with life of the reservoir. The IPM simulator is used for simulating actual production systems and assessing their responses to different production scenarios. PROSPER software is one of the most important packages of the IPM that is used to maximize the production earnings by providing critical analysis of the performance of each producing well and groups of wells. The PROSPER simulator is used to model all wells individually using actual PVT data of the deviation survey, down-hole completion, geothermal gradient, and average heat capacities. The model is constructed and matched with the real data and thereby the best fluid and well production correlations are selected. Then, the constructed model is used to determine the optimum gas injection rate for the subject well. Finally, sensitivity analysis tests are performed to simulate and investigate the effect of other parameters which are believed to have a real impact in optimized gas lift process. The investigated parameters include; injection gas composition, water-cut, well-head pressure, and tubing roughness The attained results indicated that gas lift optimization process is inevitable for obtaining high oil production rates and several variables should be considered, optimization of gas injection rate increases the oil production, injected gas composition, water-cut, and well-head pressure have an important effect while tubing.

Well integrity is a combination of several disciplines integrated into the different phases of the well lifecycle with ultimate objective to prevent well control incidents. The subject of this paper is about effectiveness of various well integrity monitoring techniques at different stages of the field life. It is based on actual Company lessons learned and recent experience in managing well integrity incidents, when all barriers got lost. Wellhead pressure monitoring is one of the most popular methods of well integrity surveillance. It is based on the double barrier envelope concept: primary barrier envelope is the one exposed to pressure; secondary barrier envelope is the one that will be exposed to pressure if primary barrier fails. Therefore, once the primary barrier fails, it is expected to observe pressure at surface as an indication of the failure. Therefore each well operator has internal fit for purpose wellhead pressure monitoring system. Some specific well categories might be monitored more frequently than another due to higher risks associated with these wells.

Double barrier policy is a well integrity requirement well-known world-wide. This policy applies to wells with positive pressure at surface capable to flow naturally. This policy is the basement for wellhead pressure monitoring system. However, based on the latest Company's well integrity experience, this system is applicable for green fields only, with brand new barriers installed and tested. In case of mature brown fields after several decades of production this system may not always work perfectly. It may happen that failure of the primary barrier envelope occurs in the wells with already failed secondary barrier envelope. In this case there is no any "grace" period to respond to the failure and we immediately get a well control incident reflecting in uncontrolled release of well media

through failed barriers. Therefore at some point of field development the time comes when secondary barrier envelope is not reliable anymore and additional surveillance activity has to be implemented to ensure safe operating conditions in the fields. This paper warns well operators on the potential gaps in the well integrity monitoring that may lead to the severe incidents. Those gaps may not exist at the early stages of development but appears during the "transition from green to brown" field. The paper helps to recognize the period for activating additional surveillance techniques avoiding unnecessary OPEX impact. It also describes various surveillance techniques for secondary barrier envelope including leak detection, corrosion logging and pressure testing.