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Challenges in Working Over-severely Corroded Water Injectors for PWRI Application

Abstract

The Nelson field is located 120kms offshore from Aberdeen in the Central North Sea. It is an important asset for Shell UK in the North Sea. This paper highlights the important steps that Shell UK is taking towards reducing its oil to sea discharge and meet compliance with OSPAR regulations. The heavily corroded state of the Nelson water injectors posed a major challenge towards successfully recovering the slot and executing a workover, which would allow produced water to be re-injected into the reservoir instead of being discharged to the sea. This paper details the work scope, the plans and execution of the workover. It highlights the challenges that were faced by the team to deliver a well capable of produced water and seawater injection. The paper details the final results obtained from the successful campaign on the Nelson platform.

Introduction

Field Background: The Nelson Field (Block 22/11) is located approximately 120km east of Aberdeen in the Central Graben of the North Sea UKCS. The reservoir interval is the Paleocene Forties sandstone and comprises turbidite sandstones deposited in a proximal mid-fan part of a large basin-floor sub-marine fan system. With a current daily oil production of around 40,000 bopd, the Nelson Field has been and remains an important asset for Shell UK Ltd. There were four seawater injectors on the periphery of the Nelson field. Together they had injected over 235 MM bbls of seawater (Figure 1).

Nelson PWRI Project: The Nelson asset needed to reduce the quantity of oil discharged to sea by 18% (compared against the oil discharge to sea in 2000) to meet the 2006 OSPAR requirements. The base forecast showed a gap between forecast oil to sea tonnage and the OSPAR regulations. Produced Water Re-Injection (PWRI) was selected as the solution to meet OSPAR commitments.

The plan was to install new produced water injection facilities on the platform and workover the existing seawater injectors to allow injection of the bulk of the produced water under reservoir fracturing conditions. The combined modifications would give the system a capacity of injecting 170,000 bbls/d. A number of producers and injectors were identified as donor wells for the project. Bearing other key considerations in mind (like subsurface value, well integrity issues), the existing seawater injectors were judged to be the most suitable candidates for conversion into produced water injectors. Annular leaks had been detected in all four seawater injectors. Water injection continued under short-term dispensation until Dec 2004, when it was shut down to preserve production casing integrity. The PWRI project was also seen as an apt technical solution to restore well integrity in these injectors. In order to establish a baseline well condition status, lead impression blocks (LIB) were run into the water injectors. The LIB results were inconclusive and a down hole camera (Omega Camera Services) was run in hole. The pictures confirmed that there was substantial damage to the production tubing and expectedly to the production casing (figure 2).

Multiple Challenges

The integrity and lifecycle operability of the production casing was the primary concern. Given the amount of damage to the completion tubing, it would not be unexpected to find the production casing in a similar state. It was difficult to judge whether a “simple?? workover would suffice or would this necessitate a full slot recovery operation to drill a new water injector. An accurate measurement of the casing wall thickness was required to answer this question. A USIT (Ultra Sonic Imaging Tool) or a Calliper log would have helped, but that could only be possible after retrieval of the production tubing.