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Screening method for platform conductor integrity assessment for life extension prioritisation

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ABSTRACT

Most of the major oilfields in the North Sea, Persian Gulf and South China Sea are becoming very mature, with their assets exceeding their calculated design life. Severe corrosions on the metallic structures of oil wells consisting of the conductor and casings, combined with spalling of annular cement forming the barriers can result in catastrophic events leading to structural collapse and wellhead vertically dropping onto the platform deck. With the collected inspection records, a systematic approach is deemed essential to assess the in-place condition of these wells and to categorise them for life extension works. This paper presents a simplified screening method for the structural integrity assessment of platform conductors towards the end of their design life and the prioritisation which follows thereafter for life extension operations by bridging the gap between design data and inspection records. The deterministic and probabilistic integrated approach is taken to address this problem, by considering the information collected from the as-built design records to the in-place inspections, coupled with the operating and metocean loads. The pragmatic and novel conductor operating guideline curves are proposed and constructed to present the evaluated integrity states, which will enable operators to rapidly categorise conductors for rehabilitation. This screening method is applied to a group of 40-year old water injection wells, and is demonstrated to have the practical prospect, and can be automated to provide a robust and effective assessment technique.

1. Introduction

Well integrity is perceived commonly as the actions leading towards reducing the risks of release of formation fluids into the environment during its operating lifespan. NORSOK [1] is a functional governing standard in matters concerning well integrity, and specifies the minimum requirement of a two-barrier well construction to prevent any leaks to the environment. The conductor and casings fall into the category of the well structural barrier, along with the annuli cement. Typical wells are designed for 25 years of service life, and operators worldwide are beginning to encounter wells operating beyond 30 years such as in the South China Sea (offshore Malaysia), and even up to 40 years, in some areas such as the North Sea [2] and the Persian Gulf. An example of a shallow water platform is shown in Fig. 1, highlighting the conductors, followed by the well construction layout inside the conductor, in Fig. 2.

Continued services are usually expected from these older wells for several reasons. The primary reason is due to availability of significant amount of reserves remaining in the reservoir, accompanied by excessive costs in replacement/abandonment activities. This is usually followed by requirement from the operator to maintain the existing platform whilst an alternative long-term solution is

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Fig. 1. Shallow water jacket platform in the persian Gulf, showing typical conductor arrangement [4].

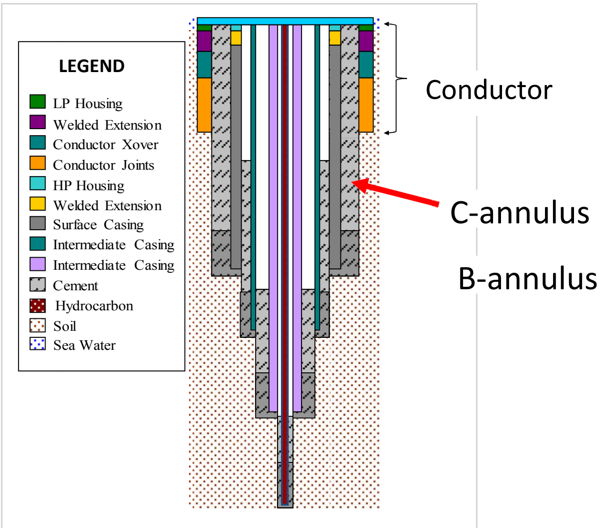

Fig. 2. Platform well construction schematics.

being developed, either the construction of a new platform, artificial islands [3] or tie back options. In any of these cases, the integrity of the wells must be kept pristine if extended service life is expected. It is common for operators to carry out scheduled site inspections and surveys to monitor the integrity of their wells, and it is very likely that these data are underused or misinterpreted in evaluating the integrity of ageing wells, potentially resulting in catastrophic failures such as casing collapse, or wellhead and surface tree settlement onto the platform deck.

In an ageing well, the heavy external corrosion on the conductor and casing's outer diameter (OD) will result in the loss in overall stiffness to resist the topside weights and environmental loads. In areas with large pits and holes, seawater ingress will cause internal corrosion on the conductor inner diameter (ID), and to some extent the surface casing ID too. The continued conductor ID corrosion can result in rust flakes formation [4,5] which will in turn diminish the annular cement capacity to bond with the pipes inside the C-annulus effectively, and over time, will cause the cement shortfall, i.e. the cementation losing its shear bond capacity and dropping farther downhole [4,6]. These occurrences are depicted in Fig. 3.

Under potentially high loading from the well topsides equipment (axial) and the environment (bending), and from the reduced