Deepwater Flowline Internal Corrosion Control – Safety by Design

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ABSTRACT

As exploration activities in deep water areas have kept increasing, the deepwater development and production have presented unique challenges throughout the oil and gas industry. The operating conditions, such as temperature and pressure, can become substantially harsher with regards to internal corrosion for carbon steel flowlines, which are valuable and ubiquitous assets to upstream operations. Any failures or leaks of deepwater flowlines may result in serious environment and safety impacts, as well as significant financial consequences. Therefore, the integrity challenges associated with deepwater operation require establishing a safety mindset in the early stage of a project. This paper introduces the concept of safety by design for deepwater internal corrosion control and specifically addresses the increased challenges during the design phase to ensure the pipeline integrity over the operation life. The emphases on design considerations to alleviate the pipeline integrity concerns including a robust corrosion inhibition system and design safeguards that minimize the risks from both uniform and localized corrosion are discussed.

KEY WORDS: Deepwater, Corrosion Inhibitor, Safety by Design

INTRODUCTION

A rapid increase in deepwater oil and gas production activities has been observed in recent years, driven by the demand to increase oil and gas reserves and production, as well as the emerging cutting-edge offshore technology advancement. Apparently, the definition of deepwater has evolved with regard to time, region, and technological improvement, as drilling and production activities have moved further away from continental shelf shallow water to deeper water over the years. For instance, drilling is classified as deepwater for water depths of more than 152 m (500 ft) by the US government and 400 m (1,312 ft) in many European countries. Water depths of greater than 1500 m (4921 ft) are typically defined as “ultra-deepwater” (McKinnon, 1999). Driven by increasing global demand for resources, the exploration and drilling in deep water areas have kept increasing for the last decade.

Frequently, the deepwater concept used by the drilling and exploration is borrowed and directly used by corrosion and materials engineers. The deepwater development and production have presented unique challenges from all perspectives to the oil and gas companies. Compared to conventional offshore drilling and development methods, deepwater challenges include: greater water depths, higher pressures, extra-long riser pipe requirements connecting the wellhead to the rig, low seabed temperatures, and overall higher development costs. From a corrosion standpoint, the operation conditions, such as temperature and pressure, can become substantially more severe for carbon steel flowlines, which are valuable assets to upstream operations. Any failures or leaks of the deepwater flowlines may result in serious environment and safety impacts, as well as significant financial consequences. Therefore, the integrity challenges associated with deepwater operation require establishing a safety mindset in the early stage of a project within the cost and schedule constraints.

This paper introduces the concept of safety by design for deepwater corrosion control for carbon steel flowlines and specifically addresses the increased challenges during the design phase to ensure the pipeline integrity can be managed over the life of the facility. The emphases on safe design considerations to alleviate the pipeline integrity concerns include a robust corrosion inhibition system and design safeguards that minimize the risks from both uniform and localized corrosion. To illustrate the safety by design concept, various influential factors on the deepwater corrosion inhibitor qualification are discussed in examples on both brown and green field developments. The paper also discusses some key deepwater parameters, which are not typically emphasized in the onshore or shallow water projects in the early design phase, such as low temperature viscosity profile and elastomer compatibility. These parameters can adversely put integrity management considerations on a