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Water Level Variation due to Global Warming and the Evaluation of Offshore Jacket Structure's Elemental Behavior

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Abstract

This paper presents the results of a research on water level rise. Although there are different kinds of water level rise (tidal water level rise, water level rise due to seabed's subsidence, water level rise because of storm surge) exerted on offshore structures, one special water level rise, which is due to global warming, is considered in this study. One Jacket offshore platform is modeled using ANSYS finite element software. It is supposed that this structure has been installed in a medium water depth and the water level rise about 2.5 is exerted on this structure beyond its design water level. For evaluating the effect of design water level on the structural behavior after water level variation, three different models with three different design water levels is applied. For this purpose, Von Mises stress is used as an ideal criteria for evaluating steel structures serviceability. More detailed studying is done by assessing variation of utilization ratio because of water level variation. The results of this research show that depend on structural elements location on the whole structure, different behaviors are possible. For some elements, water level rise causes to increase in Von Mises stress and consequently in Utilization Ration of these elements but for some others the results are vice versa.

Introduction

The most commonly used offshore platforms in the Gulf of Mexico, Nigeria, California shorelines and the Persian Gulf are template type platforms made of steel, and used for oil/gas exploration and production[2-3]. Jacket structures are generally used for exploration and production of hydrocarbons. Offshore jacket structures have been used in petroleum activity for decades. They are the most commonly adopted structure foe shallow and intermediate water depths (say d<150m). The existing jackets have typically been designed for a life of around 20 years [1]. The design of jacket structures is generally based on the expected response of components to the applied loads anticipated. There is uncertainty on both the loading and resistance sides of this equation so characteristic values are derived from the available data. The main aim of structural design and in-service assessment is to ensure that the structure adequately fulfills its requirements with respect to serviceability and safety. In traditional design/re-assessment practice, the focus is on component-level checks. The water level variation is one of the effects of global warming which may be acted on offshore and inshore structures. The global warming phenomenon has caused some changes on the wave regimes and water depths. The Caspian Sea being the largest inner sea and, thus, considered to be a lake, has its surface level below the level of the World Ocean and unites quite a big watershed areas of such deliberate rivers as Volga, Uhral, Kura, Tereck and etc. and has no connection with the World Ocean. Having its level below the one of the World Ocean and the evaporation area the largest