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Seismic Time History Response of the Maleo Producer

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Abstract

The Maleo Producer is a converted Bethlehem JU 250 (1970's design) mat-supported jack-up that is currently operating as a gas production platform in the Madura Straits, offshore Indonesia. The field is located in a seismically active region. This paper summarizes the procedures used to assess the structural adequacy of the platform for seismic loading. The reported results along with those for overall foundation stability were accepted by the American Bureau of Shipping for class approval of the structure as a fixed offshore installation.

Introduction

The Maleo Producer is a Bethlehem JU250 (1970's vintage) mat supported jack up that was converted to a gas production platform for operation in the Madura Straits offshore northern Indonesia. The site design water depth is 187 ft. This mode of operation is a significant departure from its original design as a mobile offshore drilling unit (MODU). The conversion technically defines the platform as a mobile offshore production unit (MOPU), however the platform will operate on location for a period of 14 years. Consequently, the unit was classed as a fixed offshore structure. Class was sought with the American Bureau of Shipping using the requisite class documents (ABS, 1997). The procedures of API RP 2A (API, 2000) were used to define the seismic analysis methodology and determine structural response for seismic loads.

The class process required confirmation of platform adequacy for storm and fatigue loading. These loading conditions were part of the original platform design basis and hence the structural performance, with minor modifications to account for ageing, was readily demonstrated. Seismic loading was not part of the original design basis of the structure and thus required rigorous investigation to confirm adequacy in terms of strength, ductility, and overall stability. The issue of overall stability was further compounded by the site soil conditions which were relatively soft (Neubecker and Audibert, 2008 and Spikula and Garmon, 2008). Demonstration of overall stability of the platform was carried out by a combination of analytical methods (Murff and Young, 2008) and three dimensional soil structure interaction analyses (Templeton, 2008). Results from the soil structure interaction analyses formed the input loading to the structural time history analyses and the study of load transfer through the pins that support the deck.

Background

Platform Structural Details

The Maleo Producer is a self elevating unit that employs two sets of six pins (per leg) and hydraulic rams (two per leg) as a jacking mechanism. Pin sets are alternatively engaged and rams extended or contracted to raise and lower the deck. The platform was originally designated as the Cliffs Drilling Number 10 (CD10) which operated in early years in the Gulf of Mexico and laterally as a Mobile Offshore Production Unit (MOPU) in the Arabian Gulf. Conversion of the platform for gas production was carried out in Sharjah in 2005-2006. The conversion included a complete refurbishment of the deck and addition of new process equipment, addition of a flare tower, reduction in leg length from 312 ft to 282.25 ft, modification to the leg and mat connection for improved fatigue performance and the addition of sponson tanks to improve afloat stability during installation. Details for the platform configuration in production mode with deck elevated are given in Table 1.