UNIVERSITI TEKNOLOGI MARA

LIFE EXTENSION VIA RISK BASED MANAGEMENT FOR TABULAR LEG STRUCTURE OF MOBILE OFFSHORE PRODUCTION UNIT USING FINITE ELEMENT METHOD

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MSc

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations Of University Teknologi MARA. It is original and is the result of my own work unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

A Mobile Offshore Production Unit (MOPU) is any type of portable structure that can be reused when procuring oil and gas from the seabed. There are a few reasons why MOPU was chosen over the conventional fixed offshore platforms, mainly due to its ability to be installed and relocated in a short period, low installation and abandonment cost, and providing adequate time for properly evaluating the new reservoirs. In certain circumstances, MOPU may be required to remain at the same location for a longer period beyond its designed life. This study explains the method of life extension assessment to extend the useful life of the MOPU. A three-legged jack-up rig MOPU in cruciform shape was designed, constructed, and commissioned based on the American Bureau of Shipping (ABS) Classification requirement with a design life of 5 years. The MOPU was constructed with three tabular legs with hull hanged at the tabular using jacking-pin at the equal elevation. The MOPU was put in laid-up mode, non-operational, and clear of hydrocarbons after 10 years in operation. The MOPU is intended to remain at the site for another 5 years or beyond before any plan is developed. The legs are the main focus of the condition assessment for the life extension of the MOPU. The method of condition assessment used is Non-destructive Tests (NDT). No severe defects or cracks were recorded at the stress concentration points. All NDT measurements were found within the acceptable ranges, which qualifies the Fatigue Design Factor (FDF) to be reduced from 5 to 3 at the critical inspectable location and 10 to 5 at the critical non-inspectable location for the new Fatigue Design Life calculation. The maximum stress calculated is 343 MPa located at leg 2 at the jacking pinhole. The result of the life extension assessment shows some locations have exceeded the Design Fatigue Life (DFL), where the lowest fatigue life calculated is 10.3 years. A crack simulation was developed to assess the crack propagation at the lowest fatigue life location where 0.4 years of crack propagation time was calculated before the crack propagate to the next phase. Based on the crack propagation time, the Risk-Based Management (RBM) method was deployed to develop an inspection interval aimed to provide an early deterioration detection at the most susceptible location to ascertain the Fitness For Purpose (FFP) of the MOPU for a life extension.

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