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Air-gap effect on life boat arrangement for a semi-submersible FPU

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Abstract

In the offshore project such as semi-submersible FPU and FPSO, the free fall type life boat called TEMPSC (Totally Enclosed Motor Propelled Survival Craft) has been installed for the use of an emergency evacuation of POB (People on Board) from the topside platform. For the design of life boat arrangement for semi-submersible FPU in the initial design stage, the drop height and launch angle are required fulfill with the limitation of classification society rule and Company requirement, including type of approval as applicable when intact and damage condition of the platform.

In this paper, we have been performed the numerical studies to find proper arrangement for the life boats consider drop height in various environmental conditions such as wave, wind and current. In the calculations, the contributions from static and low frequency (LF) motions are considered from the hydrodynamic and mooring analysis as well as damage angle from the intact and damage stability analysis. Also, Air-gap calculation at the life boat positions has been carried out to check the effect on the life boat arrangement. The air-gap assessment is based on the extreme air-gap method includes the effect of 1st order wave frequency (WF) motions, 2nd order low frequency roll/pitch motion, static trim/heel and set down.
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Keywords: Semi-submersible FPU; Life boat; Drop height; Damage; Intact; Air-gap

1. Introduction

In the initial design stage of offshore projects, there are a number of issues that influence the design of a functional life saving arrangement for a semi-submersible Floating Production Unit (FPU). It is important to maintain an interdisciplinary and coordinated approach to the arrangement design to ensure functional capacities and location of all equipment.

The aim when designing the life saving arrangement shall be to develop an arrangement that will provide the highest possible level of reliability and safety. So, the life boat arrangement on the topside deck or living quarter should be considered including the drop height and launch angle. The drop height and launch angle for life boat are required fulfill with the limitation of flag state such as Safety of Life at Sea, SOLAS (Solas, 2008), Mobile Offshore Drilling Unit, MODU (MODU Code, 2009), Classification Society (DNV Offshore Standard, 2009) and Company Requirement in BoD, i.e. Basis of Design when intact and damage condition of the floater Units. Fig. 1 shows the life boats on semi-submersible FPU.

Tregde et al. (2011) validate the compatibility of CFD to simulation the free fall life boat drops including accelerations and hull pressures. This paper presents the result of the life boat drop height of semi-submersible FPU in various environmental conditions such as wave, wind and current. To calculate drop height of the life boat, the hydrodynamic and mooring analysis has been carried out as a global performance analysis. For the accurate analysis of motion and mooring response of the semi-submersible FPU, a three dimensional ship motion program, WADAM (WADAM ver. 8.1, 2010) is

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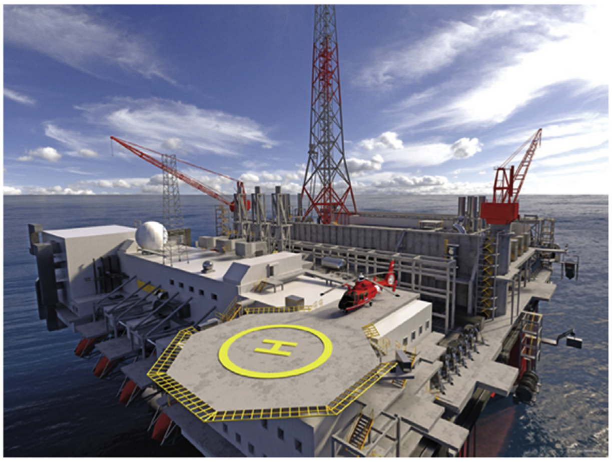

Fig. 1. Life boats on semi-submersible FPU.

used for the hydrodynamic analysis. WADAM is developed by DNV, and can solve the linear ship motion and wave load in frequency domain. Also MIMOSA (MIMOSA ver. 6.3, 2010) program is used for the mooring analysis.

The main objective of this paper is to complement the life boat arrangement and to provide a general methodology for calculate the life boat drop height and launch angle of semi-submersible FPU in operating loading conditions.

2. Information of semi-submersible FPU

For the life boat drop height calculation, the future operating loading condition is taken from the Stability analysis report (B930-AS-REP-10000-rev-V, 2014), which contains the basic information of hull with hydrostatic data for various loading conditions.

2.1. Principal particulars

Table 1 provides the principal particulars of designed semi-submersible FPU. The Height and draught are measured from the base line, which is defined as the inside of the pontoon bottom plate (molded).

2.2. Loading conditions

Table 2 and Fig. 2 show the selected loading conditions as design cases of designed semi-submersible FPU for life boat drop height analysis. Normal operation condition is selected.

Table 1
Principal particulars.

Free board (m)	22.00
Draught (m)	26.00
Column width (m)	26.65
Pontoon width (m)	26.65
Pontoon height (m)	11.88

Table 2
Loading conditions.

T_AP (m)	26.00
T_FP (m)	26.00
Disp. (MT)	152,731.0
KG (m)	34.90
LCG (m)	0.001

2.3. Environmental conditions

The environmental conditions for drop height calculation are shown in Tables 3 and 4. The wave heading angles are equally distributed from 0 to 360° with 45° interval. The drop heights are calculated at return period (RP) of 1 year and 100 years.

3. Methodology of life boat drop height calculation

The life boat drop height analysis for the semi-submersible FPU has been performed by using a three-dimensional ship motion program, WADAM (WADAM ver. 8.1, 2010), developed by DNV. It is noted that WADAM uses a three-dimensional diffraction theory with various boundary conditions in frequency domain. In this paper, the following programs are used to obtain the life boat drop height results:

- WADAM (WADAM ver. 8.1, 2010), linear three-dimensional frequency domain program is based on the pulsating source panel method. Wave loading program for calculation of hydrodynamic loads and rigid body motions by 3D diffraction and Morison theory. The 3D potential theory in WADAM is based directly on the wave loading program WAMIT developed by Massachusetts Institute of Technology. WADAM calculates RAO(Response Amplitude Operator) for motions, hydrodynamic pressure and sectional forces of the vessel.
- MIMOSA (MIMOSA ver. 6.3, 2010) is a computer program for analysis of mooring systems for moored vessels (semi-submersible, ship). The program is up-to-date with respect to calculations which comply with the applicable standard (DNV), e.g. calculation of slow drift, line dynamics and transient motion. Frequency domain techniques to compute vessel motion and dynamic mooring tension are employed. Time domain transient analysis after line failure will also be performed by MIMOSA. For air gap and motion analyses Mimosa is used to determine the low-frequency and static motions.
- POSTRESP (POSTRESP ver. 6.2, 2007), wave statistical post-processor for determination of short and long term responses of motion and wave loads.

3.1. Co-ordinate system

Throughout the paper right-handed Cartesian co-ordinate systems are used. The structural coordinate system is used in

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