Optimization of Marine Growth Cleaning Program: A Reliability-Based Study on Jacket Type Offshore Structures

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Current challenges for requalification of existing offshore structures through the reassessment process draws attention to the importance of updating information about the state of structural safety. One of the most important phases during the design or re-assessment level of a jacket-type offshore structure is the re-evaluation of environmental loads and updating data concerning the state of biocolonization, structural damage, corrosion, etc. The randomness nature of biofouling and the existing uncertainties make modeling of environmental loading complicated. The biocolonization process is a complex phenomenon and the related data can contain a large diversity among marine growth classifications and species. The general species of marine growth can be classified into two main categories: vegetal (e.g. algae), and animal (e.g. corals). Even structures with the best protection schemes against biocolonization start to be covered by various types of marine growth after a few weeks or months. Biofouling is known to cause adverse effects on the performance of offshore structures. Its presence can modify the surface roughness and the diameter of structural members and hence changes in the level of hydrodynamic coefficients. Moreover, modifying the added mass can change the natural period and hence dynamic responses of the structures. The influence of bio-colonization on an offshore structure is of concern for a number of reasons: obstructing or prohibiting the periodical inspections of the structure, considerable cost of cleaning programs for offshore industries, and increasing the hydrodynamic forces on structural members. Considering these issues and depending on the offshore fields, it is shown that biocolonization has a dominant effect on the cost of maintenance and cleaning programs of offshore structures. Cost-effective safety management of such structures involves allocating the optimal amount of resources to periodical inspections and maintenance activities in order to control risks (expected life of the structure). This study aimed to address a stochastic modeling of biofouling based on Response Surface Methodology as well as a reliability-based optimal cleaning program for offshore structures. Moreover, it focused on the uncertainty and sensitivity studies considering the effects of waves, wind-sea, and currents. The probabilistic modeling, concerned corals in Guinea Gulf with a time-dependent thickness and roughness model that changed the reliability with strong non linearity along the time. This was simulated through monte-carlo simulation from probabilistic models which represented changes in biocolonization process due to environment.

Keywords: marine growth, jacket type offshore structures, optimal cleaning program, reliability, reassessment process, biocolonization