

Estimation of Probability of Subsea Installation on the Basis of Wave Statistics

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ABSTRACT

Application of subsea technologies near shore or simultaneously with platforms far offshore on the Russian Arctic continental shelf with harsh ice conditions seems to be feasible or at least should be considered within the range of concepts due to possible good economical effect. Installation is one of the crucial marine operations related to the subsea technologies. Right forecast of the weather and wave conditions is the key issue in the planning of installation operation of subsea modules. Limitations of subsea installation related to waves have been shown in this work. Optimal time period for installation, probability of success per one season and mean time of installation have been determined on the basis of statistics accumulated in RMRS' directories.

KEY WORDS: Subsea technology; marine operations; installation; forecast; wave conditions.

INTRODUCTION

Subsea technologies on the Russian Arctic continental shelf with harsh ice conditions seem to be applicable or at least have to be considered within the range of concepts. These solutions may have a good economical effect. Taking into account the significant progress achieved in offshore development with subsea technologies over last decades and increased reliability one may with high degree of certainty conclude that these systems are important and perspective for Russian shelf. This can also be confirmed by announced plans to use floating structures, which require elements of subsea development.

At the same time there is a number of limiting factors enhancing the application of subsea technologies, such as long distances to the shore, ice gouge of seabed at the location of templates or pipelines, limited service and maintenance availability in ice infested waters, limited installation period.

Installation is one of the crucial marine operations related to the subsea technologies, which can be executed during ice-free period lasting in some areas about 3-4 month. Therefore right weather forecast, forecast

of wave conditions, assessment and determination of available and favorable installation period is a key issue.

This paper shows limitations of subsea installation related to wind and waves. Optimal time period for installation, probability of success per one season and mean time of installation have been determined on the basis of accumulated in RMRS(Russian Maritime Register of Shipping) directories statistics.

The work described in this paper is of practical interest and can be extended to the wide range of marine operations, such as transportation, installation, repair and maintenance operations. Authors consider this work only as a preparation phase to the development of the instrument which will enable to forecast available and most favorable time frames for the number of marine operations and thus will help to estimate corresponding risks.

Average time of subsea modules installation (including trip operations) on the basis of world experience is assumed to be 48 hours. It is also assumed that installation operation is limited due to safety reasons by the wave height equal to 2m. Therefore execution of installation operation requires «weather window» of 48 hours with wave height <2m.

Mean duration of «weather window» (wave height is less than 2m) and number of these windows for one month can be estimated by using statistics from RMRS. Experience shows that an exponential distribution (Eq. 1) describes the duration, D , for a given event reasonably well.

$$P(D > d | H < h) = \exp\left(-\frac{d}{D}\right) \quad (1)$$

where D – mean duration of «weather window» (hours), d – time required for installation (hours), H – maximal wave height within 48 hours, h – limiting wave height, P – probability of success for one attempt.