Sandwaves: Where and Why

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Abstract

This paper describes the results of an initial study with the objective to construct and use a Geographical Information System to improve the understanding of the occurrence and behaviour of sandwaves in the southern North Sea. The paper describes the main contents of the system and presents indicative results. This work forms a part of a number of studies aiming at developing a practical tool for the routing and engineering of pipelines and cables through sandwave areas.

1. INTRODUCTION

Offshore oil and gas pipelines must be protected against failures which may lead to loss of hydrocarbons and consequently environmental and ecological damage. Therefore, these pipelines are positioned on, in or even below the seabed to provide stability and protection. One of the most critical potential hazards is a pipeline coming into a free span.

In sandwave areas the probability of unacceptable exposures or free spans is significant. The solution at this moment is deep trenching at installation (often requiring large volumes of offshore dredging), retrenching when unacceptable exposures occur or even stabilizing the pipeline with for instance rocks or mattresses.

All these alternatives are quite expensive and causing a significant environmental impact. If the long term behaviour of sand waves can be predicted, this will used in optimizing the routing and design of the pipelines, resulting in significant cost savings and reduction of the environmental impact.

2. SANDWAVES

The seabed is covered with various types of bedforms. Ranging from small ripples (order of cm) up to large sandbanks (order of kilometers). There is some confusion about the definition of sand waves. The most commonly used definition is the following.

Sandwaves are elongated depositional bed forms with an undulating surface, which are located mainly transverse or with a small angle to the dominant current direction. Their height ranges roughly from 1 to 10 metres and their wavelength from 100 to 1,000 metres.

Sand ‘waves’ are able to propagate or migrate, like most waves. Measurements indicate migration rates ranging from negligible to up to 10-15 m per year. For most offshore structures with design life’s ranging from 20 to 100 year this migration rate should be taken into consideration.

However, among the driving forces behind the formation and migration of sandwaves, much is still unknown. It is still not possible to predict the migration rate of a sandwave field with sufficient reliability, which inevitable lead to conservative designs of pipeline burial and free spans. In some cases a few years of survey data is available which of course helps in assessing the sandwave behaviour.

Various studies are being carried out and being planned which all aim at improving the understanding and predictability of sand waves. These will lead to cost reductions in pipeline installations through sandwave areas.

3. WHERE AND WHY

Information about sandwaves is available in literature but only rather scattered. There was a need to collect the relevant sandwave data systematically.

3.1 Where

The first question asked is always about the location of the sandwaves: where are they and how do they look like.

The location and dimension of sandwave areas are mainly extracted from geological and bathymetrical charts of the North Sea. Up to now, these geological charts are only available for the part of the North Sea located South of 54 °N and West of 4 °E.

Additional information is available for the Dutch coastal waters, prepared by the survey department of the Dutch Ministry of Transport and Public Works. The collected information comprises:

- sandwave locations
- maximum sandwave heights
- sandwave orientation.

3.2 Why

The second question asked is always about the migration rate of the sandwaves. Do they migrate and if so, how fast. As long as systematic and accurate surveys, are not available for a sufficiently long period, other methods should be used. If we understand why sandwaves are present under certain conditions, we may also be able to say something about their migration rate. As said before, this is a topic for further research, but we have started with collecting the (probably) most relevant data which may influence the development and migration rate of sandwaves. The following data has so far being collected.