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Pipeline Integrity in Geohazard Prone Seabed Terrain: What is the Real Risk?

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Abstract

Geohazard features can now be mapped in great detail to all required water depth as a routine and mature task for the design and installation of submarine pipelines. The perceived risk associated with some of these highly characteristic morphological and geotechnical phenomena remains however a combination of quantitative modelling and engineering judgement.

This note references examples of several deepwater long distance pipeline projects in which geohazard has played a dominant factor in the assessment of risk to the pipeline, and revisits the application of engineering geohazard assessment to pipeline routeing and design. Geohazard in this context is limited to geological process at or near seabed that could result in catastrophic damage and loss of containment.

Introduction

Project's requiring the design of a pipeline system that traverse's coast margin shelf, slope and deepwater basin, will encounter a range of 'normally' expected and generally well understood geological terrain, each of which will include characteristic process and features at the seabed presenting potential risk to pipeline integrity. Pipeline engineering in deepwater therefore requires an early and authoritative appreciation of the regional setting for route selection, in support of key decisions regarding project concept, feasibility and investment
The observations and opinions discussed below are from the author's experiences both in the engineering supervision of geohazard specialists and as Project Management Team advisor on engineering geoscience and survey aspects for deepwater pipeline design.

Base Data

The overall bathymorphological configuration of coastal shelf, slope and abyssal plain for long distance pipelines is initially established from public domain bathymetry, generally satellite derived data (approaching 1 km resolution) and maritime navigation charts. Mature area development projects locally benefit from high quality exploration derived bathymetry data as a starting point (normally better than 100m resolution). In certain areas of high academic and industry funded research interest, we may be fortunate to access reconnaissance survey grade bathymetry data (typically 30 m resolution) including geophysical data and geological cores with regional interpretation.

During the subsequent Engineering Design phases, the resolution and fidelity of the seabed imagery and quantitative description improves to a point at which confidence in the final assessment of risk to the physical and economic security of the pipeline can be validated. However, it remains the careful and considered planning of initial route geometry and provision for alternatives at the project feasibility level which governs overall efficiency of engineering effort and the most appropriate final design alignment.