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Ormen Lange Pipelines – Geotechnical challenges

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ABSTRACT

The selected development scenario for the Ormen Lange gas field is a subsea tie-back to an onshore terminal located at Nyhamna in Mid-Norway. There are large variations in soil conditions along the 120 km long pipeline routes from shore to the template area. In narrow valleys in the near shore area one of the main challenges was to find enough space for installing all pipelines within the same corridor. The severe seabed requires rock supports for free span mitigation of the gas pipelines both near shore and in the deep water area. For the service lines, protection against trawling and dropped objects was required along the entire length and this turned out to be particularly challenging at the steep Storegga slide slope and in the rough terrain at the deep water area with soil shear strength of 1 kPa. The quasistatic stability of rock supports higher than 0.5 m was not satisfactory for the 10^{-2} earth quake load event due to the soft soil conditions. A deformation criterion was therefore applied both for the 10^{-2} and 10^{-4} earth quake load events.

KEY WORDS: Pipelines; Offshore; Seabed; Intervention design; Slope stability; Earthquake; Rock fill.

INTRODUCTION

Ormen Lange is a major gas field located 120 km west of Mid-Norway. The selected development scenario is a subsea tie-back to an onshore terminal located at Nyhamna on the island Gossen. The project Ormen Lange consists of two 30" multiphase pipelines, two 6" MEG pipelines and two umbilical's connecting the onshore terminal to the two templates at the deep water field. The first 33 km of Langeled, a 42" gas export pipeline to UK, is also included in the project as the near shore part is installed in the same corridor as the Ormen Lange field pipelines. StatoilHydro has been the operator for the development phase whereas Shell is the operator for the operational phase. Reinertsen AS has been responsible for the detail engineering of the pipelines with GeoPartner Marin as subcontractor responsible for the geotechnical engineering.
This paper focuses on the geotechnical challenges related to seabed intervention work and how these were solved during the detail engineering of the Ormen Lange project. In total 961 rock supports (including both pipe supports and rock covers) and 206 counter fills have been installed on the seabed. The total design required more than 1.4 million cubic meter of crushed rock, of which the counterfills required about 440 000 m^3 Including rock settlement and installation tolerances, 4.5 million Tonnes of rock was used. The rock installation was performed by VanOord.

SOIL CONDITIONS

The seabed soil conditions show large variation along the 120 km long pipeline route. The pipeline route can be divided in three main areas, nearshore, offshore shallow water and offshore deep water, as shown on Figure 1.

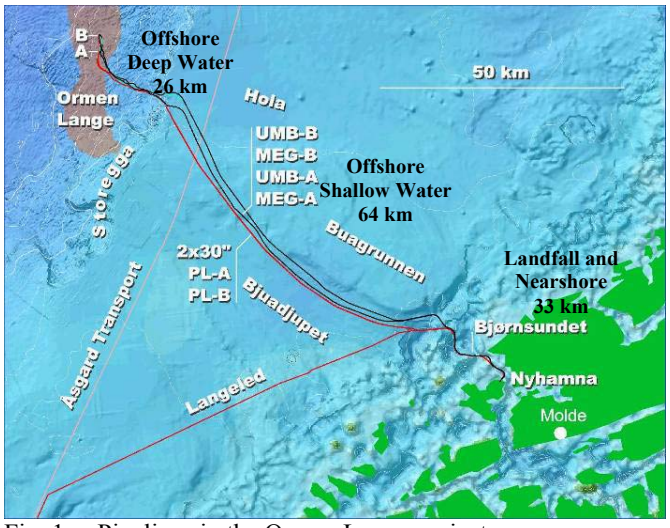

Fig. 1 Pipelines in the Ormen Lange project