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Design for Thermal Buckling of Åsgard Transport Gas Trunkline

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ABSTRACT

The Åsgard Transport System is a 707-km-long, 42-in pipeline for the export of rich gas from the Åsgard field offshore Mid-Norway to the Kårstø onshore terminal on the southwestern coast. The pipeline route traverses the western coast of Norway, including the Norwegian Trench, with a water depth varying from 55 m to 370 m. As a result of high pressure and high temperature in combination with an uneven seabed in the northern section of the pipeline, the potential for large-scale seabed intervention work to control thermal buckling and reduce the effects of trawl pullover loads was initially identified. This paper presents the main aspects leading to the optimised and cost-effective design for control of thermal buckling and expansion.

INTRODUCTION

The Åsgard Field is located 200 km off the coast of Mid-Norway (Fig. 1). The field comprises 60 subsea wells producing gas, oil and condensate from 3 different reservoirs: Smørbukk, Smørbukk South and Midgard. In addition to the numerous subsea templates and flowlines, field development involves a production ship for oil and condensate (Åsgard-A), an offshore loading and storage tanker for oil (Åsgard-C), a semisubmersible (Åsgard-B) for gas treatment, and an export riser base (ERB), which is the tie-in point for the 707-km-long, 42-in Åsgard Transport pipeline. This runs to the Kårstø terminal.

Eight subsea Tee structures have been installed in-line with the 42-in gas trunkline in order to facilitate future connections for potential gas fields along the 684-km-long offshore route. Already, 2 of these subsea connection points have been utilised for tie-in of export gas pipelines from the Norne, Heidrun and Draugen fields.

Some of the main technical challenges for the structural design of the Åsgard Transport (ÅT) pipeline were:

- Fatigue and static strength of a large number of free spans: The ÅT trunkline traverses the Norwegian coast, including 300 km of very uneven seabed (iceberg scars, rock outcroppings, pockmarks etc.).
- A large-diameter pipeline installed in 370-m waterdepth stretched the capability of the existing pipe-laying vessels (Gjertveit et al., 1999). Fig. 2 shows the route profile.
- Control of thermal expansion and buckling resulting from the high temperature (heat-affected zone for the first 100 km) in combination with the uneven seabed.

The latter is the main subject for the discussion below.

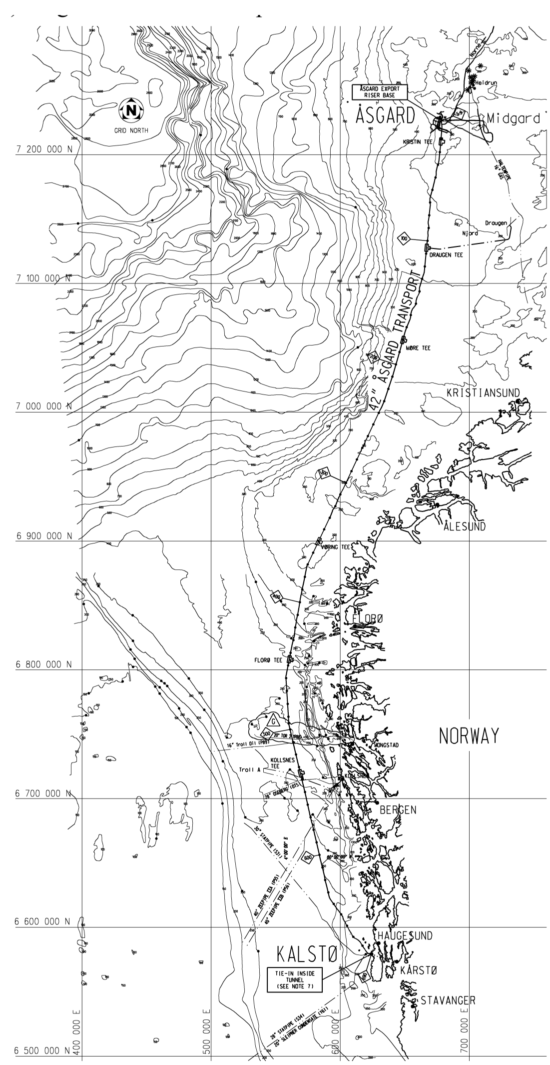

Fig. 1 Åsgard Transport route

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KEY WORDS: Pipeline, thermal buckling, lateral snaking, limit state design, strain-based design, expansion control, uneven seabed.