Boskalis
Dredging & Marine Experts

PROJECT SHEET

DEEPENING OF THE EEMS-PIPELINE
PORT AND WATERWAY ENGINEERING, PROJECT DEVELOPMENT

INTRODUCTION

The 42" Eems pipeline is part of the pipeline connection between the gas cleaning and drying plant of Phillips Petroleum at Rysumer Nacken in Germany, and the natural gas pipeline network in the Netherlands. The gas is obtained from the Ekofisk gas field in the Norwegian region of the North Sea.

The pipeline crosses the morphologically dynamic Eems estuary over a length of 4 km, passing both the deep shipping lane 'Oostfriesche Gaatje' and the shallow sand bank 'Paap'.

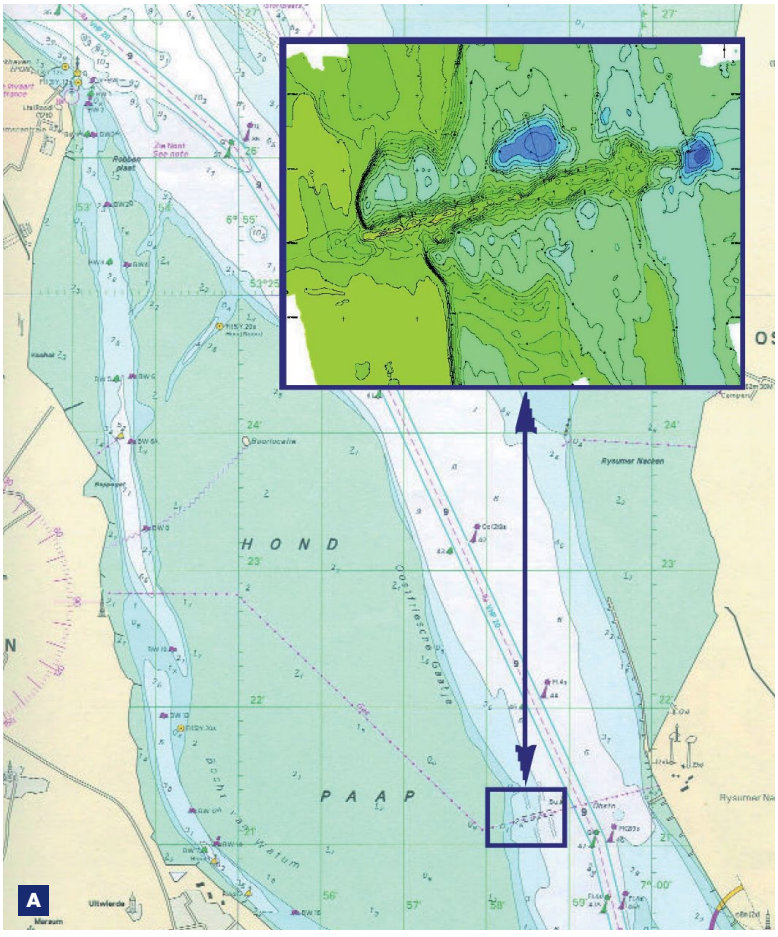
Since the installation of the pipeline, the Eems' strong currents have exerted a strong scouring effect on the edge of the sandbank. Over the years, this has resulted in the recurring exposure of a 500 m long section of the pipeline. In order to protect the pipe, and to prevent the occurrence of free spans, scour protection material (stones, sandbags and screens) were repeatedly placed on top of the exposed pipeline. The dumping of scour protection material gradually accumulated to a situation where there was a 500 m long dam within an area where the surrounding seabed had eroded to a level some 10 m deeper, causing a serious navigational hazard.

As a permanent solution for this problem the pipeline was to be lowered over a distance of 900 m to a level below the calculated future scour level.

The work was executed by a consortium within which Boskalis was responsible for dredging, survey and positioning. Hydronamic was responsible for the dredging related engineering during the project preparation phase, as well as during execution of the works.

FEATURES

Client	Gastransport Services
Location	Eems estuary, The Netherlands
Period	2002/2003



A Location map
B Frames for supporting and lowering the pipeline

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PROJECT PREPARATION

The two most important requirements prescribed by the Client were:

1. a guarantee of the continuity of gas flowing through the pipeline, and
2. a controlled and safe working method.

The project surroundings formed a difficult working environment. The choice of a working method was governed especially by the exceptionally high current velocities flowing over the top of the dam, as well as the occurrence of very stiff to hard clay in the soil beneath the pipeline. During preparation of the work method, Hydronamic was involved in the detailed evaluation of the available soil data, so that the best equipment and work method could be selected for the job.

Furthermore, on-site measurements were made of the local current conditions. These measurements were used to calculate a detailed estimate of the expected sedimentation in the trench. Based on the results of these calculations, the choice was made to add the suction dredger Nordland into the work-schedule, especially for the removal of siltation-material from the trench.

RISK ANALYSIS

During the project preparation period, Hydronamic engineers assisted the Client with preparing documents for obtaining the necessary permits and licenses.

The most important input consisted of the preparation of a qualitative risk assessment regarding execution of the project, stating all risks to be encountered during various phases of the project, and the necessary mitigating measures. Furthermore, the Client received assistance with the preparation of a quantitative risk assessment detailing the chance of damage to the pipeline caused by passing vessels entering the working-area unexpectedly.

ON-SITE ENGINEERING ASSISTANCE

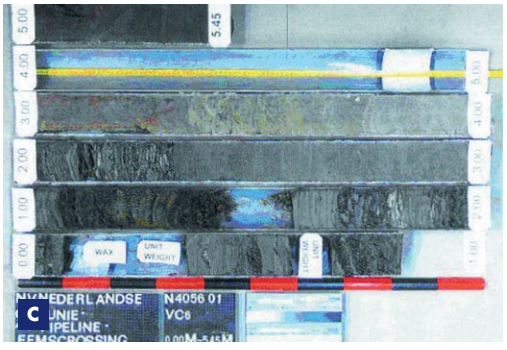
During execution of the project, the most important requirements continued to be the integrity of the pipeline and the general safety on site.

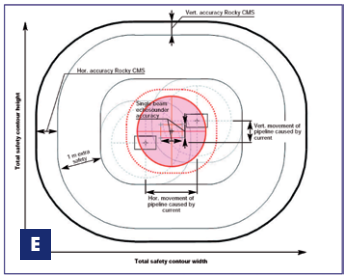
In order to maintain the highest level of security during dredging, Hydronamic provided a site engineer during the execution phase, mainly responsible for maintaining the safety measures on site. Other tasks included the execution of regular current measurements, in order to verify previous sedimentation-calculations, as well as assistance with project progress planning.

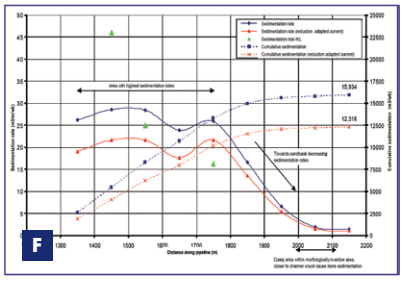
The site engineer was responsible for determining the size of the safety contour for the various pieces of equipment during varying dredging activities, as well as for checking the correct functioning of the safety measures.
For example: the backhoe dredger Rocky was able to work most closely to the pipeline, due to the especially installed new, improved version of the Boskalis Crane Monitoring System (CMS), which has the opportunity to model a 3-dimentional free hanging object, with a surrounding safety contour.

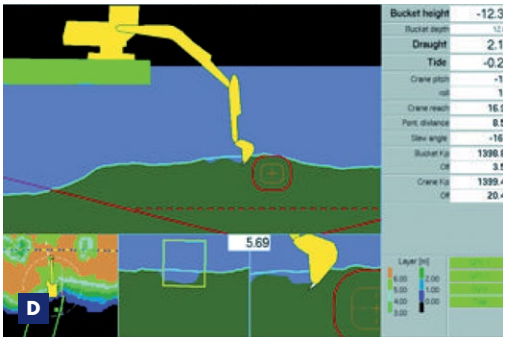
In case any part of the backhoe threatens to penetrate the safety contour, the CMS will automatically alter the movement to guarantee the integrity of the contour, without jamming the hydraulic systems of the backhoe.

The size of the required safety contour depends on the accuracy of various monitoring and positioning systems involved.









C Soil samples
D Safety contour calculation for backhoe dregder Rocky
E Frames for supporting and lowering the pipeline dredger Rocky, showing impenetrable safety zone
F Calculated weekly sedimentation rates along the length of the trench

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