Boskalis
Dredging & Marine Experts

PROJECT SHEET

OPERATIONAL MONITORING OF TRENCH DREDGING

NORD STREAM PROJECT, GERMAN LANDFALL

GENERAL

The Nord Stream Pipeline Project consists of two 48-inch pipelines which run in parallel through the Baltic Sea from Portovaya in the area of Vyborg and St. Petersburg in Russia to Lubmin in the Greifswald region in Germany.

The construction of the German landfall of the Nord Stream Pipeline Project comprised the installation of two 48-inch pipelines in a 28 km long trench that is 10 m wide and over 3 m deep. The seabed in the project area consists of different soil types such as sand, silt and marl. As the project was located in a relatively shallow area relatively small dredging units had to be deployed for trench dredging and backfilling the trench. Because of the tight window for execution of the project a large number of units were working simultaneously during execution.

ENVIRONMENTAL SETTING

Most of the project site is located in a Natura 2000 site (an ecological network of protected areas within the European Union) in the German Exclusive Economic Zone and Territorial Waters. The Greifswalder Bodden area is a shallow basin in the southwestern Baltic Sea. At the entrance to the bay, the Boddenrandschwelle shoal forms the transition zone to the Baltic Sea and contains various environmentally sensitive, and therefore protected, areas such as sandbanks and mudflats, large shallow inlets and bays, reefs, salt

FEATURES

Client	Nord Stream A.G
Location	Greifswalder Bodden and Baltic Sea, Germany
Period	May-November 2010
Contractor	Saipem Ltd

A

A Location map
B Nord Stream cofferdam construction and trench dredging.

B

C Installation and deployment of a monitoring station.
D Installation and deployment of a monitoring station.
E Installation and deployment of a monitoring station.

meadows, and shifting and fixed dunes. In addition, the extensive reefs and sandbanks in the vicinity of the Boddenrandschwelle are one of the major spawning grounds for spring spawning herring in the western Baltic Sea. At the Baltic Sea side of the Boddenrandschwelle the project borders an international important Flora and Fauna Habitat Directive Site.

This environmentally sensitive location meant that the construction activities were subject to various environmental restrictions.

MONITORING

With regard to dredging operations, potential increases in turbidity were identified as the most significant environmental impact. Although turbidity caused by dredging is temporary, monitoring is important in sensitive areas since it allows for the control or even prevention of the dispersion of suspended solids to sensitive areas. A turbidity monitoring program was set up comprising the following elements:

- operational turbidity monitoring at fixed locations;
- background turbidity monitoring at fixed locations;
- hydrodynamic measurements at fixed locations;
- monitoring of Total Suspended Solids concentrations.

Turbidity monitoring locations were chosen to optimize turbidity control along the length of the trench, ensuring that turbidity levels from dredging, disposal and backfill are monitored simultaneously. Measurements were – to the extent that this was feasible within operational constraints – carried out in the 'buoy corridor', i.e. within 500m from the work site.

To minimize the impact of the construction work on the surrounding environment, an extensive monitoring program was set up along the pipeline trench and the offshore temporary storage site for dredged material. The monitoring program was implemented to ensure the operations comply with the water quality and sedimentation restrictions. The program includes continuous real-time turbidity measurements at twelve permanent monitoring stations around the project and the environmental sensitive areas. All permanent monitoring stations were equipped with sensors measuring turbidity. Turbidity levels are related not only to the dredging and backfill activities but also to natural variations in, for example, current and wave

regime, sediment characteristics and seasonal processes such as algal bloom. Two stations were therefore designated for measurements of background turbidity and hydrodynamic conditions. One station was located in the Greifswalder Bodden while the other station was located offshore at the Usedom disposal site. In addition to measuring turbidity, the two background stations were equipped with wave and current measuring devices for recording real-time hydrodynamic conditions, both in the sheltered Greifswalder Bodden area and in the offshore Baltic Sea. The turbidity limits were directly linked to the background turbidity levels, and so all turbidity measurements taken from the stations along the dredging and backfill activities were compared with the natural background levels.

TURBIDITY MANAGEMENT

All real-time turbidity data collected at the fixed monitoring stations were transmitted to an onshore online database and were immediately available via a web server. A detailed turbidity response procedure was set up, allowing preventive measures to be taken swiftly if water quality threatened to exceed limits.

When turbidity warnings were activated, an automated message was sent to the relevant person in the project team for the appropriate follow-up.

When a warning notification was sent, a detailed investigation into the cause of the elevated turbidity levels took place so that an adequate response was possible if turbidity levels kept increasing until the turbidity alarm limit was exceeded.

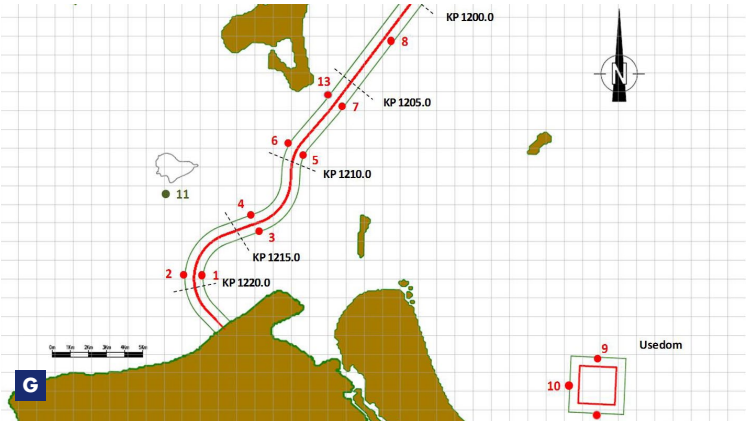
The investigation was used to determine whether the exceedance of the warning threshold was associated with the marine operations. If the investigation established that the cause of the exceedance was linked to the process, mitigation measures were selected and implemented to ensure that turbidity levels were lowered to acceptable levels.

All marine works, including the dredging, disposal and backfill operations, were executed so that turbidity impacts on sensitive receptors were within the specified limits. To achieve this goal, several different control measures were in place during the preparation and execution of the marine operations:

- upfront investigation into the expected turbidity levels in the water surrounding critical marine activities (principally the dredging operations);
- continuous monitoring of the turbidity levels in the vicinity of the operational activities (fixed monitoring stations);
- continuous monitoring of the hydrodynamic conditions on site, which helped to estimate the development and dispersion of monitored plumes of elevated turbidity;
- continuous fine-tuning of the marine operations (especially the dredging, disposal and backfill operations) to optimize the production and progress of the works, while ensuring the amount of turbidity generated was within limits; and
- implementation of relevant control measures to reduce turbidity plumes if the controls listed here – i.e. upfront investigations, estimating predictions or actual monitoring results – confirmed they were needed.

CONCLUSION

The combined efforts of the construction teams ensured that turbidity monitoring and incident response procedures were in place, allowing for the implementation of mitigation measures when necessary, resulting in the knowledge that, after six and a half months of intense and unhindered construction activities, no damage had been done to the sensitive receptors in the immediate vicinity of the site and no turbidity limits had been exceeded.



F TSHD Willem van Oranje dredges a trench for the Nord Stream pipeline.

G The project site: pipeline route and offshore storage ground (red line), 500 m environmental project boundary (green line), 12 turbidity monitoring stations (red) and 2 background turbidity, wave and current stations (green).

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