Nord Stream 2
Committed. Reliable. Safe.

Seabed Preparation Works – Guaranteeing the Safety and Integrity of Nord Stream 2

Nord Stream 2 AG | June-28

Picture: Boskalis

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Seabed Preparation Works

1. Managing Varieties in Seabed Topography

The Baltic seabed is not a flat plain, but one with a varying topography. The northern part is dominated by an uneven seabed with rocky outcrops alternated with soft clay valleys. The southern part sees a moderately corrugated seabed with sandy sediments.

Although the Nord Stream 2 route was extensively optimised, some seabed preparation works are still necessary. Preparation works are required at different locations, before and after pipelines are laid to guarantee on-bottom stability, provide support and protection at crossings and a stable foundation, among others. During normal operation, the pipeline can move on the seabed. Such potential changes in topography are detected by maintenance surveys, and seabed intervention works will be performed if needed.

Similar to what was needed for the existing Nord Stream Pipelines, a number of scenarios make intervention works necessary to safely install the pipelines.

2. Preparing the Seabed for Nord Stream 2

Environmental loadings in shallow waters – dredging or trenching

The offshore installation of the pipelines along some sections of the route, especially in shallow waters, requires additional stabilisation and/or protection against hydrodynamic loading (e.g. waves, currents), which can be achieved by trenching the pipeline into the seabed where rock placement is deemed impractical.

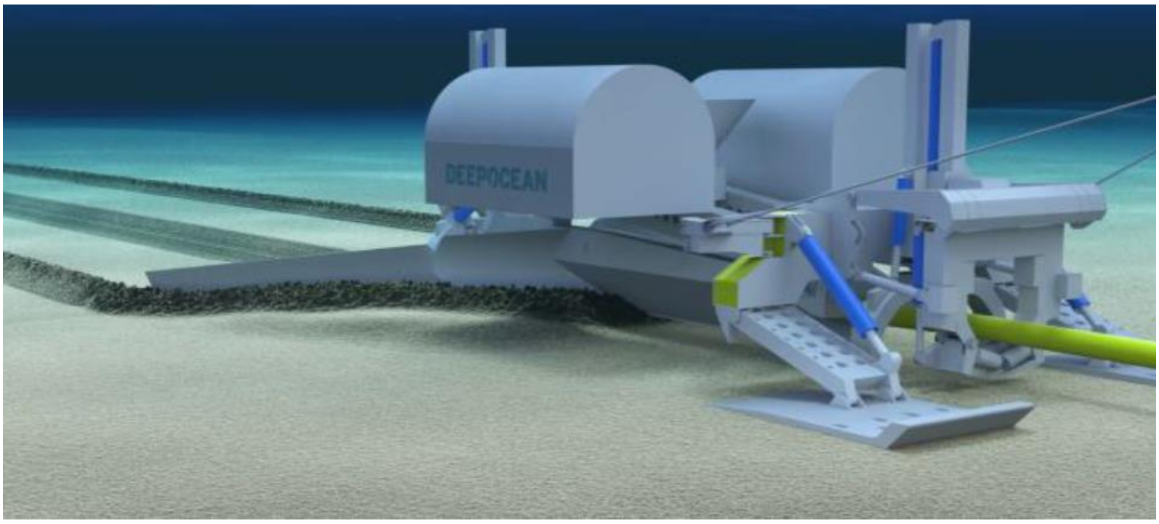
Pipeline installation in a pre-lay excavated trench by means of dredging, is the preferred trenching method in these shallow-water areas.

At the landfalls in Russia and Germany, the pipelines will be entirely buried in the seabed to ensure their stability. The excavated material will be removed, temporarily stored and then can be used for backfill. Dredging will be required for a distance of approximately 3.5 kilometres in Russia and 50 kilometres in Germany.

An alternative to pre-lay dredging is post-lay ploughing, where trenching is performed after pipelay. Post-lay ploughs are towed by a powerful surface support vessel and create a trough of pre-determined length, depth and width. In some shallow water locations, laying the pipeline into a trench adds stability. Accurate positioning of the plough onto the pipeline is achieved using state-of-the-art survey and positioning systems.

Post-lay ploughing is the most widely used trenching method in deeper water. It requires only local excavation in the immediate vicinity of the pipeline, whereas pre-trenching involves excavation over a larger width to allow for installation tolerances. Partial, natural backfilling occurs over time as a result of currents close to the seabed.

Ploughing is estimated to be required for around 40 kilometres in total along six sections in Sweden, and around 27 kilometres in total at 8 locations in Denmark.



Pipeline plough in operation on the seabed (Image: DeepOcean)

Rock placement

The seabed along the entire route has been carefully surveyed ahead of pipelay. Rock berms will not be placed along the entire route, but only at designated places, for instance where the seabed is uneven. The rocks, which support the pipeline in areas of high seabed relief, serve as basement structures and protection at pipeline crossing areas as well as stabilising the pipeline wherever required. The types of required rock placement works include installation of rock berm supports (before and after pipelay) and rock cover (after pipelay) in precise locations.

Due to the uneven seabed in some locations, the pipeline may have to cross a ravine or valley, effectively forming a “bridge” with a free space beneath it, called a freespan. The length of such freespans may affect pipeline integrity. Rock placement conducted before the pipeline is laid is the main method to mitigate freespans.

The rock material used is granite with an average size of 60 millimetres, with 90% of the rock crushed to size up to 100 millimetres. These rocks may not contain any contaminants, such as heavy metals that can be dissolved into the water, nor any clay, silt, lime or vegetation. In order to further minimise the environmental impact, only clean, freshly crushed rocks are used. They originate from two Finnish land quarries located at Inkoo and Rajavuori near Kotka. Both quarries are operated by the main contractor Boskalis-Van Oord’s Finnish sub-contractor Rudus Oy.

Bravenes, one of the state-of-the-art fallpipe vessels, used for the rock placement (Photo: Van Oord).

Boskalis-Van Oord, the joint venture in charge of all rock placement along the pipeline routes, has commenced rock placement operations at the end of April, 2018 in the Finnish Exlusive Economic Zone. Boskalis-Van Oord uses dynamically positioned fallpipe vessels (FPV) such as “Rockpiper” and “Bravenes” to carry out the work. Between two and three of their modern vessels will be working simultaneously along the pipeline route.

Rock material is transported by the FPV to each of the identified positions where rock placement is required. The rock is transferred from the FPV’s holds and is loaded onto conveyors which transfer the rock into the fallpipe. The fallpipe traverses the water column and ensures that the rock is accurately installed at the pre-determined berm locations on the seabed. The lower end of the fallpipe is fitted with a state-of-the-art ROV (Remotely Operated Vehicle) which guides the FPV during the rock placement operation to ensure that the rock is installed per design. The size and shape of each rock berm is designed individually depending on the conditions on the seabed. The size and amount of the rock used for each berm is also calculated on the basis of the requirements of each site’s seabed structure and stability.

Most of the rock required is in the Gulf of Finland due to its uneven seabed. Finland requires just over half of the total amount of the estimated rock material required for the project, Russia a third, and Sweden around 10%. Rock placement requirements in German and Danish waters are negligible.

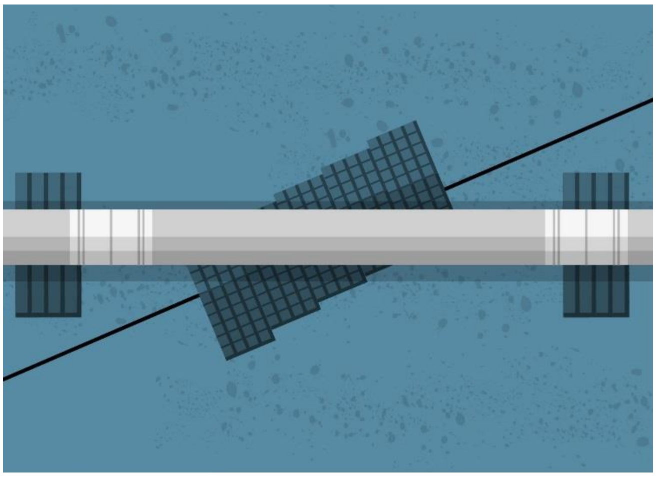
Cable crossings and crossings with existing or future pipelines

Where cable crossings exist, seabed intervention works are necessary to protect cables from the pipeline’s weight.

The Nord Stream 2 Pipeline routes cross power and telecommunications cables (existing and planned), the two existing Nord Stream pipelines and will also cross infrastructure that is being planned in the Baltic Sea. Crossing designs have been developed and agreed with the various cable owners according to established industry practice. When a pipeline crosses a cable, the placement of concrete mattresses is usually the preferred crossing method. When a pipeline crosses another pipeline, the placement of rock berms is often also required in addition to mattresses.

Nord Stream 2's planned route crosses 46 existing cables. A combination of flexible and solid concrete beam mattresses will be used to ensure that the pipelines are separated from these cables. For instance, in the Swedish EEZ, seven operational power or telecommunications cables will be crossed, with about 122 concrete mattresses placed to cross them. In the Finnish EEZ there are 29 telecommunications cables, including also out-of-use cables that require crossings in addition with the Nord Stream and Baltic Connector pipelines.

Concrete mattresses being up-loaded to vessel Oceanic performing the mattress installation works.



Concrete mattresses keep a pipeline separated from a crossed cable (the black dotted line).

Staying Safe

To ensure that workers are safe at all times, the project has a Health and Safety strategy that includes specifying minimum requirements for all contracts, detailed plans submitted by the contractors, and follow up visits and audits to make sure that risks have been identified and all the necessary risk reduction measures put in place.

In order to provide and maintain a safe workplace at all times, all employees have obtained training, instruction and information covering the specific workplace security, health and environmental hazards around working in the sometimes harsh Baltic environment to prepare them to stay safe and work and to minimise the impact of the project on the marine ecosystems of the Baltic.

Nord Stream 2 employs specialist marine warranty surveyors to visit survey, dredging, rock placement and pipelay vessels to make sure that the stringent requirements for working in the delicate Baltic environment have been met.

All workers on board are issued with high quality Personal Protective Equipment to cope with working in harsh weather, protecting heads, hands, eyes and feet and for working at height and on specialist trades such as welding.

A detailed traffic management plan has been put in place to minimise the impact of road transport of large volumes of rock to the ports where the rock placement vessels are waiting to take the rocks to the installation locations.

3. Tailored National Environmental Monitoring Programmes to Determine Impacts

At Nord Stream 2 AG, we are aware of our responsibility to treat the sensitive ecosystem of the Baltic Sea with respect. We are committed to act in a way that avoids unnecessary impact and to mitigate. The experience gained during the first Nord Stream project serves as a reliable blueprint for our actions. Nord Stream 2 has drafted national monitoring programmes in consultation with the relevant authorities to determine any impact of the preparatory activities, construction and operation of the pipeline. The overall project environmental monitoring varies in spatial range, duration and monitored parameters from area to area in accordance with the potential adverse impacts predicted and in relation to potential receptors. The activities also address requested national requirements.

In general, a comparison of results from the baseline surveys and the surveys performed during and after construction of the existing Nord Stream Pipeline system showed that the construction activities and the seabed intervention measures used only had a minor and temporary impact.

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About Nord Stream 2

Nord Stream 2 is a planned pipeline system through the Baltic Sea, which will transport natural gas over some 1,230 km from the world's largest gas reserves in Russia via the most efficient route to consumers in Europe. Nord Stream 2 will largely follow the route and technical concept of the successful Nord Stream Pipelines. The new pipelines will have the capacity to transport 55 billion cubic metres of gas per year, enough to supply 26 million European households. This secure supply of natural gas with its low CO_2 emissions will also contribute to Europe's objective to have a more climate-friendly energy mix with gas substituting for coal in power generation and providing back-up for intermittent renewable sources of energy such as wind and solar power. **www.nord-stream2.com**