Nord Stream Pipeline Construction

> In April 2010, Nord Stream began installing the first of its two natural gas pipelines through the Baltic Sea. Construction started in Swedish waters with the Castoro Sei, the laybarge that will handle the majority of the job. Another two vessels will work on sections within the Gulf of Finland and at the German landfall.

From Vyborg in Russia to Lubmin near Greifswald, Germany, each pipeline runs about 1,220 kilometres along the Baltic seabed. Once fully operational, they will transport 55 billion cubic metres of natural gas a year – enough to satisfy the needs of 26 million European households. Nord Stream has commissioned Saipem, a leading Italian offshore project company, with the construction of the pipelines. About 70 percent of each of the pipelines will be laid by Saipem's Castoro Sei, a moored pipelay vessel. In the Gulf of Finland, the Allseas' Solitaire, a laybarge that can position itself without the use of anchors, will be used in this area known for dense ship traffic and historic sea mines. Each vessel is a floating factory where pipes are received from carrier vessels, welded together and then laid at an average pace of about 2.5 kilometres a day. In the shallow waters near the German landfall, Saipem's anchored, flat-bottomed Castoro Dieci will lay an average of 500 metres daily. Once completed, the pipelines will be subjected to rigorous testing before gas can be transported. From the receiving terminal in Lubmin, the gas will enter the European gas grid where it will reach consumers in countries such as Denmark, France, Germany and the UK.

Construction Schedule for the First Pipeline

From April 2010, vessels will work 24 hours a day, seven days a week to construct the first of the two pipelines. The schedule takes many environmental factors into account. For example, installation will not take place during seal breeding and fish spawning seasons.

Helipad
Personnel is transferred to and from the vessel via helicopter, which lands on the helipad at the stern of the Castoro Sei.

Pipe Carrier Vessel
Pipes weighing about 22 tons each are shipped to the laybarge from five stockyards strategically located along the route.

Crane
Two cranes that fully revolve and travel on rails on the main deck. Each can lift up to 200 pipes a day onto the barge.

Stinger
The stinger provides support to the pipeline as it is progressively lowered to its designated place on the seabed.

Pre-Pipelaying Survey
Though the seabed was surveyed during the route planning phase, a pre-pipelaying survey performed before pipeline installation confirms past data and ensures pipelay safety.

Post-Pipelaying Survey
As it touches down on the seabed, the pipeline is monitored to ensure that it is correctly positioned.

ROV
A remotely operated vehicle (ROV) fitted with sensors and instruments including cameras transmits information from the seabed directly to the survey vessel.

S-Curve
As the pipeline is lowered to the seabed, it forms an "S" shape, which prevents it from being damaged during installation.

Rock Placement
The strategic placement of coarse gravel is necessary in some locations along the route to create a stable base on which the pipeline can rest.

Pontoons
The Castoro Sei floats on twin pontoons located below the water surface. The pontoons can be submerged by adding ballast water, making the vessel more stable in turbulent seas.

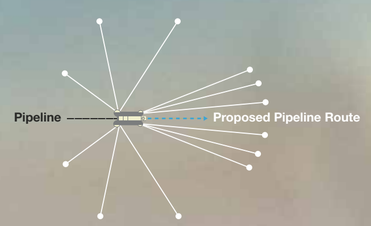
Castoro Sei Laybarge

Saipem's semi-submersible Castoro Sei pipelay vessel has an extensive track record of installing complex pipeline systems in deep and shallow waters. It will lay 70 percent of each of the pipelines.

- 152-metres long, 70.5-metres wide
- Operating draught (typically): 14 metres
- Nord Stream Pipeline lay rate: Circa 2.5 kilometres daily

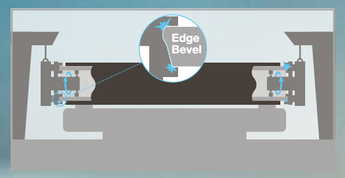
Anchor Pattern

During construction the Castoro Sei is positioned by means of a 12-point mooring system. This system enables it to maintain accurate positioning. Each of the 12 mooring lines, or anchor lines, are controlled by a tension winch weighing 124 tons. The vessel also features thrusters to further ensure precise positioning.

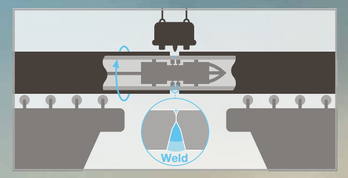


Pipelaying Process

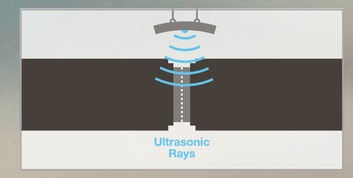
1 The pipes are unloaded from the pipe carrier vessels and stacked on the storage areas on each side of the laybarge. Pipes are delivered regularly to ensure that there are always enough supplies on board to maintain the 24-hour construction schedule.



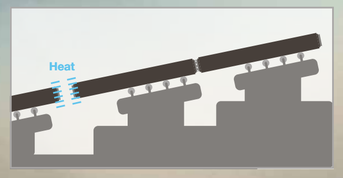
2 To prepare the pipes for welding, the ends are bevelled to make them exactly the right shape to be fitted together. The inside of the pipe is then cleaned using compressed air before it is conveyed to the double-joint welding station.



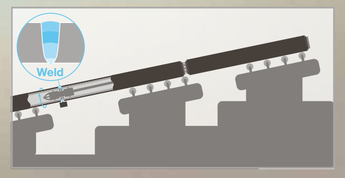
3 At the double-joint welding station, two bevelled, 12-metre pipe joints are aligned and welded together to create a double-joint segment measuring 24 metres. These double-joint sections will later be connected to the main pipe string.



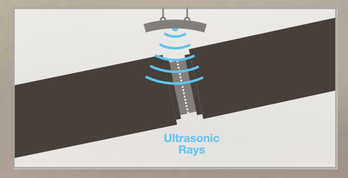
4 The double-joint is moved to the non-destructive testing station where every millimetre of the weld undergoes ultrasonic testing to detect any unacceptable flaws. If required, the defect will be repaired and the weld rescanned to meet international quality standards.



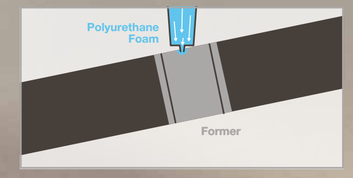
5 Following non-destructive testing, the double-joint is moved in a pipe elevator to the central assembly line, or "firing line". There, the insides are checked for debris. The ends of the double-joint are then pre-heated in preparation for welding onto the main pipe string.



6 The prepared double-joints are now joined to the end of the pipeline in a semi-automatic welding process. Qualified welders oversee each of the steps to ensure that welding procedures meet Nord Stream's and authority approved quality standards.



7 The weld of the double-joint that has been welded onto the main pipeline also undergoes ultrasonic testing at another non-destructive testing station. Any unacceptable flaws will be repaired, and the weld rescanned so that it meets international quality standards.



8 Once the weld is confirmed acceptable, a corrosion-resistant, heat-shrink sleeve is applied around its entire circumference. Then, polyurethane foam is poured into a mould surrounding the weld area. This foam hardens, providing further protection.

Infographic produced by KircherBurkhardt, April 2010
Pipes shown in yellow for clarity.

Nord Stream
The new gas supply route for Europe