Nord Stream 2
Committed. Reliable. Safe.

Offshore Pipeline Construction

Constructing an underwater pipeline is a major undertaking. Approximately 200,000 pipes have been produced to create Nord Stream 2. Pipelaying began in the summer of 2018. Through a carefully planned and tightly managed process, individual lay vessels have constructed the pipeline at a rate of 3–4km per day.

The Nord Stream 2 twin pipeline will stretch over 1,230km from Russia's Baltic coast, through the Baltic Sea, reaching landfall at Germany's coast near Greifswald. Once fully operational, the pipeline will have the capacity to transport 55bcm of natural gas per year – enough to satisfy the needs of 26 million European households. Nord Stream 2 will largely run in parallel to the Nord Stream system in operation.

Nord Stream 2 has worked with some of the world's leading contractors to lay the pipeline through the Baltic Sea. Safety and environmental protection are foremost considerations throughout the pipeline's construction. The individual 12-metre pipes were produced at plants in Germany and Russia, and have a constant internal diameter of 1.153mm and a wall thickness of up to 41mm. The pipes were then coated internally to reduce friction, and externally to reduce corrosion, increase protection and add weight, making the pipeline more stable on the seabed.

Nord Stream 2 has used several pipelay vessels to install the pipelines. A number of measures have been taken to minimise disturbance to the sensitive Baltic Sea environment, which has dense shipping traffic and historic munitions.

Each pipelay vessel is a floating factory where the pipes are received from carrier vessels, welded together into a pipeline in the firing line, and finally installed on the seabed. The completed pipeline will undergo rigorous testing and assessment by an independent certification body. Once the safety of the pipeline is assured, gas will be able to flow directly from the world's largest natural gas reserves into the EU's internal energy market.

Pipe Carrier Vessel
Pipes weighing up to 24 tonnes each were shipped to the pipelay vessels from a number of logistics hubs strategically located along the route.

Crane
Pipes are unloaded by crane from the carrier vessel to the pipelay vessel.

Helipad
Personnel are transferred to and from the vessel via helicopter.

Pre-Pipelaying Survey
Though the seabed was surveyed during the route planning phase, a pre-lay survey performed before pipeline installation confirms that no significant changes have occurred along the route since the previous survey.

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

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

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

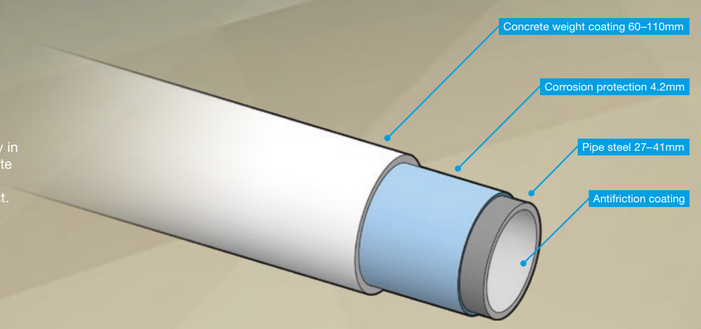
ROV
A remotely operated vehicle (ROV) fitted with sensors and instruments including cameras transmits information from the seabed directly to the survey vessel.

ROV

ROV

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

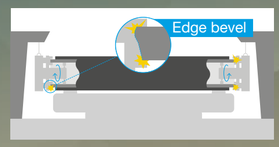
Pipe cross-section



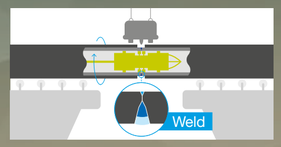
Pipes shown in yellow for clarity.
Pipelay vessel design is for illustration only.

Pipelaying Process

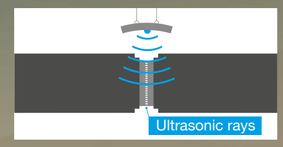
1 The pipes are unloaded from the pipe carrier vessels and stacked on the laybarge. Pipe deliveries occur regularly to ensure that there is always an adequate linepipe buffer on board to keep construction going 24/7.



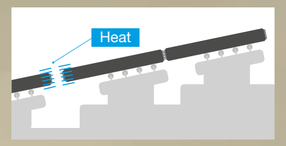
2 To prepare the pipes for welding, the ends are bevelled to make them exactly the right shape to be fitted together for welding. The inside of the pipe is then cleaned using compressed air before it is conveyed to the double-joint welding station.



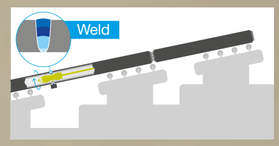
3 Here, 12-metre pipe joints are aligned and welded together to create a double-joint segment measuring 24 metres. These sections will later be connected to the main pipe string.



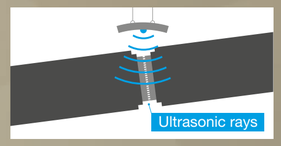
4 The double-joint is moved to a non-destructive testing station where every millimetre of the weld undergoes automatic ultrasonic testing (AUT) to detect any unacceptable flaws. If required, the defect will be removed and the weld rescanned to ensure it meets international standards.



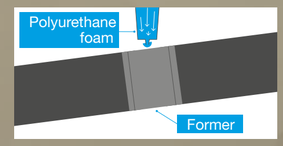
5 Following AUT, the double-joint is moved in a pipe elevator to the central assembly line. There, the insides are checked for debris and the double joint is aligned with the main pipe string in preparation for welding.



6 The double-joint is now joined to the end of the pipeline using a semi-automatic welding process. Qualified welding inspectors oversee each of the steps to ensure that welding is performed in accordance with Nord Stream 2's and authority approved welding procedures.



7 Following welding, the weld between the double-joint and the main pipeline undergoes automatic ultrasonic testing (AUT). Any unacceptable flaws will be removed, and the weld rescanned to ensure it meets international standards.



8 Once the weld is confirmed acceptable, a corrosion resistant, heat-shrink sleeve is applied over the circumferential girth weld. Then, polyurethane foam is poured into a former surrounding the weld area. This foam hardens, providing further protection.

Solid Foundations

Design, construction and operation of the new twin pipeline system draw on Nord Stream experience. However, thorough preparation was key. By the end of the project, 71,000 line kilometres of seabed will have been surveyed to define the optimum route for the twin pipeline. The varying topography of the Baltic seabed meant that in certain places, preparatory works had to be performed before pipelaying began. To avoid excessive freespans in the two pipeline strings, among others, rocks between 60 and 100 millimetres in size were placed on the seabed at dedicated locations to create supporting berms. In the shallow waters near the Russian and German landfalls, dredging took place over 3.5 and 50 kilometres respectively to bury the pipelines for their stability, protection and the security of marine traffic and fishing activities. To ensure safe installation and operation of the pipeline, potential munitions from the World Wars were avoided where possible, and cleared where necessary. After pipelaying began, post-lay surveys were performed to determine where additional support, stabilisation or protection was needed once the pipelines rested on the seabed. As much as 90 percent of all rock placement has taken place post-lay, using only new, clean and crushed granite. At some locations along the route where this was deemed impractical, post-lay ploughing was carried out to stabilise the pipelines.

What Does it Take to Install an Offshore Pipeline?

Andrew Turnbull, Deputy Manager Offshore Construction, explains how the pipeline is constructed to the highest safety, environmental and quality standards.

What are the challenges involved in building the Nord Stream 2 pipeline?
Maintaining a 24/7 construction schedule. To achieve this, our logistics team has to make sure that the pipelay vessels are regularly supplied with pipes and consumables such as welding wire and field joint coating materials.

The scale of this project is massive: Whereas an ordinary offshore pipelay operation would last 1–2 months, our project has involved vessels working 24/7 for a much longer period. Each pipeline consists of 100,000 pipe joints. Each joint weighs 24 tonnes and causes significant wear and tear on the loading surfaces and other pipe handling equipment used on board. To prevent any malfunctions from disrupting construction, maintenance teams have been permanently stationed on board each pipelay vessel. The contractors also have had to keep producing consistently and reliably to the highest quality standards.

How is quality managed on this scale?
Every weld on board undergoes ultrasonic inspection and must match our specifications 100 percent before we let it into the water. Nord Stream 2 has kept about 16 of its own people on board each vessel, and the external certification authority DNV-GL, in addition to the national authorities in Germany and Russia, have also been present on the vessels.

How do you ensure safety during construction?
All of our contractors have first-class safety systems in place that fully match our health and safety requirements. Our HSES department along with the marine warranty surveyors make sure these are met. All employees were trained and instructed in workplace security, health and environmental hazards. To guarantee the safety of the working vessels and minimise risks to marine traffic, we have agreed on appropriate measures with the relevant national authorities.

What are the environmental considerations?
HELCOM & MARPOL rules that govern how waste, sewage and water is handled, apply to our vessels. The ships also comply with local conditions along the route. In German waters, Audacia used a specific retrofitted anchor system to position itself during pipelay and limit disturbance to the seabed. Where unexploded munitions are common, pipelaying took place without anchors: Only the pipeline touched the seabed, which minimised impacts on marine traffic and the environment. The construction plan also takes environmental restrictions into account: For example, to avoid disturbing seal breeding, there was no offshore pipelaying during the winter ice period.

Nord Stream 2
Committed. Reliable. Safe.

Facts and Figures

360 pipes
have been delivered to each pipelay vessel every day.

100,000 pipe joints
are needed to construct each of the pipeline strings.

>1,000 people
have worked on the vessels simultaneously.

Up to 10
pipe-carrier vessels
have made the trip from the logistics hubs to the offshore construction site each day.

18,000 hours of work
are required to build the entire twin pipeline.

Nord Stream 2 AG
Baarerstrasse 52
6300 Zug, Switzerland
T +41 41 414 54 54
F +41 41 414 54 55
info@nord-stream2.com

MIX
Paper from responsible sources
FSC® C104247

March 2021

Find us on Social Media:

www.nord-stream2.com

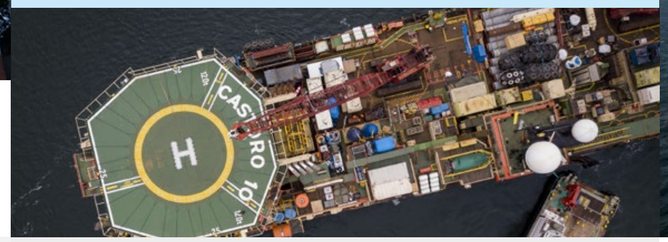
A Strong Team from Coast to Coast

Nord Stream 2 has worked with several pipelay contractors to build its twin pipeline through the Baltic Sea. Of these, Allseas has been the main contractor, with three vessels mobilised for the project.

Allseas Group
Allseas is a global contractor for pipeline installation, heavy lift and subsea construction. The group operates a fleet of state-of-the-art ships. To date, Allseas has already laid more than 21,500 kilometres of pipeline in offshore projects. As the chief pipelay partner, the company was responsible for installing the majority of the two pipeline strings. It used three of its vessels – Solitaire, Pioneering Spirit and Audacia – to lay a total of about 2,200 kilometres of 48-inch pipeline. While the first two ships are dynamically positioned, Audacia was converted into an anchored vessel for its work in German waters.

MRTS JSC
MRTS is a Russian company which operates in the field of subsea pipeline construction. The company installed the starting section of the twin pipeline in the shallow waters off the Russian coast, including the two above-water tie-ins close to the Russian landfall.

Saipem
Saipem, headquartered in Milan, Italy is a global company that provides onshore and offshore services to the oil and gas sector. Saipem pulled ashore the final section of the pipeline and connected it to the landfall of Nord Stream 2 in Germany. It also performed three above-water tie-ins in German waters.



Pioneering Spirit

The largest construction vessel in the world was used to install parts of the offshore section of the twin pipeline system.

Designed in-house by the main pipelay contractor Allseas, Pioneering Spirit began its first offshore operations in 2016. The vessel design allows it to install record-weight pipelines in all water depths thanks to an S-lay tension capacity of 2,000 tonnes – double that of the Solitaire. Its large size and twin-hull design gives the ship very good wave response behaviour. Pioneering Spirit was used to construct the pipelines offshore in the deep water section.

Key figures
- Length: 382 metres
- Width: 124 metres
- Displacement: 1,000,000 tonnes
- Transit speed: 14 knots
- Installed power: 8 diesel generators producing 95 megawatts
- Dynamic positioning and propulsion: 12 azimuth thrusters
- Accommodation: 571 people
- Work stations: 5 double joint factories (production lines), 6 welding stations for double-joints,1 NDT and 4 coating stations

Solitaire

Allseas' Solitaire was deployed for offshore construction of the pipeline's deep-water sections.

As one of the world's largest pipelay vessels, it has laid numerous offshore pipelines, including the twin 48-inch Nord Stream pipelines. Its long length and ship shape make it particularly workable, and full dynamic positioning allows the vessel to manoeuvre precisely and safely in areas with historic mine lines and congestion in the Baltic Sea. Thanks to the vessel working without anchors, only the pipeline touched the seabed along the pipeline route. This helped to minimise the impact on the environment and marine traffic.

Key figures
- Length: 300 metres
- Width: 41 metres
- Maximum speed: 13.5 knots
- Installed power: 51.5 megawatts
- Dynamic positioning and propulsion: 10 azimuth thrusters
- Accommodation: 420 people
- Work stations: 2 double-joint factories with 3 welding stations each, 5 welding stations for double joints, 1 NDT station, 4 coating stations

Audacia

To build the shallow water section of the pipeline in Germany, the smaller and more versatile Audacia was used.

Its length and shape are also optimised to accommodate multiple workstations and allow a high pipe hold capacity, which reduced the ship's dependence on pipe supply vessels. The Audacia, which is usually dynamically positioned, had a new, anchor-based mooring system installed for this work.

Landfall Germany and Landfall Russia

Castoro Dieci
Saipem was responsible for installing the shore approach section of the pipelines close to the German mainland. Its flat-bottomed offshore installation barge, Castoro Dieci, welded pipes together and pulled them ashore to complete the terminating section of the new pipelines. The vessel was also deployed on the first Nord Stream Project.

Fortuna
MRTS's multi-purpose vessel laid the first 13km of pipeline in Russia and completed its work with two above-water tie-ins.