

# Nord Stream Delivers Gas to Lubmin



The two lines of the Nord Stream pipeline system reach land at Lubmin. At the landfall station, the natural gas is filtered, measured, and if necessary adjusted prior to transport.

### What function does the landfall facility in Lubmin, Germany fulfil?

Mikhail Sarakhan: Let me start by explaining that the landfall facility in Lubmin actually consists of two complexes: Nord Stream's landfall facility in Germany in the offshore and onshore areas, and the actual receiving terminal of the connecting natural gas pipelines, OPAL and NEL. The Nord Stream pipeline system transfers the gas that travels 1,224 kilometres through the Baltic Sea to OPAL and NEL. The Pipeline Inspection Gauges (PIGs) are also received here in the PIG traps as part of the inspection process.

### Are there any Nord Stream representatives on site, and what duties and responsibilities do they have?

MS: Three people represent Nord Stream AG on site. We are the interface between the Nord Stream operations unit in Zug, the landfall facility in Lubmin, and the technical operators of the connecting OPAL and NEL pipelines. Together we operate our facility in a safe, environmentally friendly, and cost-effective manner that is in line with all rules and regulations.

### What was the most exciting thing which happened during the first years of operation?

MS: The first internal inspection of the pipelines in September 2013 was something special. It was the longest internal inspection run ever performed to date. It was also the first time that a pipeline of this wall-thickness was inspected. The measurement tool, an intelligent pipeline inspection gauge, collected over one Terabyte of data, which confirmed that the pipelines are in top condition.

### What occurs if a fire breaks out or a leak is discovered in the landfall area?

MS: There are numerous gas

and fire detectors installed for this eventuality. For example, if the gas or fire alarm is raised from two detectors in different zones of the landfall facility, our intake shutdown valves will automatically close, and the blowdown valves opened in order to clear the facilities of natural gas. If a fire alarm is triggered, the local fire department will also be summoned. Additionally, all responsible parties will be notified by our dispatching centre in order for us to be on site as quickly as possible.



Mikhail Sarakhan, Site Supervisor Landfall Facilities Germany, Nord Stream

### How does Nord Stream ensure that it never delivers more gas than can be processed at the landfall facility?

MS: We employ several systems to take care of that. The Nord Stream landfall facility is designed for a maximum operating pressure of 177.5 bar. If, despite the monitoring system, this pressure level is exceeded, our intake shutdown valves will automatically close in order to protect our facility.

### What are the most important safety measures for operating the landfall facility?

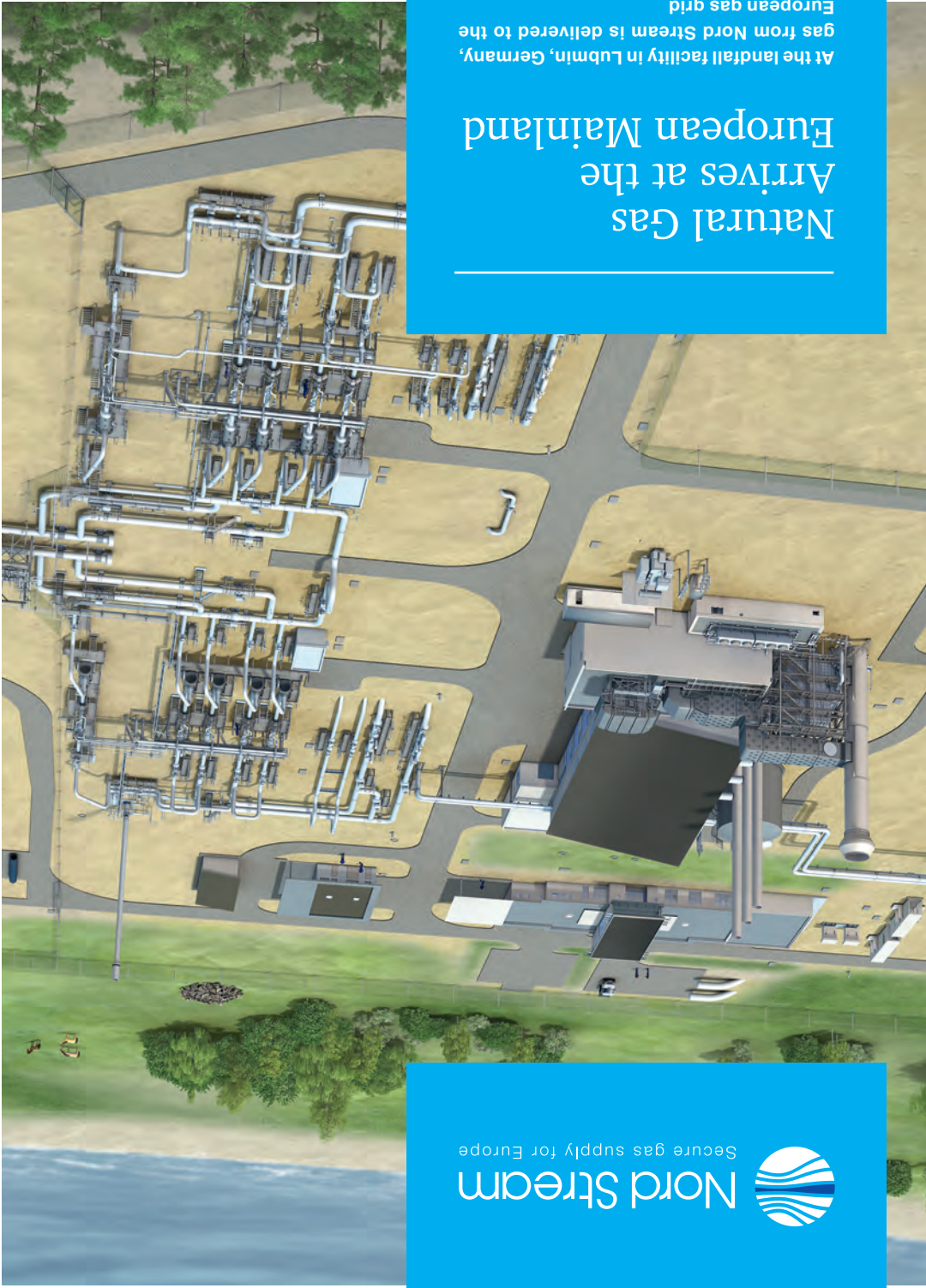
MS: Adhering to the safety regulations for natural gas facilities, which would include, for example, smoking bans. Safety measures also include securing the infrastructure that

transports the natural gas, and the entire landfall facility. The gas transportation facilities can be shut down manually and remotely.

## OPAL AND NEL PIPELINES

OPAL (Baltic Sea Pipeline Link), is Europe's biggest natural gas pipeline with a transport capacity of about 36 billion cubic metres a year. The OPAL pipeline starts where the Nord Stream Pipeline comes on shore in Lubmin near Greifswald and runs south as far as Brandov in the Czech Republic. The 472 kilometre long pipeline crosses three German states: Mecklenburg-Western Pomerania, Brandenburg and Saxony. OPAL is a joint project between W & G Transport Holding GmbH (WGTH, 80 percent) and Lubmin-Brandov Gastransport GmbH (LBTG, 20 percent).

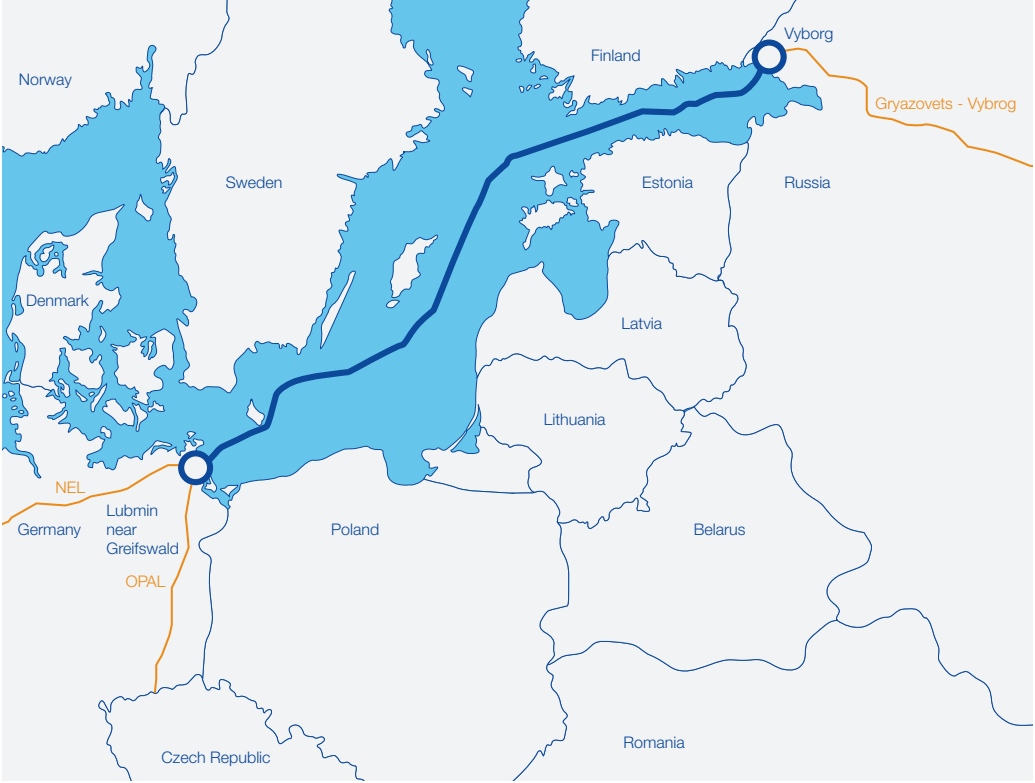
The second pipeline connecting to Nord Stream is NEL (North European Gas Pipeline). The 441 kilometres long pipeline has a transport capacity of 20 billion cubic metres. NEL runs westward across northern Germany to Rehden in Lower Saxony. NEL is a joint venture between WIGA Transport Beteteiligungs-GmbH & Co. KG (51 percent), the Dutch natural gas infrastructure company N.V. Nederlandse Gasunie (20 percent), the Belgian transmission infrastructure company Fluxys G (19 percent) and E.ON Ruhrgas AG (10 percent).



**Nord Stream AG**  
Nord Stream AG is an international joint venture established for the planning, construction and operation of the twin offshore gas pipelines through the Baltic Sea. Russian PJSC Gazprom holds a 51 per cent stake in the joint venture. The German companies Wintershall Oil AG (wholly-owned subsidiary of Wintershall) and PEG Infrastruktur AG (wholly-owned subsidiary of E.ON Beteiligungen) hold 15.5 per

cent each, and the Dutch gas infrastructure company Gasunie Infrastruktur AG (wholly-owned subsidiary of Gasunie), along with the French energy provider Engie Energy Management Holding Switzerland AG (wholly-owned subsidiary of Engie), each hold a 9 per cent stake. Nord Stream's head office and operations centre are both in Zug, Switzerland. Nord Stream's natural gas pipelines through the Baltic Sea have the design capacity to

transport 55 billion cubic metres (bcm) of Russian gas per year to the EU for at least 50 years. Both lines run in parallel for 1,224 kilometres from Portovaya Bay, near Vyborg on the Russian Baltic Sea coast to Lubmin, Germany. Each pipeline comprises some 100,000 24-tonne concrete-weight-coated steel pipes laid on the seabed along the precise route approved by the authorities of the five countries through whose waters the pipelines pass.



**Contacts**  
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## High Tech for Quality and Safety

More than 167 million standard cubic metres (later: cubic metres) of natural gas can be processed in the receiving station in Lubmin every day. A sophisticated series of valves, filters, preheating, measuring and control facilities ensure that the gas is of top quality, and the right quantities are flowing to the connecting pipelines at the right pressure and temperature.

The natural gas has travelled a long way by the time it arrives in Lubmin from Siberia by Vyborg, Russia on the Gulf of Finland and from there 1,224 kilometres through the Baltic Sea. In Vyborg, the gas enters the Nord Stream pipeline system at a pressure of up to 220 bar. The gas loses pressure along the way due to friction on the pipeline walls which typically occurs. When the pipelines reach landfall in Lubmin, Germany, the pressure has fallen to approximately 110 bar during operation. The connections between the offshore pipelines and the onshore grids are called landfalls. Pipeline expansion loops, an isolation coupling, the Pipeline Inspection Gauge (PIG) traps, and in particular the safety shutdown valves, are set up in this intake area of the receiving station. In the event that an emergency occurs, these valves reliably separate the offshore from the onshore pipelines. The connecting pipelines, OPAL (Baltic Sea Pipeline Link) and NEL (North European Gas Pipeline), also have additional shutdown infrastructure, filtering, heating, metering and regulating facilities. At landfall, the arriving natural gas is cleared of any solid or liquid impurities and warmed. This is necessary because over its long journey not only does the gas lose pressure, but its temperature drops as well. The natural gas is heated by a preheater and the associated boiler plants.



Huge double-gate valves separate the gas in the pipelines from the PIG traps when these are not in operation. They are the heaviest double-gate valves that have ever been produced.

**Preparing the Gas for Transfer**  
Two consecutive sets of safety shutdown equipment separate the landfall area from the measuring and control units of the facility. In this section of the facility, the incoming and outgoing gas streams are checked for quality, subjected to official measurement, and the volume is adjusted for transfer to subsequent pipelines. Additional safety valves are placed prior to the entry into the OPAL and NEL pipelines, and protect the two long-distance connecting lines from breaches of permissible pressure limits of about 100 bar.

### LUBMIN HEATH: AN ENERGY SITE

In the context of the energy strategy 2020 of Mecklenburg-Western Pomerania, Lubmin developed into an energy hub with a range of energy sources feeding electricity into the German distribution grid.

### DISMANTLING AND CONSTRUCTION

In 1995, the Nord nuclear power plant in Lubmin was shut down. Until 1990, the reactor produced roughly 150,000 gigawatt hours of electricity, which fed into the former GDR's national grid through more than 10 high-voltage power lines. In the meantime, the high-voltage lines of East and West have been joined. Moreover, in the new federal states alone, hundreds of kilometres of overhead transmission line have been strung. In the same time that the decommissioned nuclear plant was dismantled, the establishment of a new industrial and energy location took place in Lubmin Heath.

### INDUSTRIAL PORT

Since it started operations in 2006, the industrial port of Lubmin has become an internationally recognised place of transshipment and specialized services. Today, the port is highly attractive for businesses that benefit from the existing infrastructure for their production sites, such as crane constructor Liebherr, pipe manufacturer Erndtebrücker Eisenwerk and LubminOils, a rapeseed oil producer.

### WIND PARKS

The development of wind parks in the Baltic is also evidence of Lubmin as a focal energy hub. Baltic 1, the first German offshore wind park operational since 2011, has been a pilot scheme for the construction and operation of other projects which feed electricity into the German grid via Lubmin: Baltic 2, Wikinger, and Ostwind 1 as well as other planned projects.

### NORD STREAM AND NORD STREAM 2

Nord Stream has been another powerful stimulus behind the revival of the Lubmin Heath energy site. Since 2011, up to 55 billion cubic metres of natural gas can arrive in Lubmin annually to be fed into the European gas distribution grid. In 2013, Wingas and E.ON launched a combined heat and power plant in Lubmin, which uses a small amount of natural gas from the Nord Stream Pipeline to provide electricity for almost 50,000 households per year. The planned construction of the Nord Stream 2 Pipeline will further increase the significance of the area.

## A Connecting Hub on the German Coast

The Lubmin landfall facility is the logistical link between the Nord Stream Pipeline and the European gas distribution grid. The natural gas that arrives here from Siberia is repressurised and transported by the Nord Stream connecting pipelines OPAL and NEL to users throughout Europe.

The landfall facility in Lubmin, Germany is a connecting hub, the actual switching point of a cross-border project that contributes toward a secure energy supply to Europe for decades. At the same time, the landfall facility is only a small part of the puzzle in the entire framework. Where does the gas that is prepared here come from, and where does it flow thereafter?

**The Gas Comes from Siberia**  
Bovanenkovo in Western Siberia is the largest field on the Yamal Peninsula. Located at 40 kilometres from the coast of the Kara Sea, it covers an area of about 1,000 square kilometres. Vast gas reserves make it one of the three main Russian gas production centres. Currently, there are 32 fields producing gas, gas condensates and oil on Yamal. The peninsula produces up to 360 billion cubic metres of gas per year. Gazprom is the operator of the facilities and pipelines that transport the natural gas to the landfall facilities in Portovaya Bay. In challenging climatic and environmental conditions, Gazprom has implemented some of the most efficient, safe and innovative technical solutions of the industry while preserving the unique natural environment.

The Bovanenkovo oil and gas condensate deposit is the main natural gas base for the Nord Stream Pipeline. Discovered and estimated gas reserves amount to 4.9 trillion cubic meters which makes the Bovanenkovo field a reliable source of natural gas for Europe. The field has a design output of 115 billion cubic metres per year which can be ramped up to 140 billion cubic metres through further developments. The gas is produced by three upstream facilities. A gas transmission corridor including the connecting Bovanenkovo-Ukhta gas trunk lines supplies the natural gas from the fields towards the Nord Stream Pipelines.

### Transport by Nord Stream

The gas flows 2,500 kilometres from West Siberia to Vyborg. There, in the landfall facility in Portovaya Bay, 1.5 kilometres from the Baltic Sea, the natural gas is fed from the Gryazovets-Vyborg pipeline into the Nord Stream Pipeline. As operator, Nord Stream AG provides transport capacities through its pipeline system. Nord Stream AG has entered into a gas transportation agreement with OOO Gazprom Export to book up to 55 billion cubic metres capacity annually. The pipelines transport gas from the entry point in Russia to the exit point in Germany, where the gas is received by the connecting OPAL and NEL onshore pipelines. In total, it takes the gas about 10 days to make the journey from Siberia to Germany.

### On the Way to Europe

At the OPAL and NEL receiving station, the incoming and outgoing gas streams are checked for quality, subjected to official measurement, and adjusted in terms of pressure and flowrate as well as temperature, before being transported further. OPAL is one pipeline that links Nord Stream with the existing European natural

gas transport systems. Currently, up to 36 billion cubic metres of gas can flow through the OPAL pipeline annually. This amount is enough to supply a third of Germany with natural gas for a year. The pipeline runs south from Lubmin to Brandov, in the Czech Republic. Along its 472 kilometres route, the pipeline runs through three German federal states, and crosses a total of 172 roads, four highways, 27 rail lines, and 39 bodies of water. Since the gas loses pressure over the long route, it is repressurised at a compressor station in Baruth, south of Berlin.

The second pipeline that links the Nord Stream system with the European gas market is NEL. The NEL pipeline is 441 kilometres long, and runs westward across northern Germany from Lubmin to Rehden, in Lower Saxony. The pipeline has a capacity of over 20 billion cubic metres each year, which roughly corresponds to one-fifth of Germany's annual consumption.

The gas from the OPAL and NEL pipelines is transported onward to Germany itself, Czechia, Austria, Belgium, Denmark, France, the Netherlands, and the UK, along with other countries.

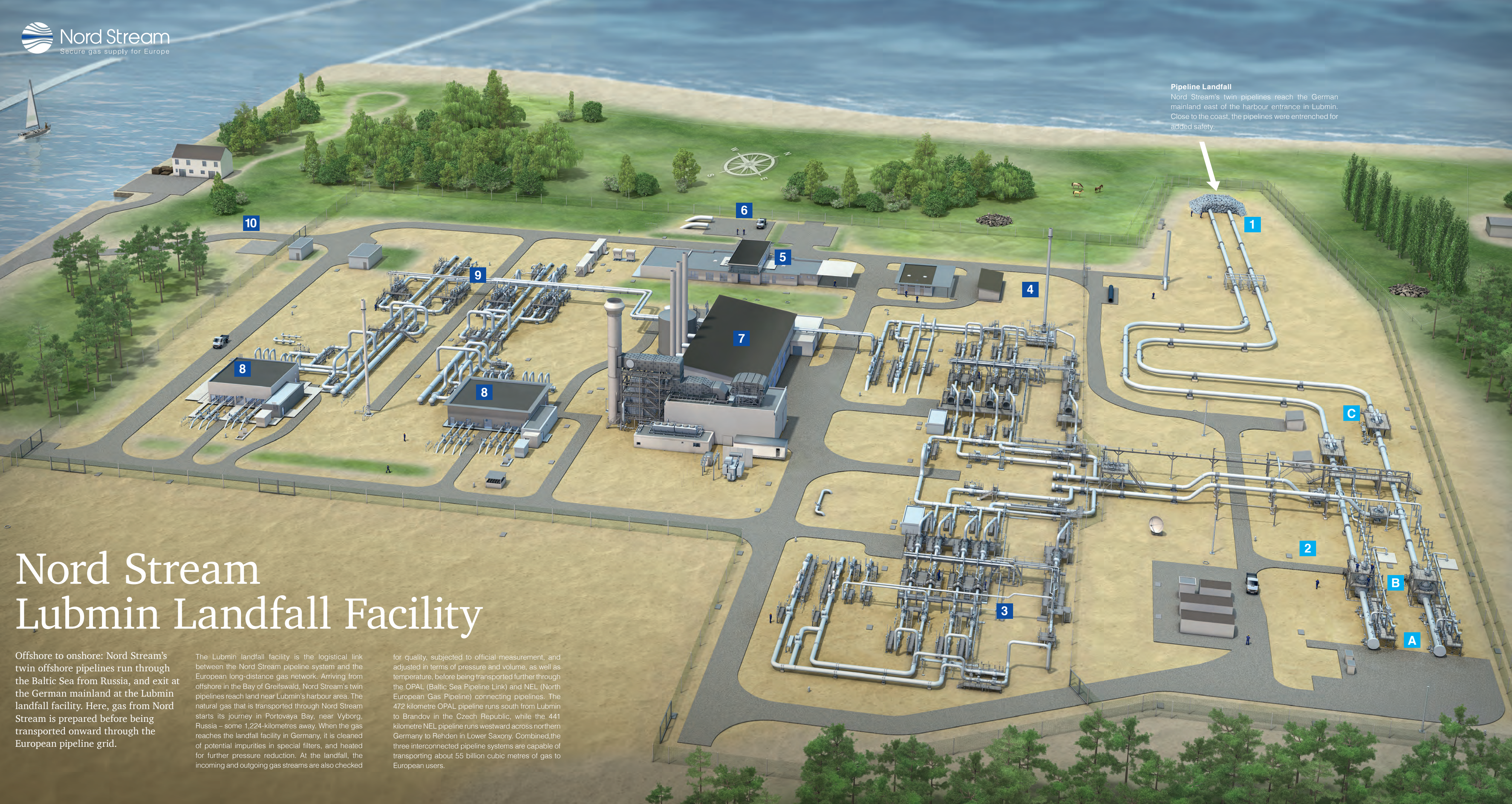
Gas flow through Line 1 of the Nord Stream pipeline system began in November 2011. The second line started operation a year later in October 2012. Together, the twin pipelines have the design capacity to transport a combined total of about 55 billion cubic metres of gas a year – that is enough to satisfy the energy demand of more than 26 million European households.

Since start of operations, the Nord Stream Pipeline has reliably transported all nominated gas volumes. The milestone of transporting a total volume of 200 billion cubic metres was passed in November 2017.



Nord Stream links the massive gas reserves in Western Siberia with the European gas distribution grid. The switching point of the project is the landfall facility in Lubmin, near Greifswald, Germany.





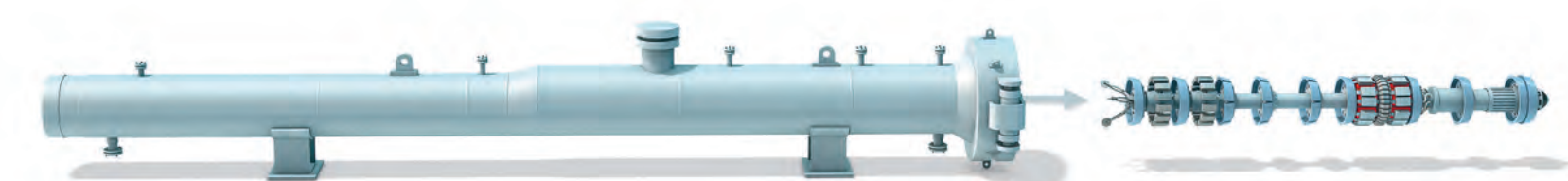
**Pipeline Landfall**  
Nord Stream's twin pipelines reach the German mainland east of the harbour entrance in Lubmin. Close to the coast, the pipelines were entrenched for added safety.

# Nord Stream Lubmin Landfall Facility

Offshore to onshore: Nord Stream's twin offshore pipelines run through the Baltic Sea from Russia, and exit at the German mainland at the Lubmin landfall facility. Here, gas from Nord Stream is prepared before being transported onward through the European pipeline grid.

The Lubmin landfall facility is the logistical link between the Nord Stream pipeline system and the European long-distance gas network. Arriving from offshore in the Bay of Greifswald, Nord Stream's twin pipelines reach land near Lubmin's harbour area. The natural gas that is transported through Nord Stream starts its journey in Portovaya Bay, near Vyborg, Russia – some 1,224-kilometres away. When the gas reaches the landfall facility in Germany, it is cleaned of potential impurities in special filters, and heated for further pressure reduction. At the landfall, the incoming and outgoing gas streams are also checked

for quality, subjected to official measurement, and adjusted in terms of pressure and volume, as well as temperature, before being transported further through the OPAL (Baltic Sea Pipeline Link) and NEL (North European Gas Pipeline) connecting pipelines. The 472 kilometre OPAL pipeline runs south from Lubmin to Brandov in the Czech Republic, while the 441 kilometre NEL pipeline runs westward across northern Germany to Rehden in Lower Saxony. Combined, the three interconnected pipeline systems are capable of transporting about 55 billion cubic metres of gas to European users.



**A PIG Traps**  
The integrity of the Nord Stream Pipeline is checked on a regular basis by what are known as intelligent PIGs (Pipeline Inspection Gauges). The PIGs are fed into the pipeline via launchers in Russia. The PIGs are then extracted safely from the receiving traps in Germany.



**B Double Expanding Gate Valves**  
Huge double-gate valves separate the gas in the pipelines from the PIG traps when these are not in operation. The valves are about 10 metres tall, and weigh 102 tonnes each. This makes them the heaviest double-gate valves that have ever been produced.

**Intelligent PIGs**  
The intelligent PIGs are carried through the pipeline by the gas stream. They automatically detect the smallest of changes due to corrosion or mechanical damage. They also register any possible movement of the pipeline on the seabed since the start of operation.



**C Shutdown Valves**  
Shutdown valves in service at the landfall facility are employed for safety purposes. In an emergency, they immediately and automatically interrupt the flow of gas into or out of the pipelines. All the valves were developed especially for the Nord Stream project.

## Main Components of the Landfall Area

**Nord Stream** **OPAL/NEL**

### 1 Nord Stream Pipelines

The twin pipelines of the Nord Stream pipeline system run 1,224 kilometres through the Baltic Sea before they reach land in Lubmin.

### 2 177.5 bar at Landfall Area

In the first portion of the landfall area, the maximum gas pressure is about 177.5 bar. In the subsequent measuring and control facilities, the maximum pressure is reduced to approximately 100 bar.

### 3 Offshore Preheaters

The arriving gas is first filtered, then warmed to the temperature required for transport through the NEL (North European Natural Gas Pipeline) and OPAL (Baltic Sea Pipeline Link) connecting pipelines.

### 4 Blowdown Valve

If an operational malfunction should occur, gas will be released via the blowdown valve, which eases pressure on the entire Lubmin landfall facility.

### 5 Operations Buildings

In addition to the control systems, the landfall facility is also equipped with ancillary structures such as a workshop and operations building.

### 6 OPAL / NEL PIG Traps

The PIG (Pipeline Inspection Gauge) traps house the intelligent PIGs, which are sent through the pipelines for inspection as required.

### 7 Boiler Building

Gas temperature sinks when transported over long distances. Therefore, before it is transported further, it will be warmed to the requisite temperature in the boiler building.

### 8 OPAL and NEL Measurement

The gas streams are checked for quality, subjected to official measurement, and adjusted in terms of pressure and volume before further transport by OPAL and NEL.

### 9 OPAL and NEL Heating

Here, the natural gas is heated to the requisite temperature for further transport through the OPAL and NEL connecting pipelines.

### 10 Landfall Access

The landfall is accessible from the harbour side. The entire compound was built on an elevated level to prevent it from being flooded during storms.