Nord Stream
The new gas supply route for Europe

BACKGROUND INFORMATION

November 2013

Operation of the Nord Stream Pipeline

Nord Stream's business model is to provide the capacity to transport natural gas from Russia into the European gas grid. This gas transportation system comprises two 1,224 kilometre pipelines through the Baltic Sea. Each has the capacity to transport 27.5 billion cubic metres of natural gas a year. The combined capacity of 55 billion cubic metres (bcm) is enough to supply the energy demand of 26 million European households. Nord Stream will meet about one third of the European Union's additional gas import requirement by the year 2035. The pipeline system is built to operate for a period of at least 50 years.

As an operator, Nord Stream AG offers gas transportation capacities via its twin pipeline system, which runs from Vyborg, Russia to Lubmin, Germany.

A contractual framework is in place to ensure the transport of gas from the entry point of the pipelines in Russia to the exit point in Germany. There, the gas is received by the connecting pipelines OPAL (Baltic Sea Pipeline Link) and NEL (North European Gas Pipeline) for further transport into the European grid.

The construction and operation of the pipelines were permitted by all the relevant national authorities in the countries through whose waters Nord Stream passes. Additionally, the complete pipeline design and construction was certified by the independent Norwegian certification company Det Norske Veritas (DNV), which ensures that the highest international standards for constructing and operating offshore pipelines are met.

Nord Stream also operates four pipeline facilities: the landfalls in Russia and Germany where the offshore pipeline is connected to the onshore pipelines; and a Control Centre located in Zug, Switzerland – from where the pipelines are monitored and operated. Additionally, there is a Back-Up Control Centre.

Pipeline System Facilities

Nord Stream's twin pipelines run from Vyborg in Russia to Lubmin in Germany. In Russia, Nord Stream is connected to the Russian gas grid via the Gryazovets-Vyborg pipeline. In Germany, gas from Nord Stream is fed into the European grid via the OPAL and NEL connecting pipelines.

Construction of the Nord Stream Pipeline started in April 2010 after all required permits had been granted. Each pipeline is made up of over 100,000 concrete weight coated pipe segments, each with an average length of about 12.2 metres and a constant inner diameter of 1,153 millimetres. The pipes are made of high-tensile steel that has an internal anti-friction coating and an external anti-corrosion coating. The internal coating consists of a two-component epoxy resin flow coat, which increases

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flow capacity by reducing friction. Line 1 began gas deliveries in November 2011. Offshore construction of Line 2 commenced in May 2011. By the last quarter of 2012, Line 2 will be operational as part of a fully-integrated twin pipeline system

1.1 Landfall Facilities in Russia and Germany

The connections between the offshore pipeline and the onshore grids are called landfalls. Landfall facilities cover the section of pipeline between the waterline and the connecting pipelines: in Russia to the Portovaya Compressor Station operated by Gazprom Tranzgaz St. Petersburg, and in Germany to the Greifswald receiving terminal operated by OPAL and NEL. Equipment needed for the operation of the pipelines is located at the landfalls, including isolation and emergency shut-down valves to separate the offshore from the onshore pipelines, as well as a number of sensors to monitor all relevant parameters such as pressure, temperature, gas quality and gas flow. For integrity management purposes, intelligent Pipeline Inspection Gauges (PIGs) are sent through the pipeline every few years. To launch and remove the PIGs, PIG launchers (Russia) and PIG receivers (Germany) have been installed.

1.2 The Control Centre

The operation of the Nord Stream Pipeline system is remotely monitored and controlled from the Control Centre, located at the Nord Stream Head Office in Zug, Switzerland. The operators in the Control Centre oversee and coordinate technical operations of the pipeline system. This means that they are in constant contact with the supplier of the gas as well as the receivers to assess the flow of gas on a daily basis. Additionally, the operators monitor the physical flow of the gas through the pipelines to determine that everything is operating as planned. The control system is connected via a dedicated cable and satellite connection to the sensors and valve controls at both landfalls, enabling the operator to remotely monitor all parameters of gas flow, and to open or shut the pipeline valves with the push of a button when necessary. The Control Centre is equipped with a large video wall display and operator and engineering workstations. The facility is manned 24 hours a day, 365 days a year. For added safety during operations, a fully independent communication system is duplicated at a second location.

1.3 Compressor Station at Portovaya and Greifswald Receiving Terminal

In order to transport the gas over a distance of over 1,224 kilometres through the Baltic Sea, a powerful compressor station is needed to build sufficient pressure. At full capacity, the Nord Stream pipelines require an inlet pressure of nearly 220 bar. The compressor station at Portovaya, located upstream from the Russian landfall and managed and operated by Gazprom Transgaz St. Petersburg, enables the transport of gas all the way to Germany without interim compression. At the compressor station, the gas is conditioned to the required specifications and then compressed to the necessary pressure. Gas pressure and flow rate are controlled in the compressor station control room. After compression, the gas is conveyed to the coolers, where it is chilled to the required operating temperature. Before being fed into the Nord Stream pipelines, the gas enters a fiscal metering station, to confirm the contractually agreed flow rate and quality as well as system pressure and temperature.

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At the other end of the pipelines, the OPAL and NEL receiving terminal serves to adjust the flow rate and pressure coming from Nord Stream in accordance with the operating design conditions of the downstream OPAL and NEL pipelines. The facility is managed and operated by OPAL and NEL, which distribute the gas via their connecting pipelines into the European gas grid. At this facility, the gas coming from the Nord Stream Pipeline system is also filtered and pre-heated. Gas heating may be required to meet specifications prior to injecting the gas into the downstream pipelines, especially in the event of low ambient temperatures. The gas then once again enters the two fiscal metering stations, before being conveyed to the connecting pipelines.

2. Gas Transportation through the Nord Stream Pipeline

Nord Stream provides its partner and customer, Gazprom Export, with transport capacity through its twin pipeline system. Based on supply contracts between Gazprom Export and its European partners and customers, flow rates of gas through the pipeline are nominated daily from the Control Centre in Zug. Depending on the amount of gas in the pipelines, and the requested flow rate to arrive in Lubmin, the compressor station in Portovaya pressurises the gas and pumps it into the Nord Stream system. If more gas is needed in the European grid downstream, flow rates and pressure are increased accordingly.

2.1 Continuous Monitoring for Safe and Efficient Operation

Nord Stream's operating staff monitors safety processes and parameters – such as pressure, temperature, flow rate and gas specifications – associated with the transport nomination. The systems on Nord Stream's side interface with the compressor station and the receiving terminal to guarantee that all parameters are met. In the event of the parameters approaching an operating limit, the operators ensure, via timely communication and coordination with the compressor station and the receiving terminal, that the operating limits are not exceeded. In the case that any parameters – such as pressure or inlet temperature – are violated, automatic safeguards will close the inlet valves. The valve can only be reopened once the operating conditions have been restored. The design pressure of the pipelines is 220 bar at the entry point of the pipeline in Russia, and approximately 177.5 bar at the German landfall. During operation of the pipelines, the target pressure is a minimum of about 100 bar.

All relevant safety systems fall under the responsibility of Nord Stream. Nord Stream operators coordinate the transportation operation with upstream and downstream operators who also continuously measure the various design parameters and quality specifications at several locations on both ends of the transportation system.

All process parameters are continually transmitted in real-time via the telecommunications system to the operators in the Control Centre in Zug. Fire and gas detection equipment consisting of an array of safety sensors is installed at strategic locations for the purposes of hydrocarbon gas detection as well as flame, smoke and heat detection. The sensors are fine-tuned so as to enable the identification of any irregularities before they become hazardous.

2.2 Systems Used in Monitoring and Controlling the Transportation Process

A number of smart control systems have been installed to aid the operators in the safe management of the gas transport. The combined set of control units and safeguards make up the Pipeline Control and Communication System (PCCS). This system is installed in the Control Centre. As an added safety feature, there are two instrument equipment rooms with operator workstations at the landfall areas – one in Russia and one in Germany – that are locally supervised.

The operating staff has access to all parameter monitoring data from the sensors installed at either end of the system and from these locations they can remotely operate valves, monitor maintenance and pigging operations (internal inspection with pipeline inspection gauges). In addition, there are automatic fail-safe mechanisms that operate emergency shut-down valves at either end of the pipelines in case certain sensors are triggered by over-pressurisation or temperatures exceeding the allowed limits, or in the event of fire or a gas release being detected. A fire extinguishing system protects the pipeline equipment and the control buildings.

3. Pipeline Operations, Maintenance and Repair

3.1 Operations and Maintenance

To guarantee the reliability, availability and safety of the gas transportation system, the Nord Stream Pipeline Integrity Concept details an extensive set of maintenance activities. The system relies on the availability of all key components: the pipelines, the control and monitoring equipment installed at both landfalls, as well as the equipment and systems installed at the Control Centre in Zug and the Back-Up Control Centre.

At the landfalls, regular maintenance, inspection, testing and repair covers the Pipeline Safety System, Telecommunication System, Power Supply System, the Fire and Gas Detection Systems and Security System, as well as the shut-down and isolation valves.

The main offshore pipeline maintenance activities are related to monitoring its actual status in comparison with the initial check and includes external and internal inspection. External inspection is to be carried out by survey vessels using remotely operated vehicles (ROV) for visual and instrumental pipeline inspection.

Pigging, or internal inspections with intelligent PIGs, is used to detect even minor changes in the condition of the pipeline. This in-line inspection is scheduled to take place every few years to confirm the absence of corrosion or mechanical defects, in addition to measuring geographical coordinates indicating any pipeline movement compared with as-laid conditions. The intelligent PIGs are sent from the PIG launcher at the Russian landfall and travel with the gas flow to the PIG receiver on the German side.

An initial internal inspection performed shortly after commissioning of the pipeline provides baseline data. These data provide information and are the reference for the state of the pipeline upon its initial completion, free from operational effects.

3.2 Pipeline Repair

Pipeline repairs are not expected to be necessary during Nord Stream's minimum operational lifespan of 50 years, owing to the high quality of the materials involved and the pipeline's conservative design. However, in the unlikely event of deformation or damage to the pipelines caused by external factors, a pipeline repair plan has been developed, as part of the asset management corporate policy.

A repair would require careful engineering and planning and the use of special equipment and spares as well as the mobilisation of suitable equipment and vessels. During a major repair it is most probable that the gas flow rate would be significantly reduced or stopped. As part of its strategy of preparedness for any repair operation, Nord Stream is a member of the Pipeline Repair System (PRS) Statoil pool. Through this pool membership, Nord Stream gains access to the repair equipment owned by the PRS club (including equipment needed for hyperbaric welding on the seabed).

A repair service agreement with a major contractor is currently envisaged for the beginning of the operational phase of both pipelines. This would provide – in the case of a necessary repair operation – all the engineering, logistics, marine and construction works necessary to reinstate normal operating conditions within the shortest possible timeframe, thus further contributing to the already high level of safety and reliability of the pipelines.

3.3 The Team

Nord Stream operates the high pressure grid with a team of highly experienced and qualified technicians and engineers. They are all specialists in their fields: onshore or offshore, in operations or in engineering. Additionally, they all have an international business background and add operational excellence to the Nord Stream team.

Their goal is to operate and maintain the grid as the leading operator in the fields of safety, protection of the environment, production availability and efficiency.

More information at www.nord-stream.com

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