Nord Stream
The new gas supply route for Europe

BACKGROUND INFORMATION

September 2010

Nord Stream and Munitions in the Baltic Sea

Contents

1. Introduction

It is a known fact that chemical and conventional munitions were disposed of in the Baltic Sea after the First and Second World War, and until as late as the 1960s. Marine scientists possess a wealth of information about the type and amount of these dump sites, though some information still remains confidential to national authorities. With regards to the pipeline route, one of Nord Stream's top priorities is avoidance, and, where this is not possible, the safe and secure handling of potential finds prior to and during pipeline construction, and the subsequent operational phase.

Therefore, Nord Stream has conducted what is likely to be the most extensive high resolution survey of a defined installation corridor ever conducted through the Baltic Sea. These survey results add considerably to what is known about the state of munitions in the Baltic Sea, thereby improving the chances for informed handling of the issue in the future.

It is important to note that Nord Stream works closely with all the appropriate national and international authorities to ensure its activities are safe and produce minimal environmental effect.

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2. Munitions in the Baltic Sea: What is Known?

Mines were laid in the Baltic Sea during the First World War and munitions were dumped there shortly after the end of the conflict. In the Second World War, the Baltic Sea was strategically very important. It represented a frontier between the opposing forces, and so was heavily mined. After the war, Allied countries took munitions confiscated from Germany and dumped them in the Baltic Sea, which at the time was considered the best means of disposal. This situation was later compounded by the disposal of chemical warfare agents by Baltic Sea states such as the dumping by former East Germany in the early 1960s.

Of the munitions remaining in the Baltic Sea today, two broad categories are of primary concern for Nord Stream in the construction and operation of its pipeline:

- Conventional munitions
- Chemical munitions

A number of organisations and authorities regularly sweep discreet areas of the Baltic Sea for munitions and evaluate the impact of these munitions on the Baltic Sea. Among those are authorities and institutions that have accumulated vast knowledge over many years, mostly in connection with fishing, and the navies of NATO members. HELCOM (the Helsinki Commission) has produced several reports on dumped munitions and stresses the need to continue researching the subject.[1]

Nord Stream views its rigorous surveys as a considerable contribution to the knowledge of munitions in the Baltic Sea. The route has been planned to avoid known dump sites. Detailed surveys have been conducted to verify that it is safe for the installation and operation of the pipeline system.

Engineering analysis based on the effects of underwater explosion on the pipeline has shown, that in order to ensure the integrity of the pipeline in case of a detonation, the “security corridor” has to be 50 metre wide (i.e. +/-25 m either side of the optimised alignment). This analysis was performed by the design contractor, SES (Saipem Energy Services) and verified by the certifying body Det Norske Veritas (DNV).

3. Nord Stream’s Activities for Munitions Screening in the Baltic Sea

The company approached the issue of munitions in the Baltic Sea with no preconceptions, except that the issue cannot be dealt with lightly, and therefore gathered all available information and opinions on the subject. This included consultation of statutory authorities and experts in marine warfare.

Nord Stream has researched the seabed in a staged approach in order to retrieve the most detailed data on the exact corridor where the pipeline will be laid whilst, at the same time, ensuring that no objects that may endanger the integrity of the pipeline or adversely impact the pipeline are in the immediate surroundings of the pipeline route. The survey began with a two kilometre wide corridor that was screened for large ob-

[1] *3rd Periodic Assessment of the State of the Marine Environment of the Baltic Sea*. HELCOM 1996. HELCOM is the Baltic Marine Environment Protection Commission, an independent regional body that works to combat pollution of all types: it is the authority on dumped chemical munitions in the Baltic.

jects and then progressively narrowed down to a 15-metre wide corridor, the installation corridor which is specified by the installation tolerance defined in the contract with Saipem, i.e. +/- 7.5 metres in normal pipe laying. In this corridor ferrous objects even as small as ten centimetres could be identified.

Although there are no international regulations for dealing with munitions, Nord Stream aims to set the highest standards and follow strict procedures defined by the leading survey specialists in the Baltic Sea region. Survey work associated with the Nord Stream project has been divided into three phases.

3.1 2005 Survey

Establishing the pipeline route was one of Nord Stream's major preparatory tasks. North Transgas conducted the first survey of the seabed in 1998. This looked at possible route alternatives through the Baltic Sea and included many parts of the currently proposed route.

The first detailed screening of Nord Stream's provisional route was carried out by PeterGaz in 2005. This was principally a geophysical reconnaissance survey to establish a two-kilometre wide corridor for more detailed route assessment, through evaluation of seabed terrain, shallow geology, and cultural heritage such as wrecks.

3.2 2006 Survey

On the basis of the 2005 survey data, two potential pipeline routes were selected. These were investigated in 2006 during a second seabed survey which covered a 180-metre wide corridor along the entire length of the proposed pipeline. This was a detailed geophysical survey that provided both engineering data and the image resolution required to identify munitions. The instruments used were the best available at the time, and all "targets" (objects that might possibly be munitions) were carefully recorded and added to the existing database of targets from the 2005 survey.

Nord Stream then deployed a remotely-operated vehicle (ROV) to visually inspect each target within 20 metres of the route. In Swedish waters – one of the territories closest to the dump sites – there were over a thousand targets, yet only one was potentially munitions-related (believed to be a mine anchor). In the Gulf of Finland, Nord Stream found several munitions targets, including two mines (one deliberately sunk). A few potential targets were located near the known chemical dumping area off Bornholm, but none were positively identified as related to chemical munitions. Nord Stream recorded the locations of these unresolved targets and passed the information on to the appropriate authorities.

As a result of the 2005 and 2006 surveys outside Russian waters only two targets were clearly identified as mines. The other targets investigated were found to be items naturally occurring on the seabed or man-made items, such as:

- Boulders
- Shopping trolleys
- Oil drums
- Rubber hoses
- Peat bags
- Mine anchors (non-explosive)

- A high percentage of the objects found were discarded white goods (e.g. washing machines and fridges)

3.3 2007-2008 Survey

Nord Stream approached the 2005 and 2006 surveys without preconceptions about what it might find on the seabed along the proposed route of the pipeline and in adjacent areas. Based on the results of these surveys, a route free from significant obstacles to the construction and safe operation of the pipeline was selected.

Once this installation corridor was determined, Nord Stream began preparations to survey the route with the knowledge that the new survey campaign would produce more resolute and complete results than previous surveys. Consequently, in July 2007, Nord Stream launched a detailed and targeted third survey, in three distinct stages.

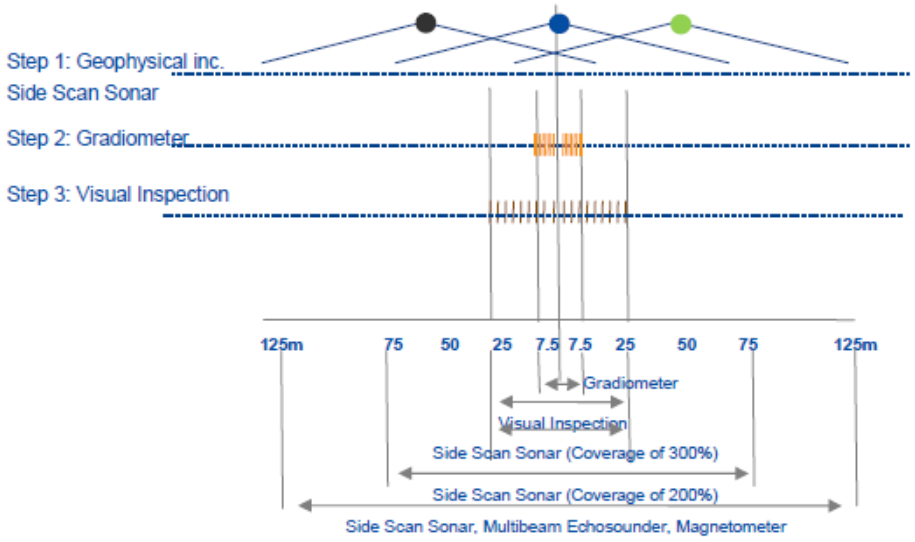

Figure 1: Operation method of the ROV to inspect possible targets

Stage One
The first stage included multi-beam echo sounders (MBES), high-resolution side-scan sonars (SSS), sub-bottom profilers and a magnetometer. Multi-beam echo sounders and side-scan sonars provide a detailed picture of the sea floor morphology and objects lying on the seabed. The sub-bottom profiler can penetrate into the material at the sea bottom to show a cross-section of the shallow geology (sequence of mud, silt and bedrock horizons) that makes up the seabed. The magnetometer provides information on ferrous (iron-based) materials.

Stage Two
The second stage used a 6.5-metre wide twelve-sensor gradiometer array mounted on a ROV to detect any ferrous (iron-based) metals on the seabed. Whereas the 2006 survey used electromagnetic induction sensors, the gradiometer array provided better lateral coverage and allowed coverage of the full installation corridor in two passes of the ROV. The higher-range capability of the gradiometer array allowed the

detection and positioning of discrete buried objects that may have penetrated the soft sediments. Concurrently with the gradiometer survey, visual coverage of the seabed was also achieved. The gradiometer data were processed within a digital model (position, field strength) to allow objects to be located for further visual inspection.

Stage Three
In the third stage Nord Stream visually inspected the targets located during the previous two stages. This allowed experts to examine and identify any questionable objects. Where appropriate, Nord Stream liaised with a team of experienced navy personnel to help identify them.

The 2007-2008 survey has produced a small number of conventional munitions finds in the installation corridor. In consultation with the responsible authorities Nord Stream has established procedures for the safe handling of all objects that have to be disposed of before construction work can start. Thanks to the cooperative attitude of the authorities and with extensive experience in safely dealing with munitions at its disposal, Nord Stream is confident that munitions do not present a significant obstacle to the construction and safe operation of the pipeline.

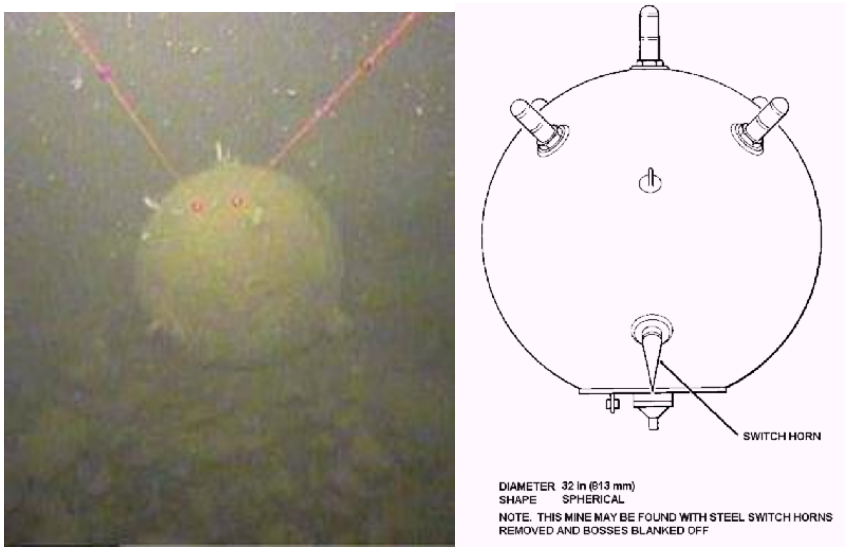

Figure 2: German UMA (U-Boot Abwehrmine A) anti-submarine mine found in the Gulf of Finland

Independent sources confirm that a multi-sensor approach to surveying is best practice. Multi-coverage high-resolution surveys of the seabed and automated data-analysis enable detection, classification and localisation of munitions and similarly-sized objects with a high degree of confidence. Different types of sensor, such as the range of instruments used by Nord Stream provide a variety of data which can be combined to produce a high-quality picture of the sea floor, regardless of environmental conditions.

The instruments and techniques employed by Nord Stream represent state-of-the-art equipment utilised in a rigorous approach to fully evaluate the risk posed by munitions: Instruments include side-scan sonar systems working at high frequency and a specifically developed twelve-sensor gradiometer array.

4. Chemical Munitions Screening 2008

Next to thorough surveys described above, additional measures have been taken to detect the remains of chemical munitions. To evaluate the potential for contamination caused by the remains of chemical warfare agents (CWA) approximately 100 soil samples have been taken in Danish waters[2]. The soil samples were collected by DHI, an independent international consulting and research organisation.

The samples were taken on regular distance along the planned pipeline route. The frequency the samples were collected was not adjusted for variations in soil type nor were any anomalities/objects specifically targeted. No intact warfare agents were found. The probability to disturb chemical munitions along the route is therefore considered very low.

The chemical testing was split between two laboratories – one in Denmark (DHI) and one in Finland (VeriFin). Therefore the CWA samples were doubled to enable the parallel processing of two laboratories. VeriFin (Finland) is an internationally recognised control laboratory for such testing and has been used for the MERCW (Modelling of Ecological Risks Related to Sea-Dumped Chemical Weapons)[3] project.

The results of the chemical analysis showed that only very few stations had evidence of contaminants related to CWA (Adamsite, Clark I, Triphenylarsine and Phenyldichloroarsine). For all other substances tested the content of CWA contaminants was below the detection limit. Overall, the extent of the contamination, where encountered, was very low in the sediment samples and pore water samples.

5. Sharing the Knowledge Gained

Nord Stream has examined numerous objects along the route of the Nord Stream Pipeline. The results of, and knowledge obtained through the munitions surveys have been provided to relevant authorities as part of the application process. Nord Stream welcomes plans to make the data available to interested organisations involved with research in the Baltic Sea and is committed to establish a data and information fund.

In addition, the teams that subsequently lay the pipeline are contractually obliged to install the pipeline within the evaluated and fully assessed installation corridor. Installation vessels that use multi-point anchor spreads are required to perform anchor clearance surveys and inspect all targets that could interfere with the anchor pattern. An inventory of all suspicious targets and instructions not to disturb any possible finds are maintained on the installation vessels throughout the contract period.

The scale of Nord Stream's munitions surveys is unprecedented, and the company did its utmost to acquire and deploy the most sophisticated survey equipment available. To ensure that its survey techniques followed and generally exceeded recommended good practice, Nord Stream also organised seminars with experts from the

[2] Tests for Chemical Warfare Agents include: Sulphur mustard, Adamsite and its degradation products, Clark I and main degradation products, Lewisites I and II and their degradation products
[3] MERCW project is funded by the EU FP6 (6. Framework Project for Research and Technical Development). As an international co-operation (INCO) project work started in the HELCOM area on 1 November 2005.

national authorities to give them the opportunity to review the survey approach and results and to consult with them if or where further investigations were required.

6. Munitions Clearance in Co-operation with Authorities

Since known munitions dump sites were avoided, only a relatively small amount of conventional munitions has been identified on the route. As of June 2010, all necessary clearance operations have been successfully completed. A total of over 100 items were cleared in Russian, Finnish, Swedish and German waters.

In Danish waters, five possible chemical munitions items were found during the surveys. The Admiral Danish Fleet assessed the findings based on documentation provided by Nord Stream and recommended that the objects be left on the seabed where found, as they do not pose a risk to the pipeline. Nord Stream will follow this recommendation and will avoid contact with these munitions during the installation of the pipelines.

Contingency plans for chance encounters with chemical warfare agents have been developed in close consultation between the contractors, chemical warfare experts and respective governmental departments such as the Bornholm Marine District.

The main objective of the clearance operations was to clear ordnance that pose a threat to pipeline installation. The clearance was performed in two phases, firstly along the security corridor, followed by selected munitions within the anchor corridor. Munitions clearance requires the safe detonation of the munitions. Safe and proven clearance methods were used which are similar to those previously used to dispose of munitions in the Baltic Sea. Over the last decade or so, the navies of the Baltic Sea States have developed methods that are both safe and effective for the clearance of mines and other explosive underwater ordnance. They routinely clear munitions – more than 1,000 since 1996. Their methods have also been used by other national navies around the world to dispose of ordnance.

Clearance was conducted in accordance with a clearance plan that was developed in cooperation with relevant national authorities. The clearance plan included clear risk assessed procedures for the technical performance of the work, together with the mitigation measures to minimise impact to marine mammals, fish and birds, and a monitoring plan.

7. Safe Munitions Clearance Procedures

Nord Stream is cooperating with BACTEC International Limited, a UK based explosive ordnance disposal (EOD) and mine-clearance company. In order to ensure a smooth operation, an environmental and a safety management plan is in place, establishing parameters for the overall monitoring programme that is part of the work package in addition to pro-active mitigation measures. All mitigation procedures are closely monitored. They include:

- Qualified Marine Mammal Observers provide technical expertise, throughout the project.

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- The detailed effects with regards to sub-surface water pressures are formulated by modelled information for each planned detonation. This information is directly correlated to the effects on a diver in the water, thus acceptable safety distances for all mammals can be determined.
- Passive Acoustic Monitoring for Marine Mammals is employed.
- Prior to any clearance operations, a survey for fish shoals is conducted.
- Prior to any clearance operations, Fish Scaring Charges and seal scrammers are used to displace fish and marine mammals.

The disposal of unexploded ordnance (i.e. a mine) was comprised of several steps, starting with an as-found survey, implementation of mitigation measures to minimise impact on marine life, placement of the demolition charge, demolition and an as-left survey. Throughout the activities, the authorities were informed on the status and any marine traffic in the area is warned to avoid the location.

8. Conclusion: Comprehensive Surveys with the Best Equipment for a Safe Pipeline

Nord Stream is aware of the multitude of munitions that have been disposed in the Baltic Sea, and it takes the potential threat they pose extremely seriously. Being the operator of the future offshore pipeline through the Baltic Sea, Nord Stream gives highest priority to the identification, evaluation and where required clearance of munitions. The overall aim is to ensure a safe installation and operation of the pipelines whilst minimising risks and impacts on the environment. Furthermore, when dealing with the munitions finds, Nord Stream carries out any activities only in strict accordance with the applicable legislation and in close cooperation with the responsible authorities.

Nord Stream has the capacities and the most current technology at its disposal to manage this sensitive issue. Nord Stream is contributing – through these extensive examinations – to enhancing current knowledge of munitions finds in key areas of the Baltic Sea. Nord Stream is thereby ensuring that future projects, including future pipelines, are planned with a heightened appreciation of the constraints associated with munitions.

More information at www.nord-stream.com

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