Design and Execution of a Giant Offshore Pipeline

Nord Stream
The new gas supply route for Europe

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Saipem
Today, gas can be transported economically over ever greater distances

Some examples
Gas Supplies to Europe by Pipeline
Gas Throughput Capacity: 5.3 bscfd (55 b m³/a)
Approx. 10% of EU 27 current gas consumption

Photo courtesy Environment New Service (ENS) 2010. All rights reserved.
The Nord Stream Project

2 x 1,224 km 48-inch diameter pipeline
1st March 2011 ON SCHEDULE

German Shorepull
Completed by Castoro 10

Position of Castoro Sei (KP 865)

Laid by
Solitaire

Russian Shorepull & Zone 2
Completed by Castoro Sei

NORDIC SEA

SWEDEN

STOCKHOLM
AIRPORT

KARLSKRONA

GREIFSWALD

MUKRAN

KALININGRAD (RUSSIA)

POLAND

LATVIA

ESTONIA

LITHUANIA

SWEDEN

STOCKHOLM
AIRPORT

KARLSKRONA

GREIFSWALD

MUKRAN

KALININGRAD (RUSSIA)

POLAND

LATVIA

ESTONIA

LITHUANIA

KAVG

HANKO

KOTKA

Z1

Z2

Z3

WT 26.8mm
KP 674-1224

WT 30.9mm
KP 297-674

WT 34.6mm
KP 0-297

SUPPORT BASE
PIPE LOADOUT YARD

TO BE LAID BY CASTORO SEI & CASTORO 10
TO BE LAID BY SOLITAIRE

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A huge project with gigantic volumes and weights

The largest and heaviest trunkline in the world

- **Overall pipeline**
  - 199,755 elements per line
  - Total weight 5,000,000 t

- **Tube element**
  - Diameter 48” (1.4 m)
  - Length 40 ft (12.2 m)
  - Weight ~ 24 t

- **Record performance**
  - Laying on the average 1.8 ÷ 2.2 miles, 6 ÷ 8000 t per day
  - Almost 2.8 miles on record days
  - Continuing operation 24/7 for over a year, no interruptions
Saipem’s Role

- *Snamprogetti (now Saipem), previous and independent design contract with Nord Stream*

- Laying of the entire pipeline system

- Many offshore and onshore services, in Russia and in Germany

- Management of an *armada* of over 40 ships involved
Castoro 6 passing Storebelt bridge >
Logistics for just-in-time tubes supply

New coating and storages facilities along the pipeline path

Shipping distance to pipelay barge less than 100 nautical miles on the entire route

> Two new concrete coating plants and marshalling yards: Mukran (DE) and Kotka (FI)
> Three additional marshalling yards: Hanko (FI), Slite and Karlskrona (SE)

Benefits:
> Direct pipe supplies, ensuring sufficient pipe supplies for the pipelay barge
> Reduced handlings, making delays less likely
> Short shipping distances and lower fuel consumption
Pipelaying never farther away than 1 hour flight by helicopter
Utmost attention to the environment
Castoro 6 passing the Storebelt bridge on the way back home in spring 2012

Laying of Line 2 completed ahead of schedule
Beyond Castoro 6

The new Castorone

<table>
<thead>
<tr>
<th></th>
<th>CASTORO SEI</th>
<th>CASTORONE</th>
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</thead>
<tbody>
<tr>
<td>Vessel Length</td>
<td>152 m</td>
<td>330 m</td>
</tr>
<tr>
<td>Vessel Width</td>
<td>78 m</td>
<td>39 m</td>
</tr>
<tr>
<td>Pipe Size</td>
<td>60 inch</td>
<td>60 inch</td>
</tr>
<tr>
<td>Storage Capacity</td>
<td>3,000 t</td>
<td>20,000 t</td>
</tr>
<tr>
<td>Tensioner Capacity</td>
<td>390 t total</td>
<td>750 t total</td>
</tr>
<tr>
<td>Station Keeping</td>
<td>#12 mooring lines</td>
<td>Dynamic Positioning DP3 - Thruster Output = 56 MW</td>
</tr>
<tr>
<td>Water Depth</td>
<td>up to 1,000 m</td>
<td>up to 3,000 m</td>
</tr>
<tr>
<td>Working Stations</td>
<td>#6 stations double joint</td>
<td>#7 stations triple joint</td>
</tr>
<tr>
<td>Firing Line</td>
<td>142 m</td>
<td>309 m</td>
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How big is the Castorone?
Castorone – The Next Performance Frontier

- Much higher productivities in S-lay and J-lay modes
  - Lower overall project cost
  - 25% productivity increase in Nord Stream-type situation
  - Better use of seasonal windows
  - Limited weather standby

- Much broader application range with significantly improved flexibility
  - From ultra-deep to shallow waters, also in S-lay, by simply adapting stinger configuration
  - Advanced weather capabilities
  - Fast moving dynamic positioning capability
  - On-board switch from S- to J-lay to suit route and depth - one vessel only for the entire project
  - In line installation of large/heavy structures
First Projects with Castorone
All in high productivity S-lay mode

Castoro lay barge, Saipem’s first offshore construction vessel, a converted oil tanker (1966)

→ Walker Ridge Export Pipeline, GoM (Chevron)
   Max 7,000 ft w.d.

→ Big Foot Oil Export Lateral Pipeline, GoM (Enbridge)
   Max 5,600 ft w.d.

→ Gas Export Pipeline for Ichthys LNG Project, Australia (Inpex)
   550 miles 42″
Let’s see how it was done