Use of DYWIDAG Multistrand Tendons for the Construction of LNG Tanks at the Arctic Circle, Norway

Reference Details:

Owner Statoil, Stavanger, Norway +++ **Main Contractor** Tractebel Gas Engineering Belgium S.A., Brussels, Belgium +++ **Subcontractor** NCC Construction A/S, Oslo, Norway

DSI Units DSI Norway, Skytta, Norway
DSI Services Supply of 1,650 t vertical and horizontal DYWIDAG Multistrand Tendons type MA, St 1670/1860 with accessories; implementation of stressing operations

1,650 t DYWIDAG Multistrand Tendons secure the construction of four LNG (Liquefied Natural Gas) tanks for the "Snøhvit" project, Melkøya, Norway

The international Snøhvit Consortium is constructing the first European plant off shore of Hammerfest (Norway), north of the Polar Circle, to produce and export liquefied natural gases. With the "Snøhvit" (Snow White) project the "northernmost industrial plant in the world" is currently being built on Melkøya Island. The gas sources, consisting of the Snøhvit, Askeladd and Albatross fields, are located about 140km northwest of Hammerfest in the Barents Sea.

From the remote controlled sub sea production facilities the gas is pumped to the LNG plant on Melkøya Island through a 160km long multiphase pipeline. In this plant the gas is liquefied at a temperature of -163°C. The carbon dioxide produced during the liquefaction process is subsequently pumped back to the production fields through a pipeline where it is stored in the second largest underground CO_2 deposit in the world.

The construction work on this 5.4 billion Euro project began in 2002. The construction of two LNG tanks, one condensate tank and one LPG tank is an important part of this industrial complex. The respective tanks have the following capacities and dimensions:

- 2 LNG tanks 125,000 m^3 , diameter 74m height 48.70m
- 1 condensate tank 75,000^3 , diameter 60m height 42.30m
- 1 LPG tank 45,000^3 ,diameter 50m height 37.90m.

DSI is responsible for the supply and installation with stressing and grouting of a total of 1,650t horizontal and vertical DYWIDAG Post-Tensioning Tendons with accessories. The polar weather conditions during the construction set specific requirements and stresses on men and material. From October to April sight conditions are heavily restricted due to strong snowfall or snow storms. Further restrictions of sight conditions due to fog are to be expected with the utmost probability throughout the entire year.

Within the framework of a short schedule and due to extreme polar weather conditions the work to be carried out by DSI Norway is concentrated on the frost-free period during the summer months.

The tank walls were constructed by means of a slip formwork with a performance of 2m/24h within few weeks. DSI supervised the correct installation and position of system components during concrete works around the clock. The actual stressing works required extensive agreements with other contractors and partly working in nightshifts to eliminate any risk for other parties working on or in between the tanks. A paticular challenge was the installation of the vertical tendons with 12 strands. The vertical tendons of tanks are typical so-called U-shaped or loop tendons. A loop tendon consists of two vertical tendons, which are connected at their bottom ends in the foundation by an 180° arc. In spite of a maximum tank wall height of 40m and a arc radius of only 1m the installation of the loop tendons by pushing single strands was carried out without any problems.

For decades oil and gas have been produced both onshore and offshore. In this connection ever strict safety measures for technology have been mandated with regard to environmental protection presenting a great challenge to all partners involved in the construction. Such demands in particular for environment-friendly and safe technologies play a very important role in the "Snøhvit" project. The owner, Statoil, has placed special emphasis on safety and environmental protection for the planning and during the entire construction work for the "Snøhvit" project.

Special features of the "Snøhvit" project with regard to technology and environmental protection:

- Construction work may not affect fishing in any form.
- The complete construction site is understood as a closed system and may not produce dangerous emissions.
- All dangerous substances are treated in a biological processing plant on the mainland and disposed of.
- The carbon dioxide produced during the liquefaction process of the crude gas is pumped back from the mainland to the production fields in compressed form where it is stored underground.
- The pipeline for the transport of the liquefied natural gas is the longest of its kind in the world.
- In cooperation with Linde AG Germany a new gas liquefaction technology was developed particularly for this project.
- New LNG tank ships are being built considering strictest environmental projection and safety standards.

Between 250 and 400 new jobs are created due to the construction of the "northernmost industrial plant in the world". DSI is proud to have made a significant contribution to the success of this project. Completion and commissioning of the plant is scheduled for October 2006.

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