

Robert Buchanan, Canusa-CPS and Sean Haberer, Bredero Shaw, Canada, describe the Langeled pipeline project and detail the pipe coating applications used on the subsea gas pipeline.

## Coating the 'long connection'

Ormen Lange is the second largest gas field on the Norwegian continental shelf, with estimated natural gas reserves of 400 billion m<sup>3</sup>. The production capacity of the field, which is operated by Hydro, will reach 70 million m<sup>3</sup>/d, totalling 21 billion m<sup>3</sup>/yr.

The gas will be transported by the Langeled pipeline from Nyhamna on the north-west coast of Norway to Easington on the north-east coast of England, via the Sleipner riser platform in the North Sea. By connecting the pipeline systems through Sleipner, there is the flexibility to send gas to the UK through the new pipeline, as well as through existing pipelines to mainland Europe. Gas from other fields in Norway could also be delivered through the new connection.

Navigate the official website for the Ormen Lange field and you will find some interesting facts about this mega-project.<sup>1</sup> The Ormen Lange field will be capable of supplying up to 20% of the UK's natural gas demand. To understand how this capacity will be achieved, it is helpful to illustrate the dimensions of the Langeled project with the following: in comparison with some of the world's most remarkable engineering feats, the pipe steel would weigh 15 times the steel used in the Hoover Dam; the concrete would build 9 Toronto CN Towers; and if the steel reinforcements were to be unspooled, they would travel 1.3 times around the Equator, constituting enough material to build 2.3 Eiffel Towers.

A number of children at Easington Primary, a school at the receiving end of the pipeline, were told about the project and the extent to which it would affect their future. Naturally, they were curious. An intriguing

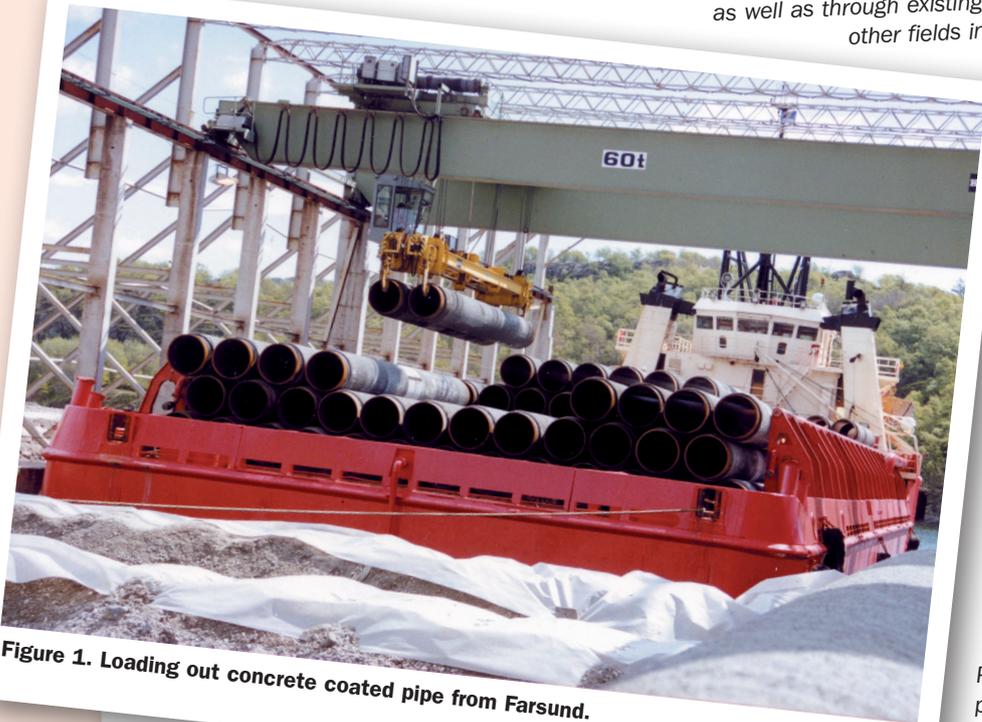
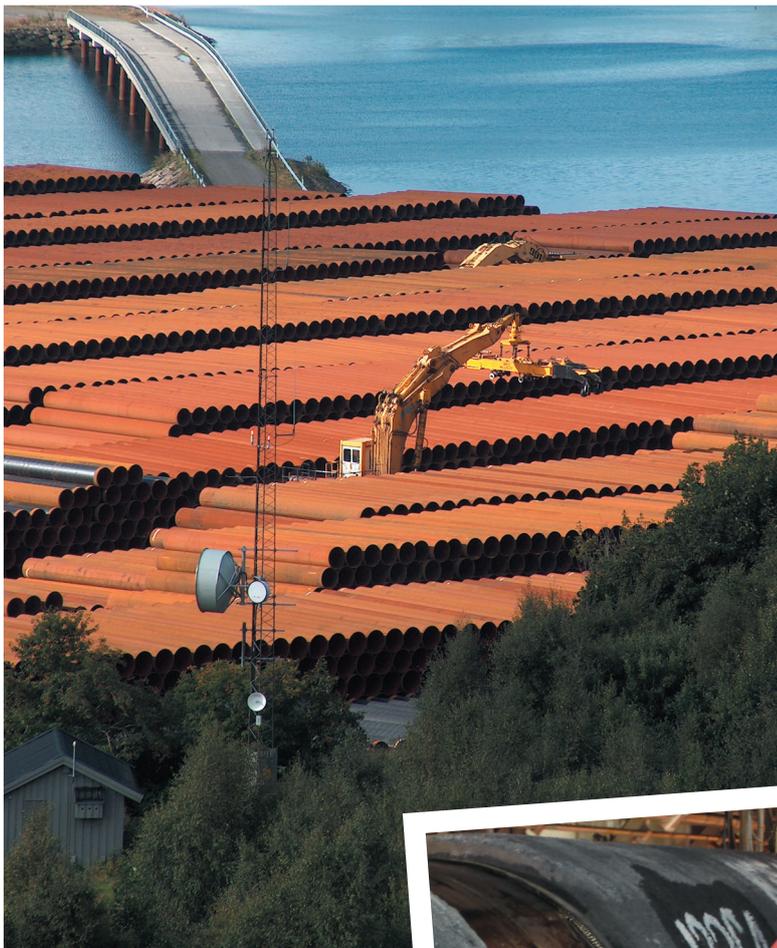


Figure 1. Loading out concrete coated pipe from Farsund.



**Figure 2. Storage of uncoated pipe in Farsund.**

question came from six year old Katy Steele, who asked, "How many sections of pipe are there... and how long are they?"

## *Optimum pipeline production*

The names Ormen Lange and Langeled, meaning 'giant serpent' and 'long connection' in Norwegian, hint at the response to this question: approximately 100 000 joints of 42 in. and 44 in. concrete weight coated steel pipe comprise the export line, which will transport 21 billion m<sup>3</sup> of gas annually. This will make Langeled the longest subsea pipeline in the world, snaking some 1200 km along the North Sea floor.

With a project of this magnitude it is especially important to have access to optimum pipeline production and laying resources. The construction and operation of Langeled is thus highly specialised, with Ormen Lange's licensees (Hydro, Shell, Statoil, Dong, Exxon Mobil), as well as ConocoPhillips, assuming responsibility for different phases of the pipeline's development.

## *The coating contract*

The contract to coat the pipes was awarded to Bredero Shaw, a division of ShawCor Ltd., and was signed in Farsund, Norway on 12<sup>th</sup> December 2003. The first pipes were received in April 2004 and thereafter began the processing of 100 000 pipes,



**Figure 3. Application of MIS-65 heat-shrinkable sleeve.**

according to Statoil and Norsk Hydro's specifications. The steps included loading in and storage of pipe; internal flow efficiency coating to improve the gas flow in the pipeline; external asphalt-based corrosion resistant coating; concrete weight coating to sink the pipe down to the sea floor, curing of the concrete and finally storing and loading out of the coated pipe. In total, more than one million tonnes of steel pipe, one million tonnes of concrete and 25 000 tonnes of steel reinforcements went through Bredero Shaw's Farsund plant during the coating operations for Langeled.

A major logistical challenge for Bredero Shaw was accommodating the great number of pipes that arrived on a continual basis. The Farsund facility has storage area for approximately 33 000 pipes of 42 in. and 44 in. at a time. That left a storage deficit for approximately 67 000 of the Langeled-destined pipes. This challenge was solved by transporting the coated pipes to intermediate storage locations near to where the pipes were to be laid. Four

intermediate storage locations were acquired for this project: Hartlepool in the UK (28 000 pipes) for the southern part; and Måløy (20 300 pipes), Kristiansund (2800 pipes) and Bergen (8900 pipes) in Norway for the northern section of Langeled. To date, 1 200 000 lifts of pipes and 430 000 transport movements have been carried out and 673 vessels have helped in the cargo movement at Farsund.

By late July 2004, the delivery of the 44 in. coated pipes to the field had begun allowing the pipe laying to begin on schedule.

## *Installation and coating*

Installation of the corrosion protective field joint

systems is one of the last operations prior to letting the pipe off the pipelay vessel. Canusa-CPS, ShawCor's field joint corrosion protection products division, was contracted to supply all of the corrosion-resistant, heat-shrinkable sleeves to the pipelay contractors. Canusa-CPS qualified a relatively new heat-shrinkable sleeve product for the project, called MIS-65. This product was developed specifically for concrete weight-coated offshore pipelines and meets the requirements of many major project specifications, such as the DNV RP F-102 and Statoil TR-1109. The advantages of using heat-shrinkable sleeves were that the product was supplied as one piece per joint, which made estimating simple. The product could also be applied very quickly using the pipelay contractor's own crew members. These factors kept costs down and gave project



**Figure 4. Completed heat-shrinkable sleeve on the lay barge.**

scheduling control over to the pipelay contractor's own people.

Acergy, based in the UK, and Allseas, from the Netherlands, are using Acergy's Piper and Allseas' Solitaire, two of the world's largest pipelay vessels, to perform the major work of the project.

Canusa provided full support throughout the Langeled contractor's on-board pre-qualification phase and provided application training on start-up, despite both contractors having substantial experience with heat-shrinkable sleeve systems. During a typical application, the joint was cleaned with a power wire brush to the specified cleanliness level and then pre-heated using either electrical induction coils or propane torches. The sleeves were then wrapped around the joint and heat-shrunk using a propane torch with the installation process taking less than four minutes (excluding surface preparation) per joint. After installation of the field joint corrosion

protection, subcontractors supervised installation of an infill system to level the gap created by the cutback in the concrete weight coating.

For field-applied girth weld joints, heat-shrinkable sleeves are the most common offshore joint protection system in the industry, providing superior corrosion protection for pipelines operating up to 130 °C. The use of heat-shrinkable sleeves is so readily accepted due to their unique combination of repeatable procedure and proven performance attributes. Application and design specific heat-shrinkable sleeves need to be considered in all cases since the adhesive provides sleeve adhesion and corrosion protection, and a tough, cross-linked polyolefin backing must be resistant to the potentially high installation temperatures of the infill system materials or abrasion and shear forces for non-concrete weight coated pipelines.

### Conclusion

The coating of the 44 in. pipes in the southern part of the pipeline was completed in 2005 and the gas is scheduled to begin flowing this year. The coating of the northern part of the pipeline was completed in March 2006 and pipelaying operation began 1<sup>st</sup> April 2006. Langeled will be ready to transport gas when the Ormen Lange field starts up in October 2007. The MIS-65 heat-shrinkable sleeve has allowed the contractor to meet or exceed their installation target. ●●●

### References

1. <http://www.ormenlange.com/>