

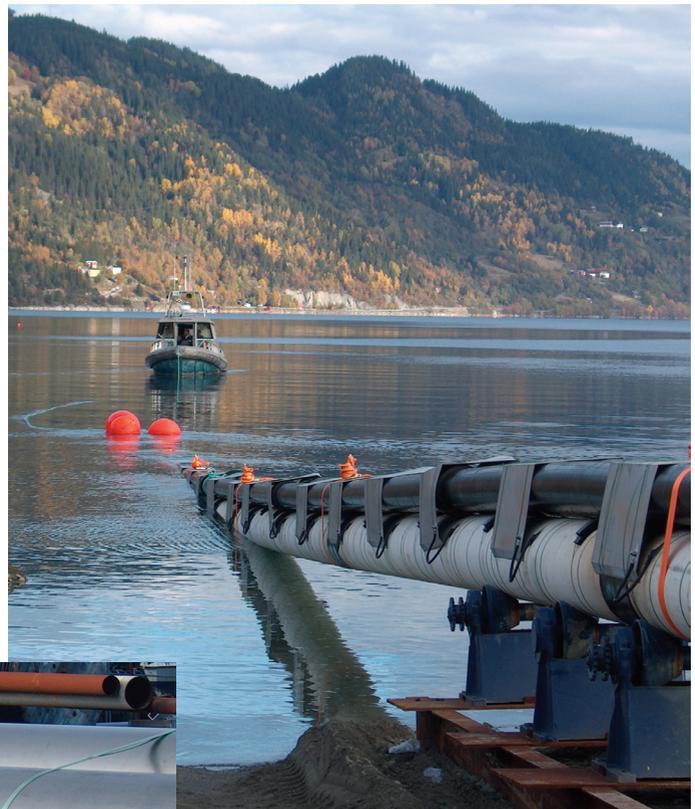
Electrical heating of subsea pipelines

Gradual cooling down to given critical temperatures reduces the fluid flow in the wellstream following a production shutdown in oil- and gas pipelines. Ice or hydrate plugs may then form and in worst case block the pipeline. A pipeline heating method is now qualified and is being used on several fields in the North Sea.

Close cooperation between Norwegian oil companies, cable manufacturers and pipelaying contractors has qualified the heating method. We have carried out most of the research and measurement tasks.

Direct electrical heating

For more than 15 years SINTEF Energy Research has been working on developing methods for keeping the temperature of pipelines above the hydrate formation temperature. Traditionally “anti-freeze” chemicals were injected into pipes to avoid situations like these. However, this is costly, and has negative environmental aspects. An early study showed that a system based on induction would be suitable, but the method requires relatively heavy investments, be complicated to install and will involve high repair costs. This is why the work continued to find an alternative based on direct electrical heating of pipelines (DEH). The method is based on the simple fact that an electrical current (in this case alternating current 50/60 Hz) generates heat through a metallic conductor such as the steel pipe. In the DEH system the transport pipe is a part of an electrical circuit that is supplied via a cable, and is laid as close to the pipe as possible to achieve a maximum output from the heating. The figure sketches the design of the system.



Installing of 18" DEH pipeline at the Orkanger test site.

Left:
Cable/pipe connection on the 18" Carbon test pipeline.

The length of a pipeline – a challenge for using the system

The system has been installed on 14 pipelines (110 kilometres in total) in the North Sea, and 8 other pipelines amounting to 100 kilometres are under planning/construction with use of DEH. Statoil is the contractor for all these projects. Since spring 2003, SINTEF Energy Research has performed a series of studies for Statoil in connection with the development of the Tyrihans Field, which involves the use of DEH. The pipeline in question poses a couple of special challenges basically related to required voltage and pipe dimensions.

SINTEF Energy Research has done the following work:

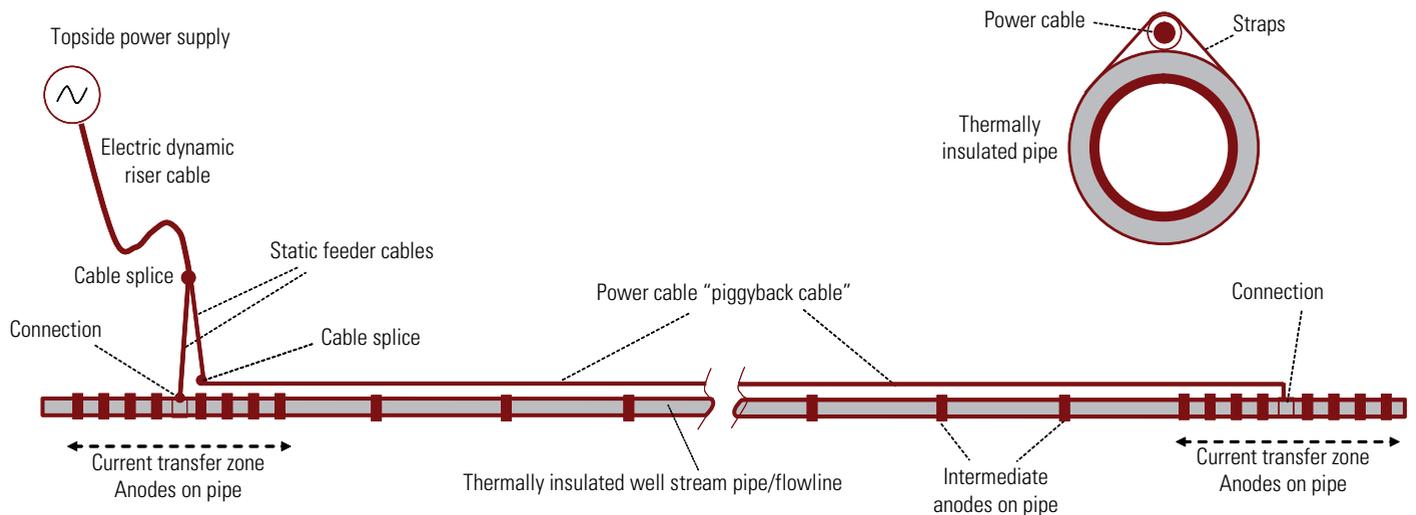
- Test of the cable materials (especially the outer sheath) and cable construction generally related to applications under high pressure, in seawater, and with varying temperature conditions. This work is carried out in cooperation with Nexans Norway.
- Laboratory examination of thermal, magnetic and electrical parameters for the components in the DEH system for large pipeline dimensions.

- Full-scale tests in seawater for relevant pipeline dimensions and steel quality. The test setup is located in the Orkanger Fjord, where the institute has had close cooperation with Reinertsen in connection with the development and installation. Measurements of current transfer in the end zones for the heating system, the efficiency of the system and thermal conditions are studied in these tests.

Investments in pressure chambers and test equipment

The development studies for DEH applications requires significant laboratory resources. SINTEF Energy Research has invested in pressure chambers to perform the testing under realistic pressure conditions. At the same time this work has been combined with tests of equipment which will be used later in underwater installations.

Through this work, the institute has obtained considerable expertise in measuring and using calculation tools. Pre-design of the DEH system in the current projects, general knowledge transfer and working closely with the project partners have put SINTEF Energy Research in an excellent position for further projects.



The DEH system.

Contact:

Research Scientist Harald Kulbotten, telephone: + 47 73 59 72 98
e-mail: Harald.Kulbotten@sintef.no



SINTEF Energy Research

NO-7465 Trondheim, Norway, Telephone: + 47 73 59 72 00, www.energy.sintef.no

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