



**SUBSEA HEAT
TRACING
SOLUTIONS**





Role of subsea technologies

Despite the research efforts to develop efficient substitutes for oil and gas, still no viable alternatives are available to cover energy needs for the economy. For years, oil, gas, and petrochemicals have been the main export commodity for many economies around the world, and transporting these is of key global importance. Importers get the energy resources they need, while in oil- and gas-producing nations, energy exports are a vital source of budget revenues.

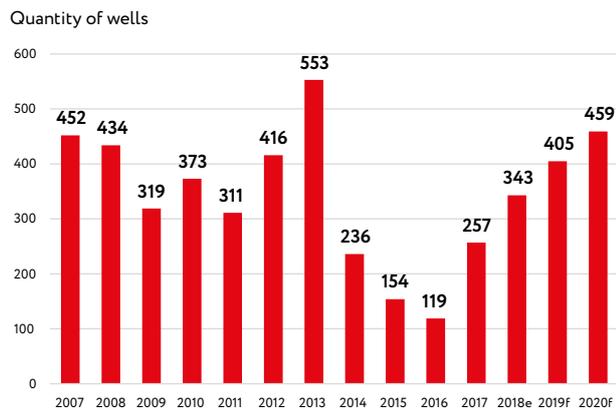
Russia has multiple water reserves – lakes, reservoirs, and rivers that are hard to cross because of their length. Building an underwater crossing is often the only viable solution.

A pipeline can not only cross onshore water bodies, but also extend offshore over a significant distance. Oil and gas from offshore fields is fed via subsea pipelines to the onshore refineries or gas distribution systems.

In any of the scenarios, the oil and gas industry faces some typical challenges when operating subsea pipelines. The sea water temperature can be as low as $-1\text{ }^{\circ}\text{C}$ to $+1.5\text{ }^{\circ}\text{C}$. In a cold environment, oil quickly becomes viscous when transported via a pipeline. Hydrates form in natural gas pipelines, and heavy oil deposits (ARPDs) block crude oil pipelines.

Pipe blockage is a true disaster for maintenance crews. To avoid this, along the most part of their length, subsea pipelines are enclosed into insulating materials to prevent heat dissipation. And to maintain the optimal temperature of the liquid or gaseous environment inside the pipeline, electric heating is used as one of the most effective solutions.

Offshore well completions and forecast



Source: Estimates from Quest Offshore Resources, Inc

Fig. 1

Analysts predict further growth in offshore well completions (Fig. 1), increasing the demand for subsea pipelines

Electric Heating Technologies for Uninterrupted Transportation of Oil and Gas

Heating of subsea pipelines

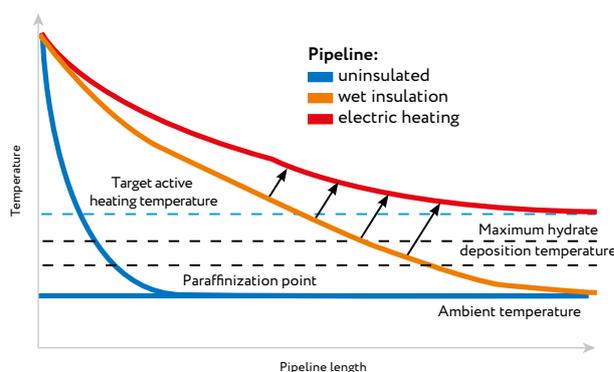
- considerably improves the economic performance of remote oil and gas deposits
- improves the production process at mature fields
- minimizes shipment capacity loss as a result of a decrease in the effective pipeline opening due to hydrate and paraffin deposits
- significantly reduces operating costs
- improves the efficiency and safety of process control in the value chain from the well to the consumer
- reduces environmental pollution risks, particularly in deep-sea projects in the proximity of nature protection areas.

Asphaltene-Resin-Paraffin Deposits (ARPDs) are a major problem in crude oil transportation, increasing flow resistance and, accordingly, energy costs. When the critical level of deposition is reached, no oil can be pumped down the pipeline. This leads to additional costs of removing paraffin deposits, an elevated accident risks and poor economic performance of the oilfield.

Paraffin deposition and precipitation mainly depends on the temperature of the extracted crude. Low temperature increases the deposition risk. This means that the main method of controlling paraffin deposition and precipitation is maintaining the temperature of the oil in the system above the paraffinization temperature.

Electric heating allows to maintain the temperature inside the pipeline above the temperature of paraffin formation, ensuring uninterrupted flow of the fluid, oil, or petrochemicals in the subsea pipeline.

Temperature profiles of subsea pipelines by insulation type



Source: IntecSea

Fig. 2

Hydrate blockage is another problem facing many offshore production systems. Blockage may shut production down, and it is challenging to eliminate. Typical conditions of hydrate formation include free water, light gases (methane and hydrogen disulfide), low temperature, and high pressure.

Such factors as water and gas content are determined by reservoir conditions beyond the operator's control. However, temperature and pressure can be controlled through system configuration and operating procedures. Hydrates stop forming at temperatures above +20 °C.

Electric heating and thermal insulation are the simplest and the most effective way to prevent hydrate formation

The complexity of subsea pipeline heating systems

- Environmental safety standards
- Challenging subsea installation and construction conditions, including the laying technology
- High heat transfer coefficient into the water environment
- Electric systems operated underwater need to be 100% leak-proof
- High pressure inside the pipeline
- Storm weather
- Sea ice
- Seismic activity

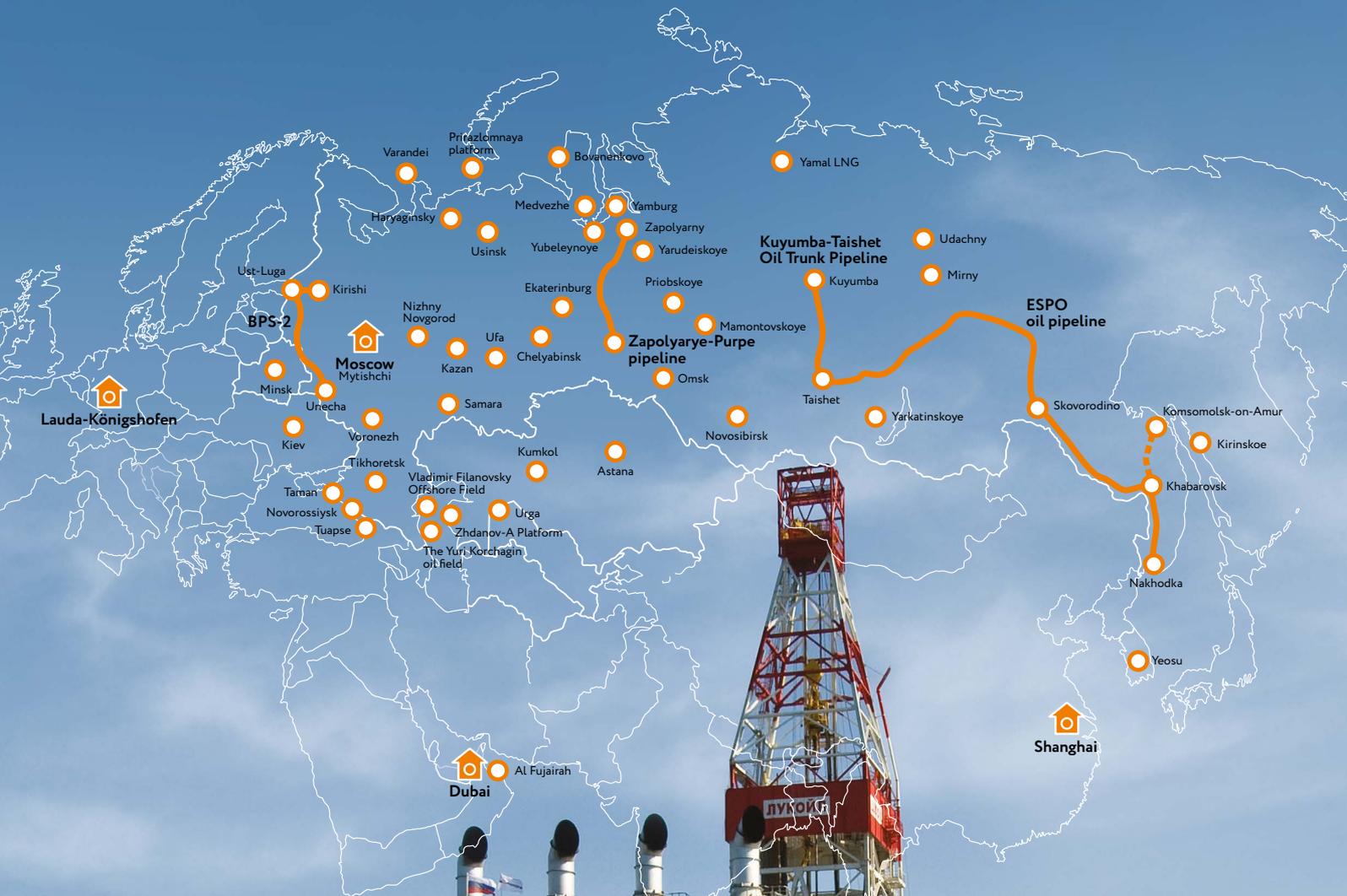
Due to the complexity of subsea pipeline heating systems, specific requirements apply to electric heating solutions

- only fire-, explosion-safe and corrosion-resistant materials and equipment must be specified
- in the offshore electric heating systems, there is always a risk of the heating cable exposure to hydrogen disulfide, requiring structural design resistant to the marine environment and chemicals
- heating element resistance to potential pipeline deformation during installation and operation

Electric heating applications for subsea pipelines

The electric heating technology is applied in offshore production systems with extended connection pipelines. Electric heating can be implemented in multiple components of an offshore system, such as pipelines, risers, manifold pipelines, linkages between wells and pipelines.





Electric Heat Tracing Solutions for Subsea Pipelines by SST Group

SST Group offers two solutions for subsea pipeline heat tracing based on electric heating cables

- **UW Skin Tracing Solution** – a system based on the skin-effect for heating of wells and subsea pipelines that stretch up to 60 km from a single power source
- **UW Very Long Line Solution** – a heating system for very long pipelines that stretch up to 150 km from a single power source

Advantages of electric heat tracing solutions for subsea pipelines by SST Group

- 100% fault-free subsea operation due to the leakproof of heating element
- Heating of long and very long subsea pipelines with power supply from one of the pipeline terminations
- Low construction and installation costs
- Automatic maintenance of the set temperature

The key feature of SST Group subsea pipeline heating technologies is high resistance of the heating elements to potential pipeline deformations during assembly, laying, and operation under high water pressure and in the aggressive subsea environment.

Electric heating systems are used to compensate for the thermal loss during the transportation process through a subsea pipeline





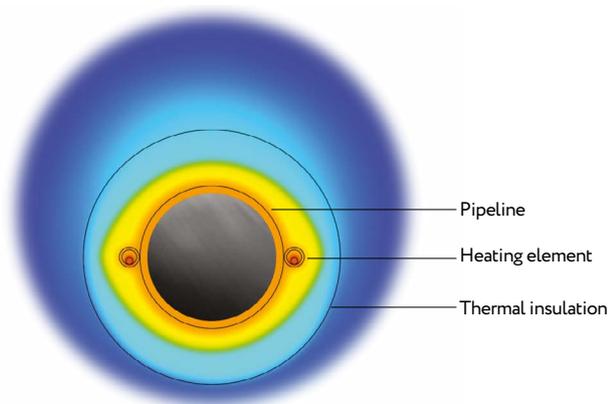
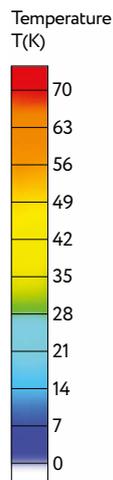
UW Skin Tracing Solution

Skin-effect arises in conductors as a result of the alternate current's electromagnetic action. Skin-effect-based electric heating systems by SST Group use unique flexible induction-resistive heating element.

Applications

- heating of wells for protection against heavy oil and hydrate blockages
- heating of subsea pipelines to maintain the desired internal temperature

Electric heating systems based on a flexible skin-effect heating element are energy-efficient. Evidence includes pilot tests of the heating element as part of the well heating system Stream Tracer™. Actual energy consumption fell by 47% compared to a series-resistance cable-based heating solution.



SST Group is the only Russian and one of the four global manufacturers of skin-effect-based heat tracing systems

Technical specifications

Maximum heated pipeline length	60 km*
Maximum operating temperature	+200 °C
Maximum allowable temperature	+260 °C
Maximum power output	150 W/m

up to 60 km
from a single power source

* without auxiliary network



UW Very Long Line Solution

UW Very Long Line is a heat tracing solution for very long pipelines that uses series-resistance cables VLL-A (aluminum core) and VLL-C (copper core). Cable cross sections are sized depending on the required power output and heated pipeline length. In preinsulated pipelines, the cables are placed into conduits on the pipe under the thermal insulation layer. Cables are connected with a sealed coupling.

- Capable of heating very long pipelines up to 150 km from a single power source
- The system can be operated in any climatic conditions
- Cost efficiency due to the three-cable design
- Simple assembly
- Complete accessories kit included

VeLL is the longest heat tracing system in the world

up to 150 km
from a single power source

Technical specifications

Maximum heated pipeline length	150 km [*]
Minimum operating temperature	-40 °C
Maximum allowable temperature	+100 °C
Maximum power output	30 W/m

^{*} without auxiliary network



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