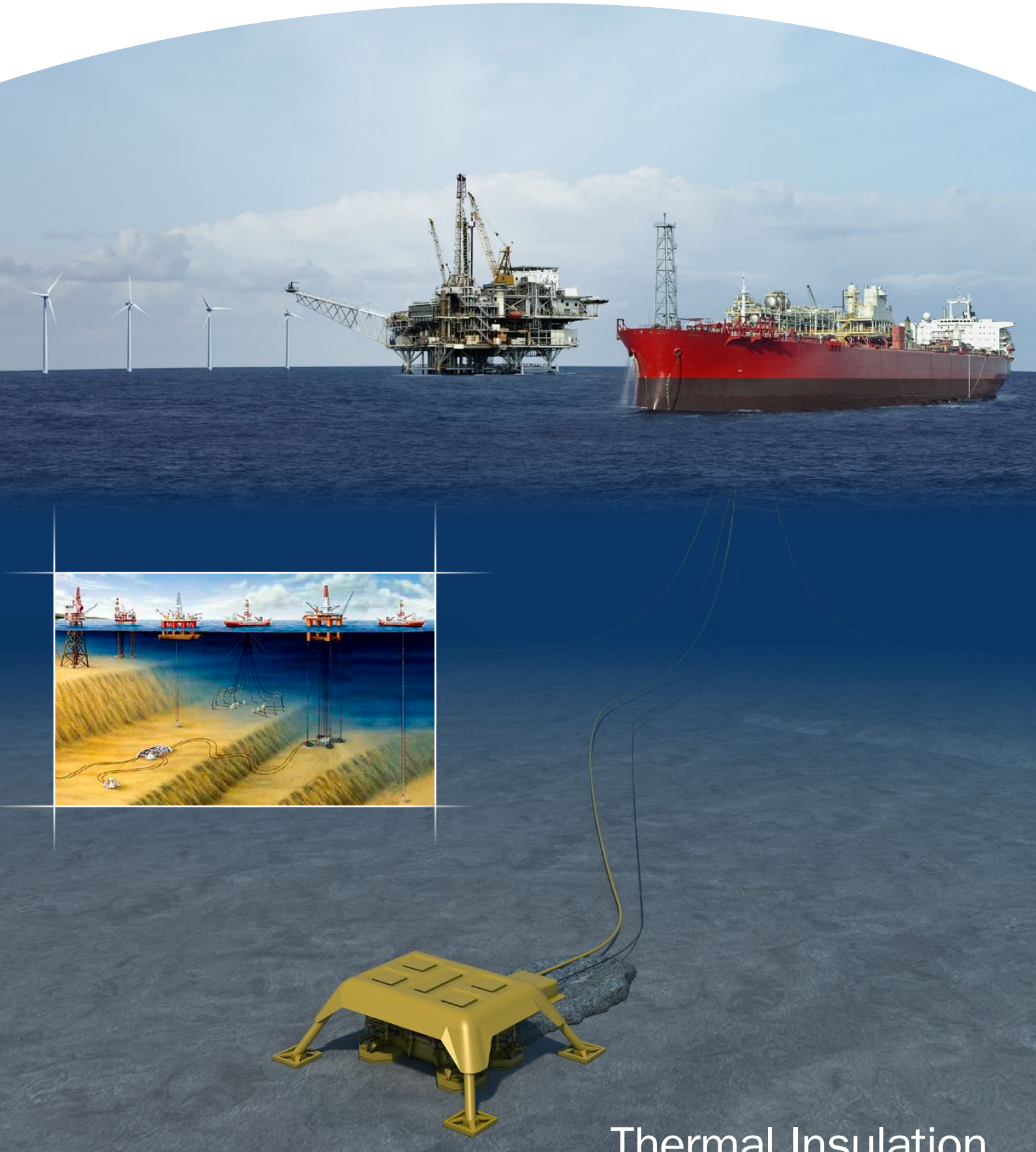
TRELLEBORG



Thermal Insulation

About us

Trelleborg Offshore Norway AS is one of the world's leading rubber companies in the offshore industry. As our core business is to protect against corrosion, increase safety through fire protection and secure flow by use of thermal insulation, our vision is:

Providing safety for people, environment and next generations

We design, manufacture, test and supply sophisticated rubber solutions based on our customers' requirements. We serve the marine, oil & gas industry, renewable energy projects, defense market, as well as the general industry and equipment manufacturers.

Our History
Trelleborg Offshore Norway, established in 1896, has been a major supplier of new products and tailored solutions towards the Oil & Gas industry for decades. Our track record proves and underlines our promises:

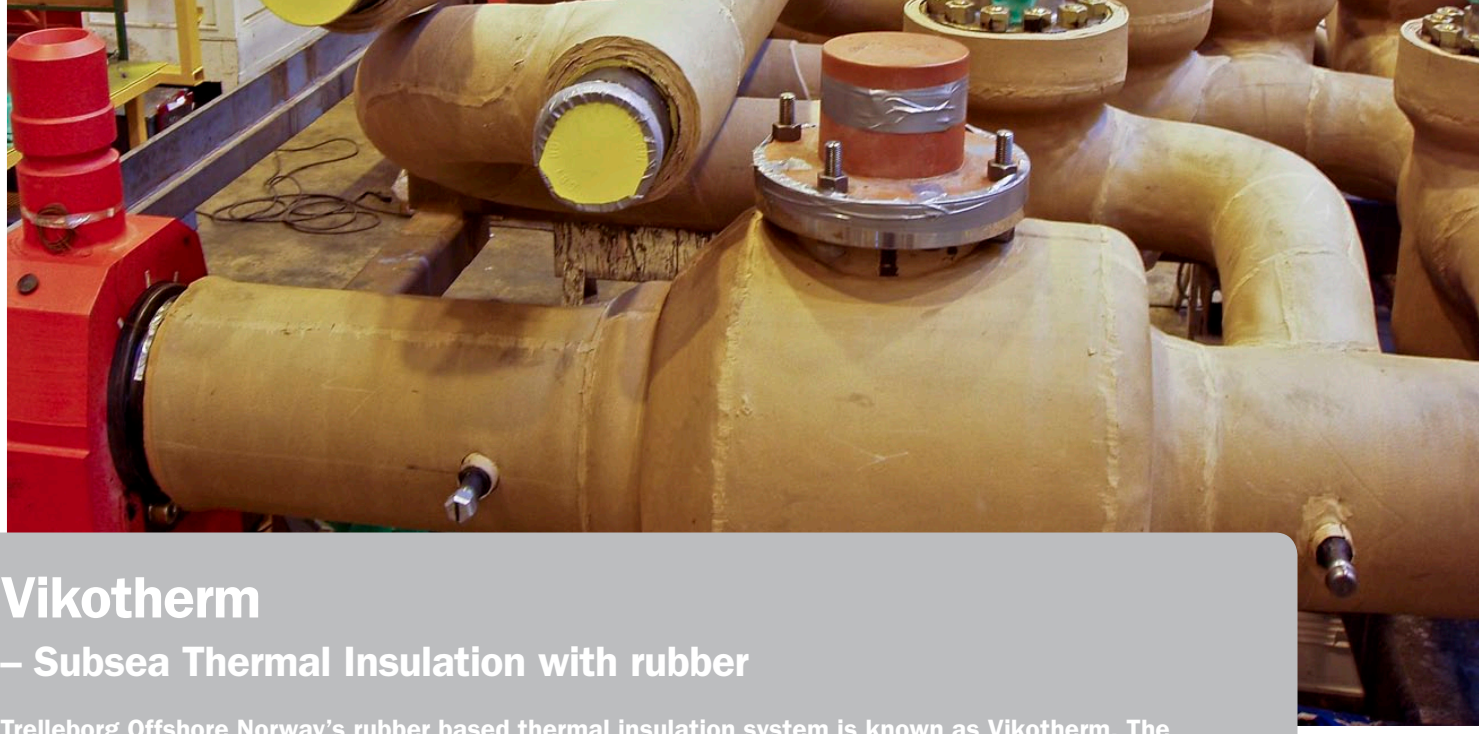
- **To create a win-win situation**
- **Reliable relationships**
- **Long lasting solutions**

Development
Trelleborg Offshore Norway is highly experienced in developing tailored solutions, combining the highest level of performance and competitiveness.
We have a well equipped laboratory and a unique Jet fire rig, with support from Trelleborg Group's extensive R & D resources; we have facilities and knowledge to meet future requirements.

Mobile factory/flexibility
Enabling us to do coating of pipes/equipment at our client's site, we have developed a mobile factory that can be mobilized worldwide.

Value Driven Company
Our Company culture is based upon a set of values chosen by the employees, reflecting our behavior and mindset.

- **Respect**
- **Responsibility**
- **Cooperation**
- **Humor**



Vikotherm

– Subsea Thermal Insulation with rubber

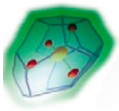
Trelleborg Offshore Norway's rubber based thermal insulation system is known as Vikotherm. The system provides excellent thermal insulation for the optimal flow assurance. The system also provides long life corrosion- and HISC protection. The Vikotherm system is ideal for thermal insulation and mechanical protection of subsea equipment, structures, tie-back spools, risers, pipelines and flowlines.

The Vikotherm System is customized accordingly the various ruling conditions specific for each offshore oil and gas project and installation.

Why insulate?

The hot oil/gas composition flows up at the wellhead and is transported through XMT's, manifolds, various critical instruments, spools and flowlines before the riser brings the oil to the surface.

Insulation is necessary to avoid formation of hydrate plugs and wax build up (paraffin). The formation of wax and hydrates will start when the oil/gas composition is depressurized and exposed to the low seawater temperature at the seabed.



Hydrates are crystalline water that is stabilized when light hydrocarbon molecules are captured in the crystal lattice. Hydrates can be formed at high pressures and at temperatures around 20–25 °C. Without insulation the cold seawater would rapidly cool down the oil, and hydrate/wax formation would make it impossible for a safe flow of oil and gas.

Thermal insulation materials are applied in order to prevent formation of hydrate/wax during a shutdown scenario.

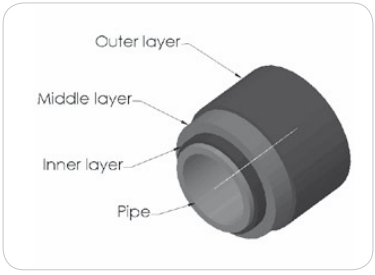
During shutdown the extra insulation shall give sufficient time for

- "short time" inspection of the pipe/equipment
- time to solve production problems etc.
- time for methanol or glycol injection (probably longtime maintenance services).

Vikotherm – Rubber based Thermal Insulation

The system is a three layer build up:

1. **Inner layer** for corrosion and/or Hydrogen Induced Stress Cracking (HISC) protection:
   Inner layer could be Neoprene compound that is qualified up to 95 °C, or an EPM compound that is qualified up to 155 °C. Both compounds providing excellent corrosion or HISC protection. Both compounds have been extensively tested e.g. with respect of adhesion, aging and cathodic disbondment.
2. **Middle layer** for thermal insulation:
   For the insulation layer various compounds are applicable related to the specific requirements. The compounds provides a k-value of 0,13 W/m^{2}K up to 0,19 W/m^{2}K. The flexibility and stability of the rubber makes this an excellent choice with respect of thermal expansion. The insulation layer is protected by the outer layer.



3. **Outer layer** for mechanical protection:
The outer layer is a strong and robust layer that provides excellent seawater and mechanical protection. This compound has a track record from the early 70ies in the North Sea.

Vikotherm - Extended Lifetime

Lifetime of an oil-field is expected to be minimum 25 years. Design temperature of the field varies, but may be up to 200 °C. An extensive test program has been carried out on Vikotherm to prove its integrity for the lifetime of the field. The Vikotherm system is qualified up to 155 °C.

To prove minimum 25 years lifetime of our products, extensive long term ageing tests have been performed. The results are extrapolated to predict material properties after 25–30 years.

Advantages of Vikotherm

- Low thermal conductivity
- High specific heat capacity
- Design Temperature range = -50–155 °C
- Installed at water depth of 2200 m
- No water absorption
- Excellent Corrosion and HISC protection
- Thermally stable – no thermal cracking
- Maintenance free

2nd Generation Vikotherm (Vikotherm II) – Mobile production

After more than 20 years in operation we introduce our second generation Vikotherm. Vikotherm II has improved elasticity, process and manufacturing flexibility compared to the first generation. The new and improved Vikotherm is enabling us to perform coating on site worldwide.

Trelleborg Offshore Norway has many different rubber compounds that can be used “alone” or in various combinations to meet specific requirements.
In addition to excellent bonding and corrosion protection of various steel, our materials adheres well and can be used in combination with other polymers like

- Polyurethane
- Polyprophylene
- Polyamide
- Polyethylene
- Epoxy
- Paints
- Rubbers

Table 1: Various opportunities for the Vikotherm System

	Temp. range	Inner layer	Middle layer	Outer layer
Vikotherm Standard	-35–95 °C	73165/73185	73585	73780/73785
Syntactic Vikotherm	-35–95 °C	73185	76027	73785
Vikotherm High Temp.	-50–155 °C	73961/73982	73585	73780 /73785
Syntactic Vikotherm High Temp.	-50–155 °C	73982	76027	73785

Table 2: Properties of Vikotherm materials

Mechanical properties	Inner layer		Middle layer		Outer layer
	73165/73185	73961/73982	73585	76027	73780/73785
Tensile strength, N/mm²	> 12	> 2,5	> 10	> 6,4	> 13
Tensile elongation, %	> 550	> 400	10	> 500	> 500
Tear strength, N/mm	> 25	> 7	> 40	> 15	> 35
Hardness, ± 5 shore A	55	40	68	50	62
Density, ± 0,05 g/cm³	1,55	1,00	1,00 ± 0,06	1,1 ± 0,07	1,54
Thermal Conductivity, W/mK	0,25	0,19	0,13	0,19	0,26

The values presented are tested according applicable standards under laboratory conditions.

OUR VISION:

Providing safety for people, environment and next generations

Please contact us for further information about our product range within:
PFP (Passive Fire Protection)
Engineered Solutions
Flexible piping system – ELASTOPIPE™
Thermal Insulation – Vikotherm
Defence
Rubber components
Corrosion-/HISC-protection

International representatives:

Please visit: www.trelleborg.com/offshore/no

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