

Electrical Heating Technologies

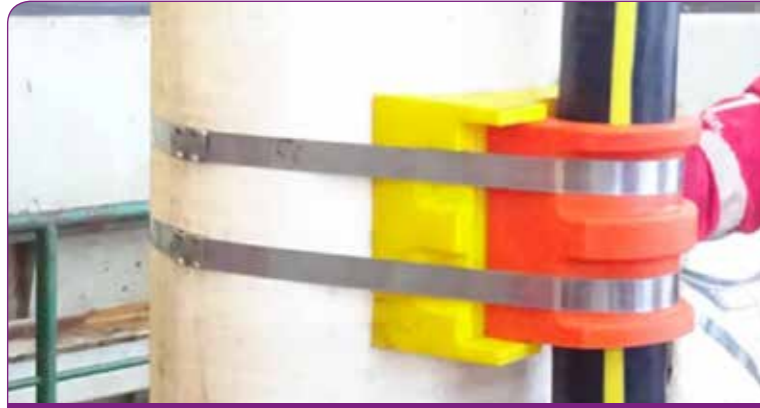
Technology product overview



Subsea 7 has been successfully installing electrical heating systems since 2007 including the world's deepest open loop Direct Electrical Heating (DEH) system. Subsea 7, with its extensive proven track record in the design, fabrication and installation of Pipe-in-Pipe solutions, has developed and is now qualifying one of the most efficient heating technologies: the Electrically Heat Traced Flowline (EHTF).

Key benefits:

- Reduced CAPEX and OPEX
- Improved access to reserves, allowing for long tie-back with no looping requirement
- Improved availability of production systems due to enhanced thermal performance



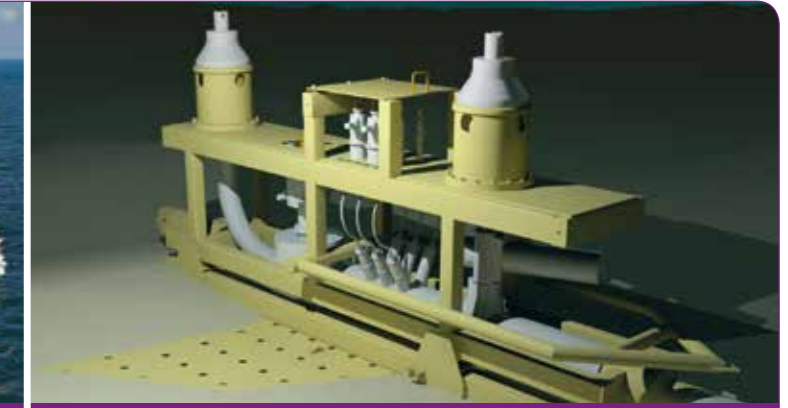
DEH cable in piggy back



DEH cable and pipeline installation



Reel-lay vessel: Seven Oceans



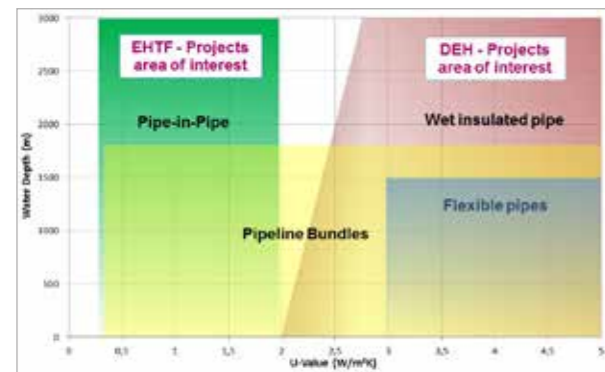
Active PLET for EHTF

Electrical heating technologies overview

Electrical heating technologies are enabling solutions for development of subsea fields. By maintaining the appropriate product temperature within the pipeline, they avoid hydrates and wax formation.

CAPEX is reduced by eliminating the requirements for looped flowlines (or a service line) for dead oil circulation. OPEX is reduced through lowering the amount of chemicals injected in the flowlines and time required to restart operations after shutdown as well as topsides chemical storage requirements.

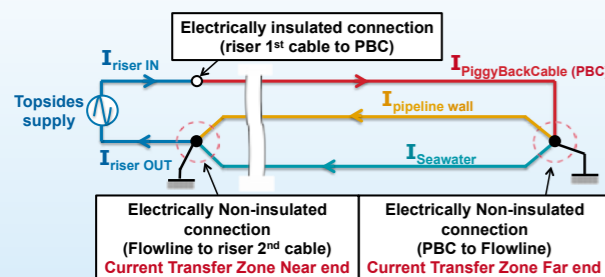
The graph below provides an overview on the performance of pipeline technologies, highlighting the areas of applicability for electrical heating systems.



DEH Overview

Design

The principle of the Direct Electrical Heating (DEH) system is that an electrical loop is generated from a Current generator located on the topsides directly connected to both ends of the pipeline.



The main heat contributor in DEH is the ohmic loss: the alternative current causes the pipe to warm up due to electrical resistance of the metal. Thermal conduction then transfers heat from the pipe wall to the production fluid.

Subsea 7 Track Record

Subsea 7 has successfully completed installation of DEH Systems by either in S-lay or Reel-lay including:

Project	Client	Year	Pipe Length	Pipe size	Depth	Pipe install
Maria	Wintershall	2017	26km	14"	300 m	Reel-lay
Lianzi	Chevron	2015	43km	12"	1070 m	Reel-lay
Skuld	Statoil	2012	14.2km	14"	380m	Reel-lay
			11.5km	12"		
Skarv	BP	2010	15km	12"	375m	Reel-lay
Morvin	Statoil	2009	20.7km	10.5"	360m	Reel-lay
Tyrihans	Statoil	2007	44km	18"	285m	S-lay

Benefits

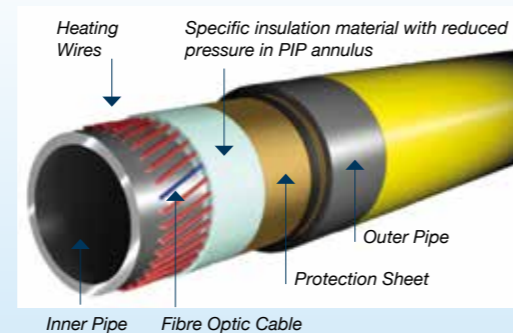
DEH is a field proven heating solution fit for:

- Wet insulated production system (U-Value higher than 2W/m².K)
- Important flowline diameters (up to 30-inch for carbon steel pipes)

EHTF Overview

Design

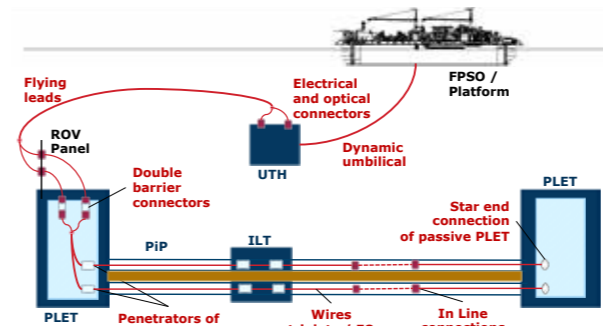
The Electrically Heat Traced Flowline (EHTF) is a combination of a high performance thermal insulation (Pipe-in-Pipe) with a resistive electrical heating system provided by wires laid between the insulation and the flowline.



Main Features of EHTF System are:

- To allow for restart after long shutdowns with no specific preservation measures
- To maintain flow-line temperature above WAT or HAT (Wax & Hydrate Appearance Temperatures)
- Low required electrical power to heat (typically 20 W/m)
- 3-phase wiring triplets in a star arrangement
- High specification insulated heating wires

Heating system electrical power is supplied from topsides by subsea electrical cables plugged into wet mate-able electrical connectors.



Subsea 7 Pipe-in-Pipe Experience

Subsea 7 possesses an extensive proven track record, built up over 30 years, in performing the full design, procurement, fabrication and installation of standard Pipe-in-Pipe systems (PIP).

Subsea 7 has successfully completed more than 50 PIP systems by S-lay, J-lay, Reel-lay and towed bundles including:

- Size range from 5-inch/8-inch to 16-inch/20-inch PIP
- Water depths from 40 to 1,400m
- Lengths up to 40km

Benefits

EHTF PiP enables development of fields requiring very high thermal performance caused by:

- Long flowline length for long tie backs from central production unit

- Reduced footprint on topsides: solution of choice for brownfield developments and tie-backs to existing infrastructure due to low power and reduced chemical storage
- Difficult fluid characteristics

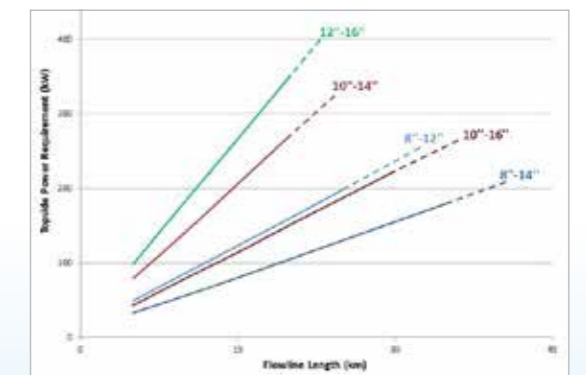
Additionally, EHTF technology allows for some redundancy with additional triplets in the cross section meaning that reliability and performance are guaranteed with a simplified and customisable topside operational philosophy.

EHTF Performance

High performance PiP associated to active heating offers:

- Up to 60km long tie-backs
- Up to 3000m water depth
- 6-inch to 12-inch typical inner diameter range (main bore)
- Down to U-Value < 0.5 W/(m².K) with low pressure annulus
- Low power requirement, minimum impact on topside
- Low voltage required, allowing for standard field proven electrical equipment

The following graph illustrates the low power required for EHTF system even in deep water and for long tie backs.



As a comparison, for a given tie-back, presenting the same flow assurance constraints, the power required by DEH would be 10 times higher than the one required with EHTF solution.

Electrical Heating Technologies

Subsea 7 / ITP EHTF references

2011 – EHTF Qualified by IOCs DNV Certificate of Fitness For Service:
for the Subsea 7 / ITP reeled EHTF (6"x10") PIP system

2012 – First ITP Trace Heated PIP:

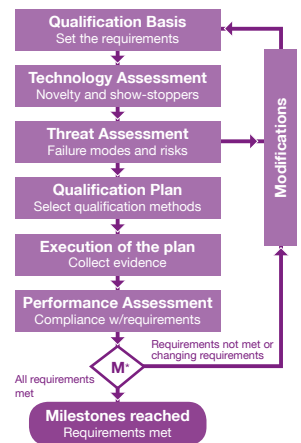
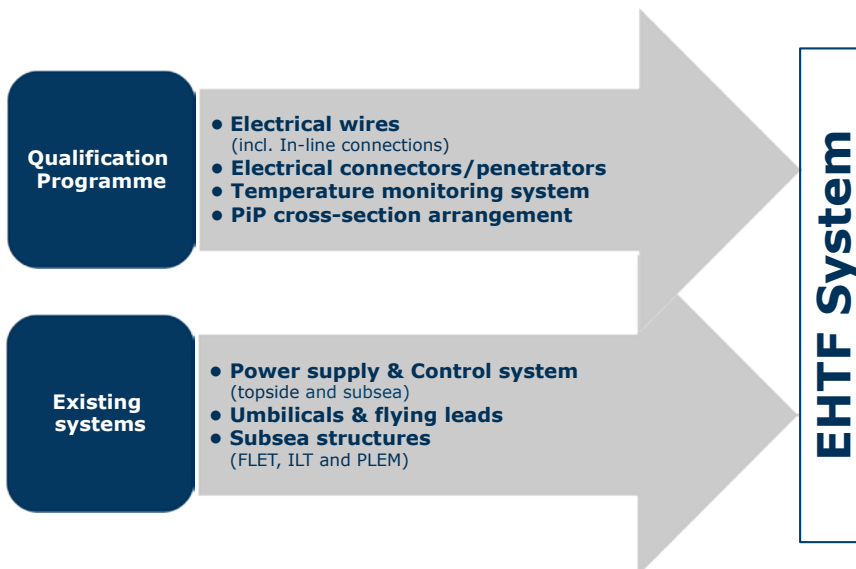
Kinosis Project for 22km onshore electrically heat traced pipeline at 150°C (design temperature)

EHTF qualification programme

A comprehensive development programme has been conducted in accordance with DNV RP-A203 to demonstrate the viability of this technology as "Fit for Service".



EHTF PIP bending trials.



*M: milestone in qualification program

Qualification process.

Main qualification plan programmes outline:

- Electrical wires qualification tests in representative (PiP annulus) environmental conditions
- Electrical connectors/penetrators qualification tests according to EHTF specification based on industry standards
- Cross section validation through full scale tests and extensive engineering studies

Products qualified for design life up to 30 years.

For further information contact

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