Electrically Trace Heated Pipe-in-Pipe

A field-proven and cost-effective solution to optimize field architecture, prevent or remediate fluid blockage and unlock reserves.
An innovative solution in operation in the UK North Sea since 2012

Electrically Trace Heated Pipe-in-Pipe (ETH-PiP) is a field proven system qualified for continuous heating over 25 years at operating temperatures up to 120°C. Extensive commissioning and operation test campaigns have demonstrated the excellent operability of this solution and performances of the temperature monitoring system with optical fibers.

A logical evolution

With about 50 projects, Technip has an extensive track record in the design, manufacture and installation of high performance reelable pipe-in-pipes (PiP) for static flowline and Steel Catenary Riser (SCR) applications. PiP has become a well established technology to prevent hydrate and wax plugging in long subsea tiebacks and deepwater field developments.

Technip’s Electrically Trace Heated Pipe-in-pipe (ETH-PiP) is the new generation of PiP technology, which enables field operators to optimize production, reduce risks of blockage or safely address them. This operational flexibility is further enhanced by the inclusion of optical fiber technology, for real time temperature profile monitoring of the flowline and live control and adjustment of active heating.

The ETH-PiP technology

In Technip’s ETH-PiP, trace heating cables are spiralled against the inner pipe, under high performance thermal insulation. Such configuration maximizes heating efficiency and uniformity. Electrical power is supplied from a single topside power source either via a power umbilical or an Integrated Production Bundle (IPB) to the connection termination assembly, located at the closest end of the ETH-PiP.

The design philosophy of the system focuses on providing a high level of reliability, taking into account the long term field life required. It maximizes the usage of standard, off the shelf components, with existing track record for similar or more stringent industrial applications.

ETH-PiP manufacturing process

The manufacturing process of ETH-PiP is very similar to that of PiP, typically 1 to 1.5 km long stalks assembled by insertion of the inner flowline inside the outer pipe. Technip designed and manufactured a cable application machine for trace heating cables and optical fiber application, aligned with the insertion process. This machine is largely inspired from Technip’s vast expertise in flexible pipe and umbilical manufacturing processes.

The advantages of reel-lay are that the manufacturing process is carried out on the local onshore plant, in factory-like conditions, away from the critical path. The frequency of in-line connections is limited to one every stalk length, as opposed to every double or quad joint lengths for other installation methods.
**ETH-PiP thermal and electrical performances**

Technip’s ETH-PiP shows high thermal performances. Typical characteristics of the system are presented below.

<table>
<thead>
<tr>
<th>PiP dimensions</th>
<th>6” to 12” flowline diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-Values performances</td>
<td>Down to 0.6 W/m².K</td>
</tr>
<tr>
<td>Cable ratings - 120°C</td>
<td>3.8/6.6 kV (Phase V / LineV)</td>
</tr>
<tr>
<td></td>
<td>120A</td>
</tr>
<tr>
<td></td>
<td>120°C</td>
</tr>
<tr>
<td>Power requirement</td>
<td></td>
</tr>
<tr>
<td>To maintain fluid temperature</td>
<td>- up to 60 W/m per heating</td>
</tr>
<tr>
<td>during shutdown</td>
<td>cable</td>
</tr>
<tr>
<td></td>
<td>- up to 50 km heated length</td>
</tr>
<tr>
<td></td>
<td>with a single power supply</td>
</tr>
<tr>
<td></td>
<td>location</td>
</tr>
<tr>
<td></td>
<td>- continuous heating for</td>
</tr>
<tr>
<td></td>
<td>25 years</td>
</tr>
<tr>
<td>Power requirement</td>
<td>30 to 100 W/m</td>
</tr>
<tr>
<td>To warm-up the fluid during</td>
<td></td>
</tr>
<tr>
<td>restart operations</td>
<td></td>
</tr>
</tbody>
</table>

**ETH-PiP design tools**

Technip has calibrated CFD & flow assurance models of ETH-PiP against the results from thermal test programmes carried out on full-scale test pieces and from Islay’s commissioning and testing campaigns. Such tools enable accurate modelling of ETH-PiP performance and flow assurance scenarios as well as temperature monitoring with an optical fiber system.

**Addressing field development challenges**

ETH-PiP is an efficient active heating system with low power consumption, and small impact on topside power generation and control equipment. Precise adjustment and control of the injected power, together with fluid temperature monitoring all along the flowline with optical fibers, offer a high flexibility of operation for preservation and continuous heating during production.

ETH-PiP is a field proven solution against hydrate and wax prevention and safe remediation concerns. With the support of major oil & gas operators, Technip has successfully performed full-scale hydrate dissociation tests that have demonstrated capability to perform safe and controlled hydrate remediation operations using active heating.
COMMERCIAL ADVANTAGES

Further to an excellent thermal behavior provided by the conventional Pipe-in-Pipe arrangement with high performance insulation, the ETH-PiP benefits from high electrical and heating efficiencies with the trace cables laid in direct contact with the flowline.

- ETH-PiP is particularly well suited to long tie-back or heavy/waxy oil field applications thanks to its low power consumption, which reduces both CAPEX (single line architecture) and OPEX by minimizing volumes of chemical injection and facilitating shut down/re-start operations.

- Optical fibers enable flowline and cable temperature monitoring, using either Distributed Temperature Sensing (DTS) or the Fiber Bragg Grating (FBG) systems.

- ETH-PiP is compatible with an Integrated Production Bundle (IPB) riser, to provide a fully heated system from wellhead to topside.

- There is no need for a return cable.

- ETH-PiP can be combined with Subsea Processing to cost-efficiently enable unlocking reserves or developing complex long subsea tie-backs.

REFERENCES

- Evaluation qualification of Electrical Heat Trace Pipe-in-Pipe for a SS flow line and selection for an application on a subsea field in UK, Islay
  H. de Naurois, D. Delaporte – Total SA; M. Helingoe, H. Greder – Technip UK; OTC 21396, 2011

- Electrically Trace Heated Pipe-in-Pipe technology benefits to subsea field development
  J. Boi, F. Gooris, A. Marret – Technip; DOT T2S2O3, 2012

- Flow assurance modelling using an Electrical Trace Heated Pipe-in-Pipe: from qualification to offshore testing
  M.K. Decrin, F. Nebell, H. de Naurois – Total; T. Parenteau – Technip; OTC 24060- MS, 2013

- Technical and economical comparison of subsea active heating technologies
  Bruno Ansart, Antoine Marret, Thomas Parenteau, Olivier Rageot – Technip; OTC 24711-MS, 2014

- ETH-PIP: Technology Upgrade for Extended Application Range
  Francois Gooris, Bruno Ansart, Olivier Rageot – Forsys Subsea; David Kaye - Technip / OTC-27022-MS-2016

- Safe Hydrate Plug Dissociation in Active Heating Flowlines and Risers – Full Scale Test
Technip is committed to contributing effectively to world progress by providing the Energy sector with solutions that are both Sustainable and Innovative. Thanks to our leading-edge approach that combines environmental-social-economic sustainability with innovation, Technip’s engineers deliver long term added-value to our Clients and win-win solutions to all stakeholders.

Sustainability & Innovation

Technip designs and delivers sustainable and innovative solutions to meet the world’s energy challenges.

Environmental benefits
- Prevention and/or remediation of hydrate or wax formation, hence mitigation of risks of accidental failures and releases to the environment (ocean protection)
- Minimum power consumption and power generation needs on topsides and associated CO₂ emissions
- High energy efficiency for heating the production fluid resulting from combination of high thermal insulation and electrical trace heating cables performance
- Major Reduction of methanol injection requirements and consequent environmental risks

Economic benefits
- 10-30 % reduction of CAPEX enabled by production flowlines lay-out simplification (single line ETH-PiP vs. a conventional loop), less risers and reduced equipment on the platform
- OPEX reduction due to higher thermal and energy efficiency, no requirement for dead oil flushing, faster and easier procedures for shutdown and re-start operations

Social benefits
- Leading-edge solution that can be implemented in local spoolbases including qualified job opportunities, for both our Client and the Country benefits
- Technip’s approach oriented to engagement of and return to all stakeholders including technology transfer

Innovation
- Addressing difficult reservoir production flow assurance challenges
- Providing operators with a means of optimizing production and managing risks of pipeline hydrates/wax blockage
- Combining Technip’s field proven PiP technology with the efficiency of electrical heat tracing
- ETH cable 2nd generation now qualified for long tie-back application (up to 50km)