

Introduction

In the current challenging climate of low oil prices, more than ever, the pressure is on operators to reduce the cost of subsea operations. Flowline procurement cost, installation cost and typically expensive and time-consuming rigid steel spool metrology & installation, drive operators to identify cheaper spoolable flexible pipe solutions.

At the same time, there is a need to reduce operational cost. One of the main contributors to operational cost for flowlines is pipeline integrity management and in particular corrosion management, monitoring, prevention and repair.

Airborne's Thermoplastic Composite Pipe (TCP) Flowline is the only product in the market that combines flexibility, ease of installation, and a product which is available in long lengths. TCP has unique low-weight and corrosion resistant properties. It is this combination that makes TCP Flowline the best option for offshore flowline applications, reducing both capital and operating expenditure.



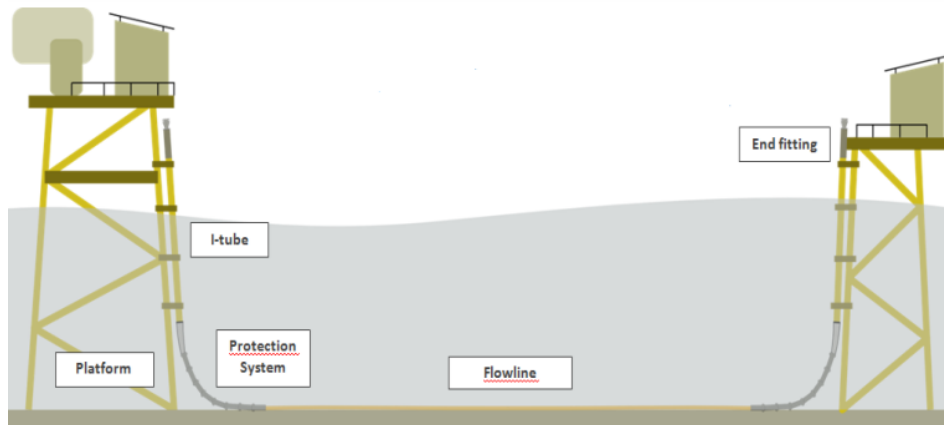
Airborne Oil & Gas has manufactured the world's first hydrocarbon transport TCP Flowline for Petronas to replace existing rigid steel flowline. Petronas has selected the TCP Flowline to permanently ban pipeline corrosion, the root cause for the replacement of the existing pipelines and to achieve a reduction of the as-installed cost compared to rigid steel pipeline.

TCP Flowline Installation

In comparison with conventional rigid pipe, installation of TCP Flowline has the following advantages:

- Installation of the TCP Flowline can be carried out with low cost installation vessels. No pipelay barge is required. Instead the TCP Flowline can be laid with a standard offshore support vessel with sufficient deck space for the deployment equipment including the reel
- No seabed preparation or free span corrections are required, the flexible TCP Flowline will follow the seabed profile
- No subsea pipeline termination (PLET) or spools are required. The TCP Flowline can be installed without subsea connections
- Platform tie-in can be completed with the same vessel in one operation
- No metrology and no divers are required to complete the installation
- Crossings with existing pipelines are simple thanks to the pipe flexibility

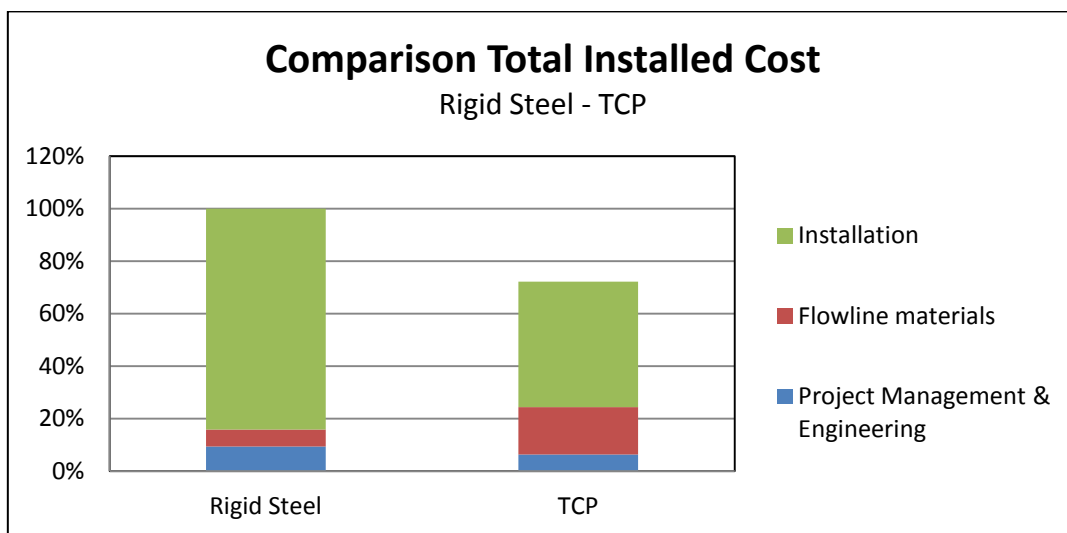
A typical platform to platform TCP Flowline is shown in the figure below.



The TCP Flowline can be installed buried (trenched/covered by rock berm) or un-buried. In cooperation with installation contractors, Airborne Oil & Gas has developed methods for cost effective on-bottom stability and protection.

Total Installed Cost Reduction

Actual cost reductions achieved with TCP differ from project to project. For a typical in-field flowline, the cost distribution between materials, installation and general project cost (PME) is shown in the figure below for both carbon steel and TCP Flowline. In the example shown, a tie-in of 3km length, a cost reduction of 30% is achieved with TCP Flowline compared to basic carbon steel. Comparisons against more exotic metal grades such as a high grade Corrosion Resistant Alloy (CRA) increase this saving even more.



TCP Flowline Operation

Similarly to material and installation cost, operational costs are very different from case to case. Operational costs are particularly hard to expose as the cost origins are embedded within different parts of the operational organizations and often shared with other cost drivers (e.g. logistical cost for chemicals transport). Studies have shown that 50% of all operational pipeline cost are related to corrosion.

The non-corrosive TCP Flowline is operated like regular steel flowline:

- TCP Flowline is piggable and can be cleaned with appropriate pigs (soft brush/suitable cups)
- All methods used for detection of corrosion are not required
- TCP Flowline can be visually inspected and gauged (caliper pigs) to confirm suspected irregularities
- Long term integrity can be confirmed with in-line polymer coupon monitoring
- Due to the smooth bore and inherent good insulation properties, TCP Flowline has excellent flow characteristics and is less susceptible to wax and scale deposits