ABSTRACT

For fields where the overall thermal performance requirement is a U-value of less than 3.5W/m²-K or 0.6 BTU/ft²-hr-°F between the wellhead and the topsides, cost-optimization is achieved by using the combination between a very well insulated pipe in pipe for the flowlines (U as good as 0.5 W/m²-K or 0.09 BTU/ft²-hr-°F), which therefore allows to relax the specification on the riser thermal performance and bring it within the feasibility limits of the wet insulation (5L syntactic PP) driving the overall installed cost down.

This architecture has been used for the Shell Bonga project for which the overall specified U-value was initially 2W/m²-K. The optimized solution finally selected by the Operator was to use a pipe in pipe for the flowlines that achieved a U-value better than 1W/m²-K and a 100mm 5LSyntPP wet insulation on the riser (U_{riser}=2.5W/m²-K). The combination of the two allowed making significant cost savings while gaining on operation flexibility due to longer cooldown times on the flowlines.

With the growing number of deeper water field developments, the cost of the flowlines and risers are paramount and this combination of pipe in pipes and wet insulation allows meeting, or exceeding, the thermal performance while ensuring the economy and feasibility of the projects.

FLOW ASSURANCE – THERMAL REACH

There are generally three temperatures of importance to design a hydrocarbon production system

- Well head inlet temperature
- Process inlet temperature
- And minimum preservation temperature for shutdown

The sea-bottom temperature is also of importance as it defines the temperature gradient across the insulating materials, but this is usually a constant 4°C for all deepwater projects, except for some very special cases.

1 Pipe-in-Pipe refers to a double walled pipe with an insulation material that is placed in the annular space. The outer pipe is designed to resist hydrostatic pressures and provide a watertight protection of the insulation material. Wet insulation refers to a single pipe that is insulated with a solid insulation material that can withstand hydrostatic pressures on its own. There is no outer pipe.