framatome

BHR

COOLDOWN TESTING FACILITY

With the growing need for deep water exploration and production and future plans for deep water wells, flow assurance of pipelines and fluids is becoming a higher priority. Subsea pipelines and components need to be thermally insulated to allow the hot fluids produced at depth to retain their heat during transport, in order to prevent the formation of hydrates or waxes.

Also, as wells get deeper, thermal insulation not only has to maintainin the temperatures within the pipelines, but also has to perform mechanically, in order to resist the huge pressures associated with the depth of water above.

OVERVIEW

Framatome BHR offers a thermal cool down testing and Overall Heat Transfer Coefficient (OHTC) determination service where the test piece can be heated internally with either air or water. Additionally, the test piece can be placed in a cold water system with temperatures matching those observed on the sea bed.

We can test straight pipe sections of 12 -15m which means that generally, test pieces can be close to full scale. For straight pipeline sections, a modular tank system is used to construct the cold water tank to the required length. Other components, such as riser assemblies can also be tested. For other assemblies, cold water tanks can be obtained up to 10 - 12m in diameter and 4m deep. Our large, high-ceiling laboratory is capable of handling very large tanks if required.

APPLICATIONS

Typical components tested include:

- Externally coated pipeline insulation
- Pipe-in-Pipe sections
- Electrically trace heated pipelines
- Riser assemblies
- Insulated valves

CASE STUDY

Test Type: Thermal Cooldown Test
Client: Trelleborg Offshore UK Limited
Component: Section of polyurethane coated pipe

Subsea pipelines are insulated to maintain temperature within the pipe to avoid hydrate formation and assure flow. At pipe terminations and interfaces it is not always possible to coat the entire structure in insulation to a sufficient thickness to meet client requirements. Therefore cold spots may form on the pipe causing flow assurance issues.

For this reason FEA and CFD are generally undertaken on the proposed system, however, these results then have to be validated against physical modelling. BHR undertakes this physical modelling work.

Test parameters

Trelleborg Offshore UK Limited designed and built a full scale thermal testing test piece, which represented the actual structure geometry as closely as possible. We then undertook a cooldown test to validate whether the insulated test piece could maintain the temperature within the pipe bore at a sufficiently high temperature for a long enough period of time. The data was also used to validate the CFD model that was produced prior to the testing being undertaken.

Instrumentation

Type T Thermocouples were used to measure the temperature of the bore, the pipe wall and the cold water used to simulate sea bed conditions. A cold water chiller/heat exchanger was used to allow the temperature around the test piece to be lowered to 4°C.

Outcome

The results for the physical testing showed that the insulation maintained the internal temperature within the required zone for the required period of time, this therefore validated the insulation design. The client subsequently co-authored a paper with BHR to disseminate the results, at the 2nd International Conference on Protection and Insulation of High Temperature Submarine Pipelines and All Aspects of Field Joint Coatings, 2013.

Cold Water Tank:	For straight pipe sections a modular tank panel system is used to construct the tank to the required length and width. For larger test assemblies water tanks up to 10 – 12m in diameter can be obtained with depths of 4 – 4.5m being available.
Cold Water Supply:	A chiller/heat exchanger unit is usually hired to give the required cold water temperature around the test piece, usual temperatures range from 3 - 4°C ± 1°C.
Test Piece Heating:	The test piece can be heated internally with water or air., iIf an OHTC measurement is required air is usually used with heating elements and recirculation fans and the power input into the system to maintain the required temperature is recorded and used to calculate the OHTC value.
Instrumentation:	Type T thermocouples are used in the temperature measurement, these are mounted internally in the test piece on a carriage with 4 thermocouples located at the 12, 3, 6 and 9 O'clock position. The number of thermocouples used is totally dependent on the size and shape of the test piece but up to 128 thermocouples can be used as standard and more can be added if required The data is recorded on a National Instrument Thermocouple module and stored on a PC. The sampling rate can be modified as required but is generally a sampling time ofevery 5 minutes is used, but this can be modified if required. The DAQ and thermocouples are calibrated together and calibration certificates for all can be provided if requested.

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