Improved Welding, Inspection and Integrity of Clad Pipeline Girth Welds

PUBLISHABLE SUMMARY

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Background

Corrosion resistant alloy (CRA) pipe materials are finding increasing use for the transport of hot and corrosive fluids in flow lines and associated risers in oil and gas production systems. Although initial material and installation costs are higher for CRA materials as compared with carbon steel materials, significant savings in life cycle costs can be accrued since corrosion inhibitor injection is not required and inspection and maintenance are generally reduced. Corrosion resistant alloy pipe materials, both solid and clad, are, however, more difficult to weld than carbon steel, and laying rates are relatively low for such pipelines. Today, the relatively high costs of pipeline materials and offshore installation have limited CRA pipe materials usage to those applications where no technically acceptable alternative solutions exist. The limitations in current clad pipeline welding and inspection practice have a significant effect on installation costs and pipeline integrity. This project will address these issues through the development of improved welding procedures including the use of alternative filler materials, the development of an Engineering Critical Assessment (ECA) approach to flaw acceptance and the development of appropriate reliable inspection techniques.

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Objectives

- To reduce root/hot pass completion times.
- To increase overall welding productivity and improvement of girth weld performance by optimising filler wire and process selection.
- To develop and demonstrate reliable weld inspection techniques of partially completed girth welds in metallurgically clad pipes to reliably detect and size root defects in as early a stage as possible and thereby drastically reduce repair times.
- To develop a procedure for ECA of girth welds in clad pipelines.
- To develop reliable inspection techniques for partially completed welds, linked to ECA requirements.

Project Outcome

- Qualified welding procedures based on the use of TOPTIG and (Cold Metal Transfer) CMT processes.
- Detailed assessment of welding process performance and weld integrity.
- Database of qualification test results.
- Guidelines for ECA and testing of clad pipeline girth welds.
- NDT technique for inspection after root and hot pass completion using phased array UT.

Benefits

- Reduced installation time and costs.
- Improved integrity of the welded joints by applying improved inspection techniques and ECA methodologies.
- Increased clad pipeline girth welding speed by increasing root and hot pass welding speeds.

Participants

The Sponsor Group comprised:

- Air Liquide
- BP Exploration Operating Co Ltd
- Corus
- Japan Steel Works Ltd
- Pipeline Technique Ltd
- Allseas Engineering BV
- Chevron Energy Technology Company
- ExxonMobil Development Company
- PETROBRAS – Petroleo Brasileiro SA
- Rontgen Technische Dienst BV

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Scope of Work

Initial Non Destructive Test (NDT) studies will involve the development of an inspection approach for partially completed girth welds, using the Phased Array UT inspection technique, after completion of root and hot pass and in between welding stations. An additional study into alternate NDT techniques such as digital radiography and internal inspection techniques which are also applicable to mechanically lined pipes (ACFM, Eddy Current, laser and camera imaging) will be carried out if sufficient sponsorship is forthcoming.

Using existing stressed based procedures as a basis, modifications will be made so that the procedures are suitable for clad material. Elastic-plastic finite element analyses will be conducted to obtain appropriate correction factors to ensure that the procedure is applicable to installation/operational stresses up to SMYS. Fracture mechanics (SENT) and tensile testing will be carried out to characterise the properties of the weld root region of girth welds in clad pipe at room temperature and 150°C made using the CMT and TOPTIG processes. These data will be used to establish flaw sizes. The impact of these on NDT reliability will be assessed.

Welding processes including TOPTIG™ and controlled short circuit transfer MIG process variants such as Controlled Short Circuit (CSC™) and CMT™ will be employed in an attempt to increase the root and hot pass welding speeds for girth welds of clad pipelines.

Price and Duration

The project had a duration of 2 years and a budget of £700,000. It was funded by 10 Sponsors each making a contribution of£70,000. The fee for additional companies buying-back into the project results is £70,000.

Further Information

For further information on how a Group Sponsored Project (GSP) runs please visit:

http://www.twi.co.uk/services/research-and-consultancy/group-sponsored-projects/

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