Development of a Qualification Methodology for Volumetric Inspection of Pressurised Welds in Subsea Sensors

JOINT INDUSTRY PROJECT OUTLINE

PROP302852

Summary

Subsea oil and gas (O&G) production relies on the application of subsea sensors to provide health metric information from the subsea (Christmas) tree assembly to the topside monitoring and control station. This data is critical to controlling the well infrastructure and to the asset management of the field. Such sensors are typically mounted on a Christmas tree fixed to the wellhead of a completed well. They are used to monitor and support the control of production of a subsea well. For example, pressure and temperature of flow is monitored for effective reservoir management. Changes in pressure and temperature can have a significant impact on recovery, production rate and safety. The safety and reliability of these sensors is therefore high on the manufacturer's agenda.

Typically these types of sensors are assembled using electron and laser beam welding. Surface inspection techniques and helium leak and pressure testing are typically used during and post manufacture. However, according to API-6A there is a requirement to perform volumetric inspection using either radiography or ultrasonic testing for Wellhead and Christmas Tree equipment. Currently the requirements of the standards the industry asks the providers of subsea sensors to adhere to, are unsuitable for being applied to a significant percentage of the typically small homogenous welds that are featured in subsea instruments. The industry is then left with the choice of:

- Having larger instruments which will increase cost through all stages of the system lifecycle (manufacturing, transportation, deployment and decommissioning)
- Accept non-conformances

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Objective

To produce guidelines for the application of a cost effective volumetric inspection of welds within subsea sensors that provide the industry with a best practice, possibly an international standard, that can be widely accepted by manufacturers of instruments, integrators, oil companies and regulatory bodies.

Benefits

- Best practice guidelines for that will enable manufacturers to implement volumetric inspections during manufacture leading to improved safety and reliability of subsea sensors.
- Documented evidence to support the acceptance of volumetric inspection techniques. This will enable the adoption of a cost effective inspection solution which satisfies the requirements of relevant codes, standards and industry stakeholders.

Approach

Task 1: Review the common joint designs, qualification and inspection requirements for subsea sensors in existing standards referenced by the O&G industry. This will include the API standards and their key references to identify where 100% volumetric inspection is currently a mandatory requirement. Best inspection practices and their suitability for small electron beam and laser welds for subsea sensors will be reviewed and identified.

Task 2: The design and locations of welds within subsea sensor assemblies and the materials used will be reviewed. Based upon a review of the weld geometries and welding methods critical flaw types and likely dimensions will be specified. Samples of subsea sensors along with CAD drawings for performing subsequent trials will be obtained from the sponsors.

Task 3: Establish outline NDT techniques based upon knowledge of flaw morphology, code requirements and prior experience. Computer modelling of the inspections will be carried out to determine the efficacy of the technique(s) for the welds concerned and technique modified as required. Based upon this, written NDT procedures will be established. Where 100% volumetric inspection is deemed not feasible, suitable alternative methods for assessing weld quality will be recommended.

Task 4: Design and manufacture test coupons containing flaws of similar morphology to those identified and reflecting the worst case configurations.

Task 5: Conduct inspection trials to demonstrate the effectiveness of the technique(s) on the representative test coupons. The subsea sensor assemblies will be inspected by computed tomography (CT) to validate the results obtained. Where necessary the assemblies will be sectioned to facilitate better minimum radiation paths to facilitate high resolution results in order to confirm size and tolerance of weld flaws present. Based upon these trials the effectiveness and limitations of the test methods and procedures will be determined.

Task 6: The results of the test coupon examination will be analysed statistically to determine accuracy and repeatability of the derived procedures.

Task 7: At the end of the project a Best Practice Guide will be produced providing detailed guidance and evidence to support technical justifications for the inspection of welds in subsea sensors by volumetric test methods. Comment will be made regarding automation of the selected NDE technique(s) and personnel training and certification.

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Deliverables

Sponsor group meetings to report on progress and agree the next period's work programme will be held every six months. Progress reports will be prepared and issued ahead of the Sponsor Group meetings. Regular updates on progress will be provided by e-mail between meetings. A final report will be prepared at the end of the project, giving the developed test procedures and all details and the results of the project including:

- Best Practice Guide for Qualification and Inspection of Welds in Subsea Sensors by Volumetric Test Methods

Price and Duration

The estimated total cost for this Joint Industry Project will be £400,000, and it will be completed in two years. It is proposed that the full programme will require 8 sponsors, each contributing £50,000 (two annual payments of £25,000). Work on the JIP will commence when five sponsors have joined the project. If full Sponsorship is not achieved, the work scope will be reduced accordingly in agreement with the Sponsors.

Further Information

For further information on how a Joint Industry Project (JIP) runs please visit:

http://www.twi-global.com/services/research-and-consultancy/joint-industry-projects/

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