Reliability of Manually Applied Phased Array Ultrasonic Inspection for Detection and Sizing of Flaws

PUBLISHABLE SUMMARY

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Background

Phased array ultrasonic technology and instruments for non-destructive testing have entered the second stage of their development. They are now widely available as affordable/portable instruments from a number of manufacturers and as laboratory based high performance systems. The cost of the portable equipment has reduced to the level where the technique can be considered justifiably for widespread high quality applications. Many case studies suggest that phased array ultrasonic technology is more reliable and provides more accurate flaw sizing than conventional manual ultrasonic inspection. However, systematic validation data is not generally available to support this assertion. This project aimed to provide industry with the objective technical information required and the confidence to make wider use of phased array ultrasonic inspection, together with an understanding of the benefits that this will bring.

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Objectives

- Provide an independent assessment of the defect sizing accuracy of portable phased array ultrasonic equipment.
- Compare the results obtained from different operators.
- Compare the performance of different instruments.
- Compare the results obtained from at least two inspection procedures.
- Explore the variation in defect sizing accuracy due to defect type and location.

Project Outcome

- Evidence on the variation in the ability of phased array operators to size flaws with training, experience, size of flaw and whether the flaws are rough or smooth.
- Recommendations for provision of good quality phased array inspections, including requirements for the training, examination and experience of operators.

Benefits

- Access to independent assessment of the performance of phased array ultrasonic methodology for the detection and sizing of flaws.
- Availability of proven procedures for phased array ultrasonic inspection.
- Data supporting the implementation of phased array ultrasonic inspection in industry, based on equipment and procedure comparisons.
- Reduced component repair costs, resulting from more accurate defect sizing.
- Data leading to standardisation of phased array procedures and defect assessment.

Participants

The Sponsor Group comprised:

- BAE Systems
- Eskom Holdings SOC Ltd
- Lloyds Register
- Petrobras
- US Navy
- British Energy Generation Ltd
- ExxonMobil
- Ministry of Defence
- Shell

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Scope of Work

Eight test blocks were manufactured containing a total of 40 flaws. The plate thicknesses ranged from 6mm to 50mm. The flaw types comprised:

- Smooth planar, to simulate lack of side wall fusion.
- Rough planar, to simulate cracks.
- Volumetric, to simulate porosity or slag.

The flaw locations, orientations and sizes comprised:

- Fusion face flaws.
- Centre-line flaws.
- Surface-breaking and sub-surface flaws.
- Through wall size from 1mm to 24mm.

To assist the statistical treatment of the results, a balanced experimental design with respect to flaw type, size and location within each test block size range was deployed.

Overall, the inspection trials generated 400 flaw size measurements from 10 phased array operators.

The results were analysed statistically with respect to flaw size, flaw characterisation and operator qualifications. The project also provided evidence and recommendations for the provision of good quality phased array inspections and operators.

Price and Duration

The project had a duration of 1 year and a budget of £180,000. It was funded by 9 Sponsors each contributing £20,000. The fee for additional companies wishing to access the project results is £20,000.

Further Information

For further information on Joint Industry Projects (JIP) and their operation, please visit:

http://www.twi.co.uk/services/research-and-consultancy/joint-industry-projects/

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