NOZZLE INSPECT

Automated Inspection of Nozzle Welds in Nuclear Environments

Autonomous robot for the automated inspection of nozzle welds in nuclear environments

- **Project budget: £1.2m**
- **End Users: Iberdrola Generation**

Regular in-service inspection is important to verify the integrity of welded nozzle sections in nuclear and other safety critical facilities. Nozzle sections made from austenitic and carbon steel can be susceptible to rapid crack growth due to thermal fatigue and stress corrosion. Early detection of cracks is therefore essential to ensure the continued safe operation of the facility in question.

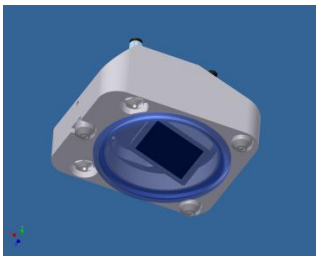
Nozzle inspections require a variety of inspection techniques and equipment. The process necessitates the plant be shut down for several weeks which leads to lost production and profitability. Although automatic or semi-automatic inspection equipment has been introduced for many applications operators are nevertheless still exposed to radiation during the equipment set-up and certain operational activities.

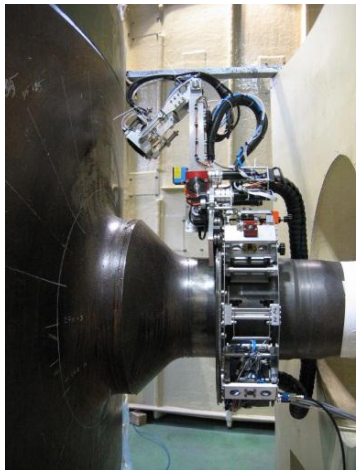
Currently inspections are undertaken using a number of conventional ultrasonic probes. As the probes need to be changed to allow full inspections of the nozzle weld areas and each change demands a recalibration be completed, defect detection and sizing capabilities are not optimum. Furthermore, as the current probes have no beam steering capability a large and expensive robot is required to provide accurate manipulation.

In order to reduce the time and cost of such inspections there is an urgent need to develop a system capable of performing a full inspection of nozzles without the need to change probes.

Such a system would offer the following clear benefits:

- Faster inspection times.
- Improved defect detectability and sizing.
- Reduced human intervention which will reduce workforce radiation uptake.
- Reduced requirement for robotic size and cost of robotic deployment system.





The objective of this project was to develop a system that will use a scanner and manipulator robotic assembly for an automatic inspection of nozzle welds. The automatic robotic assembly is carrying a novel matrix phased array probe and combined with the 3D beam steering capability, will enable a large area of the weld to be inspected in a single operation. The developed system incorporates contour following motion control software combined with real-time inverse kinematic algorithms integrated with commercial motor drive.

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