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Industrial Member Report Summary – Key Findings for Industry

Automatic TIG Ambient Temperature Temper-bead Technique for Ni-based Weld Overlay Repairs of Nuclear components - Assessment of Hydrogen Cracking by Implant Test

TWI Core Research Programme

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Industrial need

Practical challenges may make any heating cycle undesirable when repairing nuclear power plant components by full-strength weld overlays (FSWOLs). So, repair solutions that do not require preheat, PWHT or post-heating, referred to as 'ambient temperature temper bead' (ATTB), have been developed. The ATTB technique is currently permitted for the repair of nuclear power plant components by the ASME code, but it is currently not permitted by the RSE-M code. As the current rules in the RSE-M codes were established following experimental programs based on implant testing, the same type of tests would be expected to justify any changes.

Key Findings

A previous programme based on implant testing, described in a technical review of the application of ATTB to nuclear power plant components, failed to justify the introduction in the RSE-M code of the ATTB technique for the application of FSWOLs using Ni-based filler metal on nuclear components. The shortcomings of this programme were taken into account to devise the experimental programme described in this report, from which the following can be concluded:

- Implant test results showed that at the residual stress levels predicted for FSWOLs, cracking may occur in ferritic material, following the deposition of single weld beads using Ni-based filler metal and without preheat.
- A preheat temperature of at least 75°C is required to prevent hydrogen cracking, but only a limited number of specimens could be tested, which is not considered sufficient to confirm a safe condition at this temperature.
- Implant test stresses based on residual stresses acting on multilayer FSWOLs may be overly conservative when testing single bead deposits.

Full strength weld overlay applied at AmerenUE's Callaway nuclear power plant. Courtesy of the American Nuclear Society.

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