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WELDING OF NOREM IRON-BASE HARDFACING ALLOY WIRE PRODUCTS - PROCEDURES FOR GAS TUNGSTEN ARC WELDING

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Objectives: Cobalt-base hardfacing alloys used in valves and other critical components in nuclear reactors are a significant contributor to radiation field buildup and to the occupational radiation exposure of plant maintenance personnel. Laboratory studies, described in EPRI report NP-6466-SD, show that NOREM iron-base alloys exhibit wear properties matching those of cobalt-base alloys. However, wire products and welding procedures were needed for field applications.

The objectives of this project are:

- To secure metal core and homogenous weld wire of NOREM alloys suitable for deposition by automatic gas tungsten arc welding (GTAW).
- To develop welding procedures for these wire products.
- To measure the galling wear resistance of specimens prepared using EPRI's newly developed welding procedures.

Comments: Researchers obtained metal-core and homogeneous NOREM weld wire from a number of sources that relied on standard commercial practices in fabricating the product. They next used GTAW to deposit the wire on carbon and stainless steel plate and piping as well as on residual strips of cobalt-base alloy. Finally, they deposited the wire on pins and plates specially made for galling wear tests.

Researchers successfully used GTAW to deposit sound weld overlays of NOREM wire products on Type 304 stainless steel and SA-515 carbon steel substrates without any preheating. The NOREM alloy can also be deposited over a continuous or intermittent layer of cobalt-base Stellite 21 previously deposited by plasma arc welding (PTAW). Wire products with lower Mn and Si contents than used in gas atomized powder exhibited the best results. Wire cleanliness also proved a critical factor in achieving sound welds. In wear testing, NOREM PTAW overlays were as resistant to galling as specimens prepared using Stellite 21.

Remarks/Potential for dose limitation: Laboratory studies reported in EPRI report NP-6466-SD showed that the wear resistance of NOREM iron-base alloys matched that of cobalt-base alloys and possessed other properties required of hardfacing alloys. PTAW of gas atomized powder was used to successfully deposit these alloys on 3-inch valves, which were then

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subjected to long-term endurance tests under simulated PWR chemistry conditions. Extensive nondestructive and destructive evaluations showed that these valves performed better than one with Stellite 6 trim (report TR-100601). Similar valve tests are now being completed under BWR chemistry conditions. The need for field hardfacing replacements and repairs led to this NOREM wire development and welding evaluation program for in-situ applications. The study demonstrated that the NOREM alloy can be fabricated using standard hardfacing wire production practices and deposited successfully on stainless and carbon steel substrates by automatic GTAW. The NOREM alloy is weldable and exhibits wear and resistance equivalent to or better than cobalt-base alloys. Overall, NOREM alloys should be considered for field applications in both nuclear and fossil plant valves.

References:

1. EPRI NP-6466-SD.
2. EPRI Report TR-101094s
3. EPRI Report TR-100601

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