

N406. NOREM APPLICATION GUIDELINES

Wire products have been successfully fabricated and new procedures developed for machine and manual gas tungsten arc welding (GTAW) of the iron-base NOREM hardfacing alloys. These developments enhance the attractiveness of NOREM alloys both in replacement valves and in field repairs of installed valves.

An earlier EPRI report described the results of the first attempts to develop GTAW procedures for NOREM hardfacing alloys. However, utility personnel reported some difficulty in independently qualifying these procedures. Additional studies were therefore undertaken to see if more flexible welding procedures could be identified for NOREM wire products. The project team obtained some 75 variants of metal-core NOREM weld wire from a source that used standard commercial practice in fabricating the wire. They used the GTAW process to deposit these alloys on carbon and stainless steel plate and piping. Welds were inspected in accordance with ASME standards. For variants where sound deposits were obtained, the team used the GTAW process to again deposit NOREM on pins and plates, which were used to evaluate galling wear resistance. Plasma transferred arc welding (PTAW) procedure were developed by two independent organizations.

Researchers successfully used GTAW processes to deposit sound weld overlays on SA-516 carbon steel and TYPE 304 stainless steel piping without any preheating. Metal-core wire using prealloyed gas-atomized powder as filler material and featuring a lower nitrogen content than earlier investigated consistently provided sound welds and greater flexibility to the welder and could be used to perform a local weld repair. Powder with the high nitrogen content was successfully deposited by two other organizations using PTAW with a modest preheat of 200°F. Such a moderate preheat will remove residual moisture and help maintain consistent cooling rates. Preheat should be considered anytime hardfacing is applied to carbon steel substrates. Wear measurements showed that changes in alloy composition of the wire did not adversely affect the galling wear resistance of the NOREM alloys.

Loop tests under simulated reactor operating conditions and laboratory evaluations of small valves hardfaced with NOREM show that its performance matches or exceeds that of the long-established cobalt-base Stellites. Because valves with NOREM hardfacing have been purchased or installed by some 25 nuclear utilities, a NOREM product form and welding procedures suitable for field applications were needed. This study resulted in a NOREM chemistry that can be deposited more easily and more consistently using the GTAW process than the previously identified composition. In addition to its "welder friendly" status, the NOREM alloy also exhibits wear resistance equivalent to that of cobalt-base hardfacing alloys. Additional welding procedures and lessons learned from plant experience will be incorporated into revision 1 of these guidelines to be issued in about one year.

For more, "NOREM Applications Guidelines," EPRI TR-105816, Final Report, November 1995.