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R-445

DEVELOPMENT OF COBALT-FREE WEAR-RESISTANT ALLOYS FOR NUCLEAR APPLICATIONS

Keywords: CONTAMINATION PREVENTION; COBALT; LOW COBALT ALLOYS; COBALT REDUCTION; NOREM; IRON-BASE ALLOYS; HARDFACING ALLOYS; STELLITE; EVERIT; TRISTELLE; DELCROME; NICKEL-BASE ALLOYS

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Objectives: To investigate ways for improving methods of valve seat fabrication and to enhance the hardness and wear performance of certain hardfacing alloys.

Comments: Rolls Royce and Associates has evaluated several iron-base alloys as replacements for the cobalt-base Stellite alloys. In a range of wear tests, two hardfacing alloys, based upon a stainless steel composition, have given an overall wear performance as good as Stellite 6 in PWR water chemistry environment. The materials, Delcrome 910 and Tristelle 5183, have been successfully built and tested in a number of prototype valves, some of which have been put into service. New designs of equipment will contain these alternative materials.

Recent work has concentrated on improvements in the methods of valve seat fabrication, such as Hot Isostatic Pressing (HIP), and enhancing the hardness and wear performance of the basic Tristelle composition. Close control of the alloy makeup has been shown to give improved wear properties, although further studies are required to demonstrate that a robust manufacturing method can be developed.

Remarks: Nickel-base alloys typically have the following characteristics:

- Moderate wear resistance
- Moderate corrosion performance

Their applications typically are for:

- Low to moderate loads
- Non-sliding seating
- Other non-conforming geometries

The concerns with these materials are:

- Resistance to galling wear
- Long term corrosion

Iron-base alloys are characterized by austenitic microstructures with reasonable toughness. However, it is important to assess tribological requirements of individual applications.

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The hardness of Tristelle 5183 can be improved by close control of composition. Its wear and galling performance can also be similarly improved with no apparent loss of corrosion resistance.

References: Burdett, W.B., "Development and Application of Iron-Base Hardfacing Alloys in Valve Components and Future Fabrication Trends," Proceedings, EPRI Radiation Field Control and Chemical Decontamination Seminar, Tampa, Florida, November 1995, EPRI Distribution Center, P.O. Box 23205, Pleasant Hill, CA 94523.

Duration: from: 1990 to: 1997

Funding: N/A

Status: In progress

Last Update: February 12, 1996