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Processes and Practices Related to Occupational Dose

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PREFILMING AND PRECONDITIONING OF PRIMARY PIPING

Keywords: PREFILMING; PRECONDITIONING; ELECTROCHEMICAL POLISHING; PREOXIDATION; ELECTROPOLISHING; PASSIVATION; OPERATIONAL AND CHEMISTRY CONTROL; PRIMARY PIPING; PIPING

Description:

Preconditioning of primary system surfaces, either before plant start up or before installing replacement components, can significiantly reduce the deposition rate of activated corrosion products. There are two main methods of preconditioning: surface modification by mechanical or electrochemical polishing and chemical preoxidation to develop a passive oxide film before the surface is exposed to reactor coolant. A combination of electropolishing and wet air preoxidation gives the lowest rates of recontamination on replacement recirculation piping systems in BWRs.

Based upon this successful experience, EPRI has sponsored development and qualification programs to apply surface modification techniques to new or replacement PWR steam generator channel heads. The recently completed program yielded data showing electropolishing to be an acceptable technique for PWR steam generator surfaces. Metallurgical integrity of the weld overlay was found to be unaffected within a wide range of electropolishing process parameters. Following electropolishing, electrolyte removal from surfaces was complete, leaving no residiues to particulate in corrosion processes when the components are placed into service. Several utilities are now considering surface conditioning of replacement steam generator channel heads.

References and Selected Abstracts:

1. Ocken, H. and Wood, C.J., "Progress in Radiation Control Technology," EPRI Final Report NP-6708, February 1990. (Available from Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303.)

2. Aizawa, M., Osumi, K., Ito, H., and Honda, T., "Method and Device for Suppressing Deposition of Radioactive Material," (in Japanese), pp. 10, May 9, 1988.

ABSTRACT: During nuclear heating operation of a BWR type nuclear power plant, alkali chemicals are injected in a slight amount to the reactor water. Then, pH value in the water for pre-treatment is adjusted to a weakly alkaline range and the water is supplied circulately in the reactor primary coolant circuits. This forms a great amount of dense oxide films to the surface of primary coolant circuit components of the nuclear reactor. The films prevent the dissolved oxygen in the reactor water from diffusing to the surface of the components and also prevents corrosion products leached from the metal matrix upon corrosion from diffusing into the reactor water.

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Accordingly, growing of new films formed under the reactor water circumstance after the pretreatment can effectively be suppressed to reduce the radioactivity of plants.

3. Kato, S. and Kanbe, H., "Effect of Prefilming on Co-58 Radioactive Building-up on Zircaloy," (in Japanese) October 1987, pp. 1-29.

ABSTRACT: To explicate deposition and release on fuel cladding in BWR, Co-58 radioactivity build-up on zircaloy and the hydrothermal formation of spinel type oxide from hydroxide has been investigated experimentally in simulated BWR primary coolant system. (1) Co-58 radioactivity build-up was inhibited by pre-filming under strong oxidizing condition; (2) Cr ion was selectively deposited among Fe, Cr, Ni, and Co ion on zircaloy testing pieces; (3) About 60% of 58-Co build-up amount existed among Cr-deposit, about 40% of 58-Co build-up amount existed among ZrO2-film; (4) Compared with Co complex Oxide, Ni complex oxide was hard to form.

4. Ocken, H, and Wood, C.J., "Preconditioning and Passivation of Reactor Materials to Reduce Radiation Field Buildup," Proceedings of a Symposium-21. JAIF Annual Conference on Water Chemistry in Nuclear Power Plants, Tokyo, Japan, April 13, 1988, pp. v.2.

ABSTRACT: Future reductions in radiation fields will make use of preconditioning and passivation techniques to reduce the incorporation of Co-60 into the oxides that form on reactor construction materials. This paper describes Co-60 activity measurements following exposure of prefilmed stainless steel specimens in both simulated BWR and PWR coolant chemistry. An electroless layer of palladium performed best in both environments. Loop test results of a preoperational cleaning technique that holds promise for replacement PWR steam generators also are discussed.

5. Asay, R.H., "Passivation of Reactor System Piping - Prefilming Experience Using Air Oxidation," Transactions of the American Nuclear Society (USA), Vol. 54, June 7, 1987, pp. 300-301.

ABSTRACT: New piping installed in the primary system of an existing boiling water reactor (BWR) plant is know to accumulate radioactive contamination at a very rapid rate compared to the rate of build up on the original piping. A number of passivation methods have been proposed for reducing the dose-related buildup on replacement piping. The replacement recirculation piping at Cooper Nuclear Station was electropolished and passivated using the Radiological and Chemical Technology, Inc. (RCT) hot moist air method. The oxide film formed in this manner had previously been shown to retard the rate of radiation buildup on pipe specimens exposed in a reactor water bypass test loop at the Cooper Nuclear Station during the period immediately preceding the pipe replacement. After 8628 EFPH of exposure, the primary system piping at Cooper, which has been both electropolished and RCT passivated, has accumulated an average 60-Co level of 3.1 uCi/cm2. By comparison, electropolished only or do-nothing pipe was an activity level of 5.4 uCi/cm2 after the same exposure period. Thus, at this point, Cooper is experiencing a 43% lower 60-Co dose rate than what would have been expected for new, untreated pipe.