"Pre-Filming Method of Reducing Metal Release from Alloy 690 for SG in the Primary Water of a PWR"

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The major radiation sources in a PWR are metals, such as Co and Ni, released by the primary structures. The SG heat transfer tubes, in particular, are the largest radiation source among the primary structures; the most efficient exposure reduction measure is to minimize the amount of metals released from the SG heat transfer tubes.

The majority of Ni release from the SG heat transfer tubes occurs at the beginning stage of operation; therefore, minimizing the Ni release in the early operation period is expected to be most effective, and pre-filming of the SG heat transfer tubes is expected to be effective in minimizing the Ni release in the early operation period. Actual examples of application of pre-filming include the feed water heater tubes at Higashidori NPS, in which the Co release was minimized to about half the level it was prior to pre-filming treatment.

Various methods of pre-filming alloy 690 were studied, and oxidation at high temperature was achieved. The Potential-pH diagram for water at 300°C shows that Cr oxides are stable under PWR operating conditions, and thus can inhibit Ni release. The alloy 690 contains about 30% of Cr, and so it was considered that the formation of Cr oxides is possible by adjusting oxygen concentration, electrical potential, and temperature.

1) Clarify the possibility of selective oxidation of Cr in alloy 690 by controlling oxygen partial pressure and temperature.
2) Clarify the effectiveness of pre-filming on Ni release reduction from alloy 690.

Hydrogen gas and hydrogen peroxide were used as oxygen sources. The test for oxide film formation on the alloy 690 at high temperature was carried out, and an oxide film with a uniform thickness of about 0.7 μ was obtained. Next, the Ni release test was performed, and the result showed that Ni release was reduced to between 0.9 ppm and 0.01 ppm by the pre-filming treatment.

Reduction of Ni Release by Pre-Filming on SG Tubes Surface

Pre-filming on the SG tube surface is expected to reduce Ni release in the early operation period.

Figure 3 Image of Ni Release Reduction