

N3413. CONTROLLING RADIATION FIELDS AT MONTICELLO BWR WHEN USING HYDROGEN WATER CHEMISTRY

Depleted zinc injection has reduced containment radiation fields by a factor of 2 over the past 3 years, overcoming the increase in shutdown radiation fields following implementation of hydrogen water chemistry and injection of standard zinc oxide.

Northern States Power has been one of the most proactive utilities in the implementation of hydrogen water chemistry (HWC) to mitigate intergranular stress corrosion cracking of vessel internals. HWC was initiated at 0.7ppm in 1988 to protect out-of-core piping. The hydrogen concentration was increased to 1.1ppm in 1990, and then to 1.8ppm in 1991, to enhance protection of in-vessel components. Each time the hydrogen concentration was raised, shutdown radiation fields increased because in-core activation products were redistributed to out-of-core systems. To control radiation exposures to maintenance staff, chemical decontaminations were required at all three refueling outages in this period. Despite the decontaminations, collective exposures exceeded 400 rems in years with refueling outages, although they were among the industry's lowest in non-outage years.

In the mid-1980's, EPRI, in conjunction with General Electric, had shown that zinc injection reduced the buildup of radiation fields from activated corrosion products, primarily cobalt-60. Monticello implemented the zinc injection process (GEZIP) in 1990, but fields continued to increase at an unacceptable rate. Under an EPRI project, it was determined that cobalt-60 buildup in the Monticello plant was indeed being reduced by zinc, but that activation of zinc-64 in natural zinc to gamma-emitting zinc-65 was off-setting the gain, contributing 60% of the total gamma dose during the 1993 refueling outage. In early 1993, Monticello joined an EPRI project to evaluate the use of depleted zinc oxide (DZO), which is depleted in zinc-64 to avoid increasing levels of the activation product zinc-65. Since then, zinc-65 levels have steadily declined both in reactor coolant and in pipe oxide films. Contact BRAC point survey readings have declined to about 231 mR/hr at the 1994 and 1996 outages. Chemical decontaminations have been avoided at both the 1994 and 1996 outages, and based on the radiation field trends, should not be necessary for some time to come.

- Total estimated saving: \$1.62 million over 3 years.
- During the 1996 outage, it is estimated that 98 person-rems were avoided in containment and 30 person-rems avoided on the refuel floor when compared to 1993 radiation levels.
- As a result of depleted zinc oxide injection, it has not been necessary to continue routine chemical decontamination of recirculation piping at each refueling outage. Avoiding a decontamination and the impact on critical path results in a savings of greater than \$1,000,000.

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