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GERMANY **R-426**

DOSE RATE TRENDS IN SIEMENS-DESIGNED PWRS

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Objectives: To continue to investigate in a detailed and quantitative manner the extent of the contribution from various factors to the dose rates at Siemens designed PWRs.

The newer Siemens plants have been characterized by extremely low annual plant collective doses (typically 20 person-rem). This trend has continued. The Siemens PWRs can be divided into three groups:
(1) Startup before 1978, no reduction of cobalt base alloys.
(2) Startup after 1978, no cobalt reduction but other dose reducing features.
(3) Startup after 1978, reduction of cobalt base alloys.

Dose rate development at the main coolant piping is followed over many cycles for various plants. The highest increase is for plants using coordinate chemistry and with no cobalt reduction. Plants using modified chemistry but still no reduction of cobalt fall in an intermediate range. The dose rates decrease dramatically, by an order of magnitude for plants using modified chemistry and replacing up to 80% of the cobalt base alloys.

Comments: The Co-60 and Co-58 dose rates at the hot leg piping were plotted against the average activity in the coolant of each of these isotopes. The graph showed a clear linear relationship for Co-60 of the activity against the dose rate. The straight had a steep slope. This implies that major gains in dose reduction can be achieved by reducing Co-60 activity in the coolant.

The trend for Co-58 was less clear. The data points were more scattered and if a straight line fit was imposed the slope would be much less steep. This implied that the Co-58 isotope is much less important in the presence of appreciable quantities of Co-60. Nevertheless, its elimination will result in added gains in the reduction of dose rates.

Remarks: Another outcome of this work was to understand why there is an added benign effect on corrosion product concentrations from the steam generator tubing material Alloy-800. It has been demonstrated in the Japanese BWR plants that a low nickel to iron ration is beneficial for the control of radiation buildup. The Ni/Fe ratio should be maintained below 0.2. PWR plants with Alloy-800 SG tubing material also show low corrosion product concentrations. Typically the iron content in such materials is 3.7 ppb and the nickel content is 0.1 ppb. Thus the Ni/Fe ratio is about 0.03, much lower than 0.2. This therefore appears to be one of the reason for the lower corrosion product concentrations in many of the Siemens

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designed PWRs which utilize Alloy-800 in their steam generators. Metal release rates of SG tubing materials also provide support for the hypothesis that Alloy-800 is beneficial for minimized crud transport.

References: Riess, R. and T. Marchl, "Dose Rate Trends in Siemens-Designed Units," Proceedings, EPRI Radiation Field Control and Chemical Decontamination Seminar, Tampa, Florida, November 1995, available from EPRI Distribution Center, P.O. Box 23205, Pleasant Hill, CA 94523, Phone: (501)934-4212.

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