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DOSE RATE TRENDS IN WESTINGHOUSE-DESIGNED PWRS

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Objectives: To evaluate the effects of certain cobalt sources and operational coolant chemistries on Westinghouse-designed PWRs. To evaluate Ringhals 2 and Millstone 3 data more closely.

The effects of factors affecting dose rates were evaluated using a 1-year moving mean and the arithmetic averaging techniques. The quantitative effect of the following factors were found to be:

(a) Zircaloy versus Inconel 718 fuel grids at startup: 0.73
(b) Modified pH 7.4 versus coordinated pH 6.9 coolant chemistry at startup: 0.80
(c) Low cobalt impurity Alloy 690 steam generator tubing versus normal cobalt impurity Alloy 600 tubing: 0.75

Dose rates in Millstone 3 increased considerably at EOC 4, due to a combination of changing the coolant from elevated to coordinated pH 6.9, shutdown chemistry, and operation with some fuel assemblies with sub-cooled boiling. For cycle 5 operation, the coolant chemistry was changed to modified pH 7.4. The EOC 5 component dose rates decreased compared to those at the EOC 4.

Comments: In carrying out this project the three standard Radiation Monitoring Program locations were used, namely at the SG channel head, on the SG tubing and at a specified location on the piping. These locations well represent the dose rates to which workers are exposed and also different types of materials. The quantitative technique used to analyze the data was to use 1 year moving mean and the arithmetic average excluding values less than 0.5

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EFPY. In the data below the arithmetic average and 1 year mean are shown respectively. Data were as follows:

	Zircaloy vs Inconel Grids:	Modified vs Coordinated Chemistry
SG channel head	0.64 0.71	0.79 0.87
SG tubing	0.60 0.69	0.74 0.90
Piping	0.80 0.90	0.74 0.86
Average	0.68 0.77	0.76 0.88
Overall average	0.73	0.82

Remarks: Evaluation of low cobalt tubing:
Data were available from four Westinghouse plants that replaced steam generators with low cobalt tubing. Preliminary evaluation shows that dose rates in low cobalt tubing plants after replacement are about 60% of dose rates before replacement. This value was impacted also by the fact that many of these plants also improved the coolant chemistry and switched to zircaloy grids.

Ringhals 2 Data Analysis:
Ringhals 2 data was studied closely because it can aid in assessing the effect of Alloy 600 versus Alloy 690 general corrosion rate and release rate differences:

(a) Channel head and tubing dose rates were 50% compared to before replacement, reflecting operation with constant pH of 7.2.
(b) Later Co-60 trend indicates effect of lower corrosion rate and cobalt impurity concentrations.
(c) Later Co-58 trend does not support a lower corrosion rate and suggests that nickel may be preferentially released from Alloy 690.

References: Bergmann, C.A., J.D. Perock, M.J.B. Hudson and R.J.King, "Update to Dose Rate Trends in Westinghouse-Designed PWRs," 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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