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## OVERVIEW OF ACTIVITIES FOR THE REDUCTION OF DOSE RATES IN SWISS BOILING WATER REACTORS

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**Objectives:** Two Swiss BWRs, at Leibstadt (KKL) and Mühleberg (KKM) began to add 0.4 ppb Zn and 0.65 ppb Fe-III respectively to their feedwater. The aim of this study was to research the following three themes: 1) Statistical analysis of KKL reactor water data, 2) KKL reactor water analysis during the annual shutdown, 3) autoclave tests to clarify the role of water additives on the Co-60 deposition on steel surfaces.

**Comments:** Statistical water analysis showed that zinc has a moderately reducing effect of the Co-60 activity in the reactor water. Without Zn present, Fe has a strong reducing effect, with Zn, a strong increasing effect. Cr, Ni also changed sign: without Zn they have a moderate increasing effect, with Zn, a strong reducing effect.

The reactor water analysis during the annual shutdown in 1991 showed that at 24% power, the total Zn-65 activity increases by a factor of 8, mainly because of dissolved Zn-65. At 0% power, full control rod insertion, the crud particle concentration >1µm size increases by a factor of 50. At 160°C, 10 bar, an increase in the total Co-60 activity by a factor of 12 is measured.

The laboratory autoclave tests were made with different water additives and austenitic steel samples at simulated BWR conditions. After 6 time periods each of 300 h, the Co-58 buildup (%) on steel samples exposed to different water additives (ppb) was measured. The results were as follows:

20 ppb Zn	>	Reference	>	20 ppb Fe	>	1.5 ppb Zn
107 to 135%		100%		64 to 77%		47 to 69%

**Remarks/Potential for dose limitation:** In terms of the statistical water analysis, other BWR data sets have to be analyzed in order to determine whether these KKL-specific statements are of general significance. In terms of shutdown observations, it is not yet clear how the plant cooldown procedure should be modified to take these observations into account.

**References:** Alder, H.P, and Brélaz, P., "Overview Of Activities For the Reduction Of Dose Rates in Swiss Boiling Water Reactors," *Water Chemistry of Nuclear Reactor Systems 6*, Vol. 1, pp. 45-50, British Nuclear Energy Society, London, 1992.

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