CHEMISTRY PARAMETERS INFLUENCING THE DOSE RATE BUILD-UP IN BWR PLANTS

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Objectives: The purpose of this paper is to discuss several parameters that are known for influencing the dose rate buildup in BWRs. These factors are related to primary coolant chemistry with certain aspects related to the steam water cycle, including:

- zinc chemistry
- Ni/Fe ratio
- oxygen concentration
- pH

Comments:

- Traces of zinc in the reactor coolant reduce dose rate levels. Zn addition requires a product depleted in Zn-64 to avoid an increased formation of the activation product Zn-65.
- Co-58 and Co-60 activities on the surface of piping are reduced by the influence of the Ni/Fe ratio. However, when increasing the iron concentration too much, the tendency of mobilizing undissolved and activated corrosion products will increase. This is caused by the increased crud deposition on the surfaces of the fuel elements.
- When the oxygen content is too low in medium of the steam water cycle in areas with low alloyed steels, then erosion corrosion of the materials can be increased. This increases the iron input into the RPV, and thus increases the tendency to higher dose rate.
- Increasing oxygen concentration significantly increases material release from cobalt base alloys.
- The use of cobalt reduced materials as hardfacing alloys can contribute highly to the minimization of the dose rate buildup.
- Increasing the pH decreases the metal release rates and mitigates the solubility of corrosion products. Increasing the pH too far causes the metal release rates and solubilities of corrosion products to increase again. Long term pH modification in BWRs is an option for the future.

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Remarks/Potential for dose limitation:

- Filtration, stripping voltametry, and ion chromatography are analytical methods practicable in the necessary low concentration range for monitoring dominating parameters for dose rate buildup and the effect of appropriate countermeasures.
- In general, it seems to be possible to influence the dose rate buildup in a BWR by changing chemical or operational parameters. However, the measures to be taken depend on the specific conditions of the plants and should therefore be determined individually for each plant. It should be considered that the above-mentioned parameters show long term effects, and that measurable results of the dose rate development of the piping will not appear immediately, but the desired effects will be detectable after one or two cycles.

References: Marchl, T.F. and Reitzner, U., "Chemistry Parameters Influencing the Dose Rate Build-Up in BWR Plants," *Water Chemistry of Nuclear Reactor Systems 6*, British Nuclear Energy Society, London, 1992.

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