

ON-LINE MONITORING OF DOSE RATES AND SURFACE ACTIVITY DURING THE CYCLE 17 SHUTDOWN OF RINGHALS 2

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Objectives: Monitor in detail and collect data for the 1993 outage in Ringhals 2.

Comments: The shutdown of Ringhals 2 after cycle 17 in May 1993 was conducted according to the EPRI guidelines for PWR shutdown chemistry. The plant was kept at acidic reducing conditions for some 48 hours. Half of this time was spent at 86°C (187°F). After addition of hydrogen peroxide, an oxidizing clean-up with RCP-operation was run for 25 hours. The shutdown was monitored in great detail by frequent analyses of chemical and radiochemical parameters in the reactor coolant water. When the shutdown was completed, the routine gamma scan of various components in the plant was performed. In addition, crud sampling from four fuel assemblies for chemical and radiochemical analysis also was performed. The reduction in dose rates and surface activity on the excore surfaces is small, within 5-10%. These findings are in agreement with the amount of activity released during the reducing phase. From the data collected, it can be concluded that some 50% of the gamma source strength in the reactor coolant system reside on the stainless steel surfaces. The steam generator tubing holds 10% and the fuel some 20%. The remaining 20% were released and removed from the system during shutdown.

Remarks/Potential for dose limitation: The 1993 shutdown removed some 20% of the total gamma source strength from the reactor coolant system, but we removed very little of the gamma source strength on the RCS excore surfaces. The basis for this statement is the dose rate and gamma scan measurements plus the release during the reducing phase. Extending the time with reducing conditions would probably improve the result, since the release rate of Co-58 was stable at the end of the reducing phase. Zion 2 recently reported substantial dose rate reductions, but they used several weeks at reducing conditions to achieve this. With the dose rates and occupational doses we have had in Ringhals 2, it has not been judged necessary to spend that time to reduce the dose rates. Possible future repair operations and new, stricter rules for occupational exposure may force us to reconsider the implementation of an extended reducing phase. It is most likely that the majority of Co-58 released (some 80%) in the shutdown originates from the fuel cladding and so does at least 50% of the Co-60. The decrease of the Co-60 release through the years indicates that we have decreased the supply of cobalt to the reactor system.

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References: Aronsson, P.O., Bengtsson, B., Bjornkvist, L., and Granath, G., "On-Line Monitoring of Dose Rates and Surface Activity During the Cycle 17 Shutdown of Ringhals 2 1993," *Radiation Field Control Seminar*, Electric Power Research Institute, Seattle, Washington, 1993.

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