

N199. Water Chemistry and Dose Reduction: New PWRs

Clearer insight into the benefits from operating above pH 6.9 is expected to come from new PWRs where no inventory of Co-60 is present.

Four Westinghouse-designed U.S. plants (Comanche Peak 1, Seabrook, and Vogtle 1 and 2) have operated with modified coolant pH since startup. This regime refers to operation with an initial pH of 6.9 until a lithium concentration of 2.2 ppm is reached. This lithium concentration is then held constant until a terminal pH value of 7.4 is reached. Channel head dose rates in these four units average 4.2 R/h after about one effective full power year of operation. This compares to an average channel head dose rate of 6.4 R/h in other Westinghouse-designed PWRs with similar design features that operated since startup at pH 6.9. Using an empirical correlation between dose rates and exposures, the dose rate reduction from operation with modified coolant chemistry leads to an anticipated exposure saving of 66 person rem per typical outage. Because of the limited time operating at lithium concentrations >2.2 ppm (which is required only for extended fuel cycles starting with boron concentrations above 1,200 ppm), corrosion of Zircaloy cladding or primary side cracking of Alloy 600 is not expected to be a concern.

Summary of Findings. Operation of PWRs with primary coolant chemistry at pH>6.9 is imperative to reduce shutdown radiation fields. Operation in the elevated lithium chemistry regime with pH 7.4, achieved by lithium concentrations of 3.5 ppm, is effective but requires a fuels surveillance program to ensure that accelerated Zircaloy cladding corrosion does not occur. Early results from plants that started up with modified chemistry, where the bulk of the operation is at a lithium concentration of 2.2 ppm, show about a 30% reduction in dose rates compared with similar plants operating at pH 6.9. Such operation should minimize concerns about the possibility of accelerated Zircaloy cladding corrosion or primary side cracking of Alloy 600 steam generator tubing.

For more, "PWR Primary Water Coolant Chemistry: The View from the USA," Howard Ocken, Nuclear Engineering International, October 1992, p. 39.