BNL ALARA CENTER

Processes and Practices Related to Occupational Dose

ID: 42

UTILIZATION OF ENRICHED BORIC ACID IN PWRS

Keywords: ENRICHED BORON; BORON-10; ENRICHED BORIC ACID; BORON REDUCTION; LITHIUM REDUCTION; PH; PWR; RCS; PRIMARY COOLANT; WATER CHEMISTRY; FUEL CYCLE EXTENSION; PLANT LIFE EXTENSION; DOSE REDUCTION

Description:

Boric acid is utilized in PWR primary coolant to absorb neutrons and affect long-term control of reactivity. However natural boron contains only 20% of the neutron absorbing isotope B-10. Utilization of boric acid enriched in B-10 has been proposed as a way of reducing boric acid concentrations. This would eliminate the need for line heat tracing, tank heater and insulation. It would also substantially reduce the amount of lithium required for a desired pH level. Because of concerns that higher lithium concentrations may accelerate Zircaloy oxidation PWSCC of Alloy-600 SG tubes, the use of enriched boric acid has also been viewed as a safer way to increase RCS pH and obtain significant ALARA benefits. Another benefit is the possibility of extending the fuel cycle without increasing the boron and lithium concentrations and the required ancillary systems.

The technical and economic feasibility of utilizing enriched boron have been investigated (References 1, 2, and 3). Consideration was given to the use of enriched boron for new plants (1, 2) and existing ones. Recycling and not recycling the boric acid were both considered. In the economic evaluation the high cost of enriched boric acid was a very sensitive parameter. In 1988 dollars the cost is $2 to $3 per gram. This cost was likely to decrease with large scale utilization.

Reference 2 suggests the following benefits for a two unit plant: (a) Extension of fuel cycle (18 to 24 months) (b) Lowering of radiation exposure (save 100 man-rem/yr) (c) Increase in power (1%) (d) Reduction in SG maintenance (e) Reduction in cost of Lithium (f) Reduction in solid waste (g) Heat tracing maintenance (h) Improvment in nuclear safety (i) Extension in plant life.

References 1 and 2 conclude that use of enriched boron may be desirable and cost-effective based on plant specific factors. Reference 3 does not consider it to be cost-effective at this time.

References and Selected Abstracts:

1. Santucci, J., "EPRI Overview and Utility Studies", Proceedings of EPRI Seminar on PWR Water Chemistry and Radiation Field Control, March 16-18, Berkeley, California 1988, ed. C.J. Wood. (Research Reports Center, Box 50490, Palo Alto, CA 94303.)

2. Battaglia, J.A. and J. Roesmer, "Utilization of Enriched Boric Acid in PWR Plants," Ibid.

3. Rodill, W.B., "Feasibility Study on Enriched Boron for Surry Power Stations, Units 1 and 2", Ibid.