

N180. Nuclear Power Plant Resource Book - Vol. 2: BWR

The Electric Power Research Institute has recently published Volume 2 of the *Nuclear Power Plant Resource Book*. This volume is devoted to Boiling Water Reactors (BWRs). The book is designed to assist utility personnel to assess the effects of changes in plant conditions or components on performance and operation. It considers the effects on radiation levels of coolant temperature, reactor water chemistry, cobalt-free hardfacing alloys, extended fuel-cycle length, and plant maintenance procedures.

Among the topics discussed are: the effect of water temperature on cobalt-60 release, the impact of switching from Normal Water Chemistry (NWC) to Hydrogen Water Chemistry (HWC), and how zinc injection can affect radiation fields.

Corrosion leading to release of cobalt-60 (and increased dose) is not significantly affected by coolant water temperature. However, controlling water purity (and pH) does significantly reduce dose. Switching from NWC to HWC raises the radiation field 30-200%. This is because of an increase in nitrogen-16 concentration by a factor of about 5. To minimize these effects, the suspension of hydrogen addition during maintenance has proven effective where dose due to N-16 is high. In a test at Dresden-2, this technique plus some other actions resulted in an increase of less than 1% to total yearly exposure. Using this process, the effect of HWC should be minimal. Also, HWC will lower radiation exposures at most plants by reducing pipe inspection and repair. Zinc injection of 5-15 ppb, in conjunction with HWC, has been shown to significantly lower dose rates.

Other points discussed in this volume deal mainly with the elimination of cobalt-containing alloys. Valves are responsible for approximately 1/2 of the released cobalt-59 in BWRs. Alloys X-750 and X-718 contain cobalt which will be released by corrosion and add to dose. Whenever possible, nickel-based alloys with cobalt impurity levels of about 0.015% should be used instead of these. The use of cobalt-free nickel-based alloys in Swedish BWRs is one of the key factors responsible for their low doses.

Extending fuel cycle length from 12 to 18 months has been shown to decrease exposure. Cobalt-60 is responsible for approximately 75% of shutdown radiation fields in operating BWRs. Cobalt input from valve maintenance is estimated at 30-90 g/yr in BWRs which is 90-270 Ci in cobalt-60. Exposure due to inspection and repair activities is minimal since it involves few people and the fuel pool water limits individual exposure to about 5 mR/hr.

Taken from Nuclear Power Plant Resource Book, S.J. Green, EPRI Report TR-100359, Vol. 2: BWR, February 1992, 162 pages. Available from Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303.