# BNL ALARA Center Data Base

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## OPTIMIZING BWR CONTROL ROD BLADE MANAGEMENT STRATEGIES

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**Objectives:** To develop software to optimize the management of BWR control rod blades. The motivation for this study was to assist the utilities in calculating the economic benefits of implementing management actions to reduce radiation exposure. Exposure reduction measures to be analyzed during the full study will include preconditioning of primary system surfaces, improving water chemistry, decontamination and modification of operating practices. In the first phase the object was to optimize the replacement of high-cobalt control rod drive blade, pins, rollers and other components. Key utility questions that the model should provide are:
(a) What will be the net cost of implementing this procedure?
(b) How much exposure reduction can be expected from this action?
(c) How much should the utility be willing to pay to reduce additional exposure?

The methodology incorporated EPRI research on radiation field characteristics and exposure. Available management options were identified, unknown quantities were represented within ranges, relationships between known and unknown variables were modeled to obtain an all encompassing value function.

**Comments:** The following alternatives were considered:
(a) accelerated replacement of entire CRB
(b) In-situ replacement of pins and rollers
(c) status quo.
The number of CRBs and the timing of the action were also taken into account. The exposure reduction resulting from each management action was evaluated, the cost of each management action was determined, and a sensitivity analysis was carried out to address the importance of uncertainties. A large number of scenarios were analyzed. The following costs were considered:
(a) blade and pin and roller replacement cost
(b) blade disposal cost
(c) Curie disposal cost.

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In a specific plant case study, replacing 20 blades eight years early was considered. In-situ replacement of pins and rollers only was also examined. Over 20 quantities were modeled as uncertain and the plant provided $ value of dose avoided was used to compare these costs to exposure reduction costs. Analysis showed that hydrogen water chemistry and zinc injection can eliminate much of the exposure that would be eliminated by pins and roller replacement. Exposure reduction from pin and roller replacement builds over several years. If HWC and zinc injection are carried out then additional exposure reduction costs through pin and roller replacement would be$25,397/person-rem.

**Remarks:** Assuming no zinc injection and HWC, accelerated CRB replacement was marginally cost-effective ($9,319/person-rem). In-situ pin and roller replacement was not cost effective ($14,910/person-rem).

Conclusions of the plant case study were as follows:-
*In-situ pin and roller replacement is not cost-effective unless:
-replacement cost is low (~$5,000 per blade)
-original blade will be retained for the entire life of the plant
-exposure due to pins and rollers is high
*Accelerated CRB replacement is a cost-effective means of eliminating exposure provided:
-discount rate is low
-replacement blade reliability is high
-exposure due ton pins and rollers is high
-blade replacement cost is low
*A more competitive business environment means that it is especially important that utilities understand:
-how much exposure reduction should be valued
-how they should value incurring replacement and disposal costs at different points in time.

**References:** Welsh, J., "Software for Optimizing BWR Control Rod Blade Management Strategies," Proceedings, EPRI Radiation Field Control and Chemical Decontamination Seminar, Tampa, Florida, November 1995, EPRI Distribution Center, P.O. Box 23205, Pleasant Hill, CA 94523.

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