Attachment to NPL 97-0416

Revised pages of the Criticality Analysis of the
Point Beach Nuclear Plant Spent Fuel Storage Racks

4.0 Discussion of Postulated Accidents

Most accident conditions will not result in an increase in K_{eff} of the rack. Examples are:

Fuel assembly drop on top of rack	The rack structure pertinent for criticality is not excessively deformed and the dropped assembly which comes to rest horizontally on top of the rack has sufficient water separating it from the active fuel height of stored assemblies to preclude neutronic interaction.
Fuel assembly drop between rack modules	Design of the spent fuel racks is such that it precludes the insertion of a fuel assembly between rack modules.
Loss of cooling systems	Reactivity decreases since loss of cooling causes an increase in temperature, which causes a decrease in water density, which results in decreased reactivity.

However, two accidents can be postulated which would increase reactivity beyond the analyzed condition. One such postulated accident would be placement of a fresh fuel assembly of the highest permissible enrichment outside and adjacent to a storage rack module. This abnormal location of a fresh fuel assembly could result in an increased reactivity. To very conservatively estimate the reactivity impacts of such an occurrence in the spent fuel racks, the impact of loading a fresh assembly at 4.6 w/o ^{235}U enrichment adjacent to an outside face, which has no boraflex, of a 9x9 array of the Point Beach spent fuel rack cells loaded with fresh assemblies at 4.6 w/o ^{235}U enrichment was determined. The reactivity increase associated with this abnormal placement of the fresh assembly is less than 0.06985 ΔK

A second accident which could result in increased reactivity would be a "cooldown" event during which the pool temperature would drop below 50°F. Calculations show that if the Point Beach spent fuel pool water temperature was to decrease from 50°F to 32°F, reactivity could increase by about 0.00081 ΔK.

For occurrences of any of the above postulated accidents, the double contingency principle of ANSI/ANS 8.1-1983 can be applied. This states that one is not required to assume two unlikely, independent, concurrent events to ensure protection against a criticality accident. Thus, for these postulated accident conditions, the presence of soluble boron in the storage pool water can be assumed as a realistic initial condition since not assuming its presence would be a second unlikely event.

The worth of soluble boron in the Point Beach spent fuel pool has been calculated with PHOENIX-P and is shown in Figure 3 on page 20. As the curves show, the presence of soluble boron in the pool water reduces rack reactivity significantly and is more than sufficient to offset the positive reactivity impacts of any of the postulated accidents. To bound the 0.06985 ΔK reactivity increase from the most limiting accident in the spent fuel racks, it is estimated that 700 ppm of soluble boron is required.

Therefore should a postulated accident occur which causes a reactivity increase in the Point Beach spent fuel racks, K_{eff} will be maintained less than or equal to 0.95 due to the presence of at least 700 ppm of soluble boron in the spent fuel pool water.

5.0 Summary of Criticality Results

For the storage of fuel assemblies in the spent fuel storage racks, the acceptance criteria for criticality requires the effective neutron multiplication factor, K_{eff}, to be less than or equal to 0.95, including uncertainties, under all conditions.Maintaining at least 700 ppm of soluble boron in the spent fuel pool water is required to mitigate the consequences of a postulated accidents as described in Section 4.0 of this report.

This report shows that the acceptance criteria for criticality is met for the Point Beach spent fuel storage racks for the storage of Westinghouse 14X14 OFA and 14x14 STD fuel assemblies with the following configurations and enrichment limits:

Westinghouse 14x14 OFA and 14x14 STD Fuel Assemblies	Storage of Westinghouse 14x14 OFA and 14x14 STD fuel assemblies with nominal enrichments up to and including 4.6 w/o ^{235}U utilizing all available storage cells is allowed. Fresh fuel assemblies with higher initial nominal enrichments up to and including 5.0 w/o ^{235}U can also be stored in these racks provided a minimum number of IFBAs are present in each fuel assembly. IFBAs consist of neutron absorbing material applied as a thin ZrB_2 coating on the outside of the UO_2 fuel pellet. As a result, the neutron absorbing material is a non-removable or integral part of the fuel assembly once it is manufactured.

The analytical methods employed herein conform with ANSI N18.2-1973, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants," Section 5.7 Fuel Handling System; ANSI 57.2-1983, "Design Objectives for LWR Spent Fuel Storage Facilities at Nuclear Power Stations," Section 6.4.2; ANSI N16.9-1975, "Validation of Calculational Methods for Nuclear Criticality Safety"; and the NRC Standard Review Plan, Section 9.1.2, "Spent Fuel Storage".