UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION OF THE EXXON NUCLEAR COMPANY REPORT XN-NF-83-71(P) MECHANICAL DESIGN REPORT SUPPLEMENT FOR H.B. ROBINSON PART LENGTH SHIELDING ASSEMBLIES

1. Introduction

The Part Length Shielding Assembly (PLSA) mechanical design, described in the report XN-NF-83-71, is a fuel assembly concept developed by Carolina Power and Light Company (CP&L) in attempting to minimize the effect of pressure-vessel thermal shock (PTS). The intent of PLSA design is to position these assemblies at the core periphery to reduce the fast neutron flux exposure at specific reactor vessel weld. Twelve PLSAs will be inserted in Cycle 10 reactor core of H. B. Robinson.

2. Mechanical Design

The PLSA mechanical design is the same as other 15x15 fuel assemblies provided by ENC for H. B. Robinson, except for the inclusion of stainless steel column inserted in the lower portion of the fuel rod. The stainless steel column provides a higher fast neutron absorption. The design lifetime of PLSA is three reactor cycles of 365 effective full power days (EFPDs).

3. Design Evaluation

The PLSA design criteria and limits are identical to those previously used and approved for H. B. Robinson fuel assembly which is consistent with the guidelines specified in Section 4.2 of the Standard Review Plan (SRP). The PLSA design was analyzed using the approved RODEX2 code to ensure that design criteria and limits were met thermally and mechanically. Because PLSAs are located in the low power core peripheral region, they do not approach limiting conditions during operation. However, three analyses are worthwhile mentioning as follows.

3.1 Axial Thermal Expansi

Because the stainless steel has higher thermal expansion than the fuel pellets and Zircaloy cladding, a concern is raised that PLSA rods may grow faster than other fuel rods. However, this is not the situation, since due to a much lower power profile, the results show that the PLSA rods tend to move axially much less than the regular fuel rods.

We thus conclude that the concern of excessive PLSA axially rod growth is adequately addressed.

3.2 Assembly Bow

The licensee uses a finite element code to analyze the effects of fast flux gradients, material fabrication condition and restraint conditions on bowing. The results show that the maximum bow of a PLSA is less than that of a regular fuel assembly. However, the licensee proposes that the PLSAs be relocated in the core periphery after the first cycle to balance the fluence gradients as much as practicable. Since the net bowing after three cycles would not be significatly reduced by a second rotation, rotation after the second cycle is deemed unneccessary.

Since the licensee proposes a method in reducing the degree of bowing and since PLSAs are located in the low power region, we conclude that assembly bow is adequately addressed for PLSAs.

3.3 Assembly Holddown

One of the results of substituting stainless steel shielding for fuel is that the holddown force margins for perventing levitation are reduced because of the lower material density. The licensee determines that the minimum holddown spring force occurs at the BOL hot condition. The analytical result shows that there is still about 100 lbs holddown margin for PLSAs. We thus conclude that the PLSA holddown capability is maintained.

4. Conclusion

Although PLSA is considered a new fuel design, because it does not create new limiting conditions and it satisfies the SRP guidelines, we conclude that the PLSA mechanical design (XN-NF-83-71) is acceptable for H. B. Robinson.