ENCLOSURE

EVALUATION OF TOPICAL REPORT ON ADVANCED LONGER LIFE CONTROL ROD (ALLCR) ASSEMBLY (TACS 56930)

By letter dated February 20, 1985, General Electric Company presented Supplements 1 and 2 to Topical Report NEDE-22290 for staff review. This evaluation is concerned with Supplement 2 which is entitled "Safety Evaluation of the General Electric Advanced Longer Life Control Rod Assembly, NEDE-22290, Supplement 2" and is dated January 1985. The Core Performance Branch has reviewed the report and prepared the following evaluation.

1. Summary of Report

The supplement describes a variant of the Hybrid I Control Rod (HICR) Assembly which has been generically approved (See Reference 1 for a copy of approval letter). The design improvements described in the supplement are intended to extend the residence time for the control rods in the reactor. The significant design changes from the HICR are described in the report and are:

a. The addition of a hafnium absorber plate to the tip of each wing of the blade, and

b. Redesign of the velocity limiter to reduce its weight in order to compensate for the increased weight of the absorber blade.

The increase in residence time is obtained by replacing the B_4C with hafnium in that portion of the blade which is subjected to the greatest flux when the control rod is partially inserted into the core. The reduction in velocity limiter weight is required in order to minimize the impact of the design changes on rod drop and scram times.

ALLCR designs are described for BWR/2-4 D-lattice (ALLCR-D), BWR/4,5 C-lattice (ALLCR-C) and BWR/6 lattice (ALLCR-6) control blades. In

addition to the major design changes described above, certain features of the BWR/6 blades (upper handle configuration and coupling release handle configuration) were incorporated into the ALLCR-D and ALLCR-C designs. These changes improve the ease of handling of the rods but do not impact safety.

In addition to a description of the ALLCR assemblies, the design bases, materials evaluation, design evaluation and safety evaluation are described. The design bases for the ALLCR rods are the same as that for the HICR rods and includes requirement for mechanical, thermal, and hydraulic compatibility with the existing rods. Nuclear performance should equal or exceed that of standard rods. The materials used in the manufacture of the ALLCR rods--including B_4C cladding materials, hafnium, sheath material and rollers--are the same as those for HICR rods.

The design evaluation of the ALLCR rods includes a mechanical evaluation of the rods, hafnium absorber plate, handles, and the new velocity limiter. The nuclear evaluation considers the reactivity worth and fluence limitations on the rods. The thermal-hydraulic evaluation considers the effect of the new hafnium plates on the performance of the rods.

The safety evaluation considers the response of the rods to off normal conditions in the core and compares that response to that for the all-B_4C rods.

2. Summary of Evaluation

The design bases for the ALLCR rods are the same as those for the HICR rods (See Reference 1) which have been reviewed and approved. We conclude that the design bases are acceptable. The materials for the ALLCR rods are the same as those approved in Reference 1 and are acceptable. The thermal expansion and irradiation growth characteristics of the hafnium rods have not changed from those of the HICR rods and are acceptable.

Extensive tests were performed on the new velocity limiter to assess its performance in combination with the ALLCR designs. Compared to the present B_4C control rod-limiter combination, the new design is less heavy for the ALLCR-D and slightly heavier for the other designs. The effect of these differences on scram and rod drop speeds has been evaluated. The results show that rod drop speeds increase slightly for the heavier rods but are still well below the design value for this quantity. With respect to scram speeds, the slight increase in weight has no effect on the scram speed for the ALLCR-6. For the ALLCR-C, the increase in scram time is a small fraction of 1 percent. The generic Technical Specification (safety analysis) value of the scram time is significantly greater than the increased value so that the small increase has no effect on safety analyses.

Analyses have been made to obtain the reactivity worth difference between the all-B_4C and ALLCR rods. The same analysis methods were used as those for the HICR rods (Reference 1). These methods were verified by comparison with experiments, including some in which hafnium rods were substituted for B_4C. The results show that the ALLCR rods had the same reactivity worth as all-B_4C rods to within the uncertainty in the calculations.

Because the reactivity worths of the ALLCRs are essentially the same as those of the control assemblies which they are to replace and because their scram speeds and rod drop speeds are only insignificantly different from the all-B_4C rods, we conclude that they may be substituted for the B_4C rods without further analysis.

The mechanical design adequacy of the ALLCR blades has been investigated by General Electric. The effect of the weight increase is negligible in view of the large margins to design limits in the blade structure. The velocity limiter has been subjected to extensive testing to confirm its ability to meet all performance and design requirements.

The surveillance program described in Reference 1 has been updated to include additional irradiations. This program, approved in Reference 1, continues to be acceptable for the ALLCRs.

3. Conclusions

Based on our review, which is described above, we conclude that Supplement 2 to Report NEDE-22290 is acceptable as a reference to the description and safety evaluation of the Advanced Longer Life Control Rod (ALLCR) Assemblies. We further conclude that the ALLCR rods may be used in BWR reactors without further analysis beyond that performed for all-B_4C rods.

General Electric has requested that the ALLCR control rod assemblies be exempted from the requirements of IE Bulletin 79-26, "Boron Loss from BWR Control Blades", except that for maintaining records of the exposure of the individual rods. (Letter from J. Klappoth, GE, to R. Lobel, NRC, May 24, 1985). Bulletin 79-26 was issued in response to the discovery of boron loss from high exposure B_4C rodlets in the control rod assemblies. The ALLCR rods have solid hafnium in the parts of the control blades subject to the highest exposure and the cladding on the remaining B_4C rodlets has been replaced by a material less vulnerable to the stress corrosion cracking which led to the B_4C loss. Further the requirement for replacement of the blades prior to a ten percent loss in reactivity worth will remain. We therefore conclude that the ALLCR rod designs satisfy the requirements of IE Bulletin 79-26 and that individual licensees may reference this SER as a basis of demonstrating compliance with the requirements of this bulletin.

References

1. Safety Evaluation of the General Electric Hybrid I Control Rod Assembly, NEDE-22290-A, September, 1983.