UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 1, 1997

Mr. Nicholas J. Liparulo, Manager
Nuclear Safety and Regulatory Analysis
Nuclear and Advanced Technology Division
Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230

SUBJECT: AP600 USE OF PASSIVE AUTOCATALYTIC RECOMBINERS (PARs) FOR DESIGN BASIS HYDROGEN CONTROL

Dear Mr. Liparulo:

In a letter dated December 6, 1996, we sent you a list of potential critical path issues in the design certification process for the AP600. One of the issues (key issue #11) involves the acceptability of the use of PARs for AP600 design basis accident hydrogen control.

PARs use a catalyst, such as palladium, to recombine hydrogen and oxygen into steam. The most significant concern that has yet to be resolved between the staff and Westinghouse is the environmental qualification of the device and what effects specific constituents of the post-accident radiation environment may have on PAR performance. The purpose of this letter is to inform you of our position relative to this concern. The Nuclear Regulatory Commission (NRC) staff has been reviewing a submittal from an operating plant in addition to the AP600 design certification application which requests use of PARs for design basis hydrogen control inside containment. The following position is consistent with our position for using PARs at currently operating plants.

PARs have been proposed to meet the requirements of General Design Criteria (GDC) 41, "Containment Atmosphere Cleanup." GDC 41 requires, in part, a system to control the concentration of hydrogen in the containment atmosphere following postulated accidents to assure that containment integrity is maintained. Equipment used to perform this safety function must be demonstrated to be capable of maintaining functional operability under all service conditions postulated to occur during its installed life, for the time it is required to operate. This requirement is embodied in GDC 1 and 4 of Appendix A to 10 CFR Part 50 and Criteria III, XI, and XVII of Appendix B to 10 CFR Part 50. More detailed requirements and guidance related to the methods and procedures for demonstrating this capability for electrical equipment are in 10 CFR 50.49, and NUREG-0588.

The qualification requirements for mechanical equipment are principally contained in Appendices A and B to 10 CFR Part 50. The qualification methods defined in NUREG-0588 can also be applied to mechanical equipment. For environmental qualification of mechanical equipment, the staff concentrates its review on materials that are sensitive to environmental effects, for example, seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms. Like the above listed materials, PARs perform their safety

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function passively. Therefore, the effect of the post-accident environment on the catalyst material must be understood and it should be part of the PARs functional capability application.

Westinghouse has taken the position that the PAR need only be qualified for a post accident environment associated with 10 CFR 50.44. We acknowledge that it is appropriate that the qualification of individual components be based on the limiting design-basis accident for which the component provides a safety function and, for the PAR, the limiting design-basis accident is that set forth in Regulatory Guide 1.7 (RG). But, in order to arrive at the radiolysis conditions described in RG 1.7, the PAR would be exposed to a design-basis loss-of-coolant accident environment involving substantial melting of the fuel as described in NUREG-0588. The PAR must be demonstrated to be capable of maintaining functional operability upon exposure to this environment.

NUREG-0588 was issued to promote a more orderly and systematic implementation of equipment qualification programs by industry and to guide the staff during licensing reviews. Although it was written for electrical equipment, as mentioned previously, it can also be applied to mechanical equipment. For currently licensed plants, the characteristics of the fission product release from the core into the containment are set forth in RGs 1.3 and 1.4 and have been derived from TID-14844. This release consists of 100 percent of the core inventory of noble gases and 50 percent of the iodines. TID-14844 also included 1 percent of the remaining solid fission products, but these were dropped from consideration in RGs 1.3 and 1.4. The 1 percent of the solid fission products are considered in equipment qualification.

This is not a new requirement for design-basis combustible gas control systems. The sole catalytic hydrogen-oxygen recombiner installed at an operating plant is capable of withstanding the total post-LOCA integrated radiation dose. The most common combustible gas control system, thermal recombiners, have also been evaluated for a post-LOCA radiation environment associated with TID-14844. These evaluations have resulted in support equipment such as electric valve operators, fans, hydrogen/oxygen analyzing equipment, and actuation instrumentation being included in the plant's qualification test program. Although PARs do not rely on these types of support systems the staff believes that the effect of such a radiation environment on the PAR's catalyst material, which includes hydrophobic coating, needs to be evaluated.

The fact that the PAR is expected to be exposed to aerosol fission products prior to the performance of its safety function raises an operability issue for the PAR. The potential of the fission products that make up the post-accident radiation environment to be catalytic poisons must be addressed. The staff's latest understanding of fission product behavior inside containment is documented in NUREG-1465. On the basis of this understanding of fission product behavior inside containment the staff has developed the following position. The fission products listed in Table 3.13 of NUREG-1465 should be

addressed as possible poisons to the PAR catalyst. Of the fission products postulated to be released in NUREG-1465, industry has only addressed elemental iodine as a possible catalytic poison.

The issue of catalytic poisons can be addressed either quantitatively, by an experimental test program, or qualitatively, based on previously established chemical principles. For determining the concentrations of the fission products inside the containment, we believe it is acceptable to use the concentrations listed in Table 3.13 of NUREG-1465. For determining the chemical forms of these fission products and other possible contaminants, the staff will confirm what industry proposes with NRC-sponsored computer codes such as VICTORIA and CONTAIN.

Other concerns the staff have about the use of PARs for the AP600 such as hydrogen mixing in containment, number of PARs, and location, are still under review by the staff. Resolution of these concerns are dependent on adequate demonstration of containment mixing via the WGOTHIC application report for AP600 (WCAP-14407).

If you have any questions regarding this matter, you can contact Bill Huffman at (301) 415-1141.

Sincerely,

original signed by:

Thomas T. Martin, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Docket No. 52-003

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AP600

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