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

November 12, 1996

MEMORANDUM TO: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: CLARIFICATION OF STAFF POSITION IN SECY-96-128, "POLICY AND KEY TECHNICAL ISSUES PERTAINING TO THE WESTINGHOUSE AP600 STANDARD PRESSURIZED REACTOR DESIGN"

In SECY-96-128, "Policy and Key Technical Issues Pertaining to the Westinghouse AP600 Standard Pressurized Reactor Design," dated June 12, 1996, the staff provided the Commission with recommended positions on policy issues pertaining to the Westinghouse AP600 standardized passive reactor design certification and requested that the Commission approve the staff positions presented in that paper. Significant interactions have occurred between the staff, Westinghouse, the Advisory Committee on Reactor Safeguards, and the Commissioners' Technical Assistants on these policy issues. The staff has also taken comments from the Electric Power Research Institute into consideration. On the basis of these interactions and, in particular, a meeting between the staff and the Commissioners' Technical Assistants on October 22, 1996, the staff agreed to clarify the recommended position on "Prevention and Mitigation of Severe Accidents." The attached clarification includes rewording of the staff position. The staff believes that its reworded position is consistent with the original position and with discussions with the Commissioners' Technical Assistants.

Attachment: As stated

cc: OPA
SECY
OCA
OGC

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Attachment

CLARIFICATION OF STAFF POSITION IN SECY-96-128, "POLICY AND KEY TECHNICAL ISSUES PERTAINING TO THE WESTINGHOUSE AP600 STANDARD PRESSURIZED REACTOR DESIGN" ON PREVENTION AND MITIGATION OF SEVERE ACCIDENTS

BACKGROUND:

Performance of numerous risk assessment studies over the past 20 years show that the risk to the public from severe accidents is usually dominated by accidents that result in early containment failure commensurate with a significant release of radioactive material. Many design features have been added to the AP600 design to reduce this risk. Examples include allowing for depressurization of the reactor coolant system, controlling hydrogen generation, and cooling of molten core debris in-vessel. The large passively-cooled AP600 containment provides significant benefit to cope with severe accident challenges because the failure modes of the containment heat removal system are independent of the scenarios that could lead to containment challenges and of the vulnerabilities associated with reliance on human actions. While the use of passive systems enhances the safety of the plant during early containment challenges, the ability to intervene and provide control over the course of a severe accident has significant benefit in terms of accident management. For existing plants this can be accomplished by an internal containment spray system and other features. However, the AP600 relies solely on enhanced natural processes for aerosol fission product removal. The state-of-the-science for evaluating the effectiveness of natural removal processes in harsh environments has uncertainty levels that are greater than those for current operating plants which do not credit these processes.

The concept of passive safety systems is appealing because the design relies primarily on gravity. Passive safety system designs are also attractive because they minimize the need for support systems and reduce reliance on human actions. However, there are uncertainties regarding the performance of passive safety systems. Net driving forces are small compared to active systems. For example, the reliability and functionality of check valves can no longer be taken for granted in passive designs. While a sticking check valve in an active system can be easily overcome by the forces developed by a pump, there is less assurance that the low driving head developed by gravity injection in a passive design will similarly overcome a sticky check valve. In addition, the parallel flow paths existing in the AP600, combined with the low driving heads, make calculation of flow distributions more uncertain. Although the staff is confident that, within the design basis, these uncertainties are bounded by testing program data and conservatisms inherent in design basis analyses, the uncertainties become much more significant when considering severe accidents.

In the very unlikely event that a severe accident in the AP600 occurs, the cause is likely to be some combination of events and passive system failures that had not been specifically evaluated or assessed. Assuming the failure of

the passive core cooling system features, the containment becomes the primary mitigation system to protect public health and safety. As with other passive systems, there are large uncertainties associated with the passive nature of the containment system design. Heat transfer and fission product removal from the AP600 containment atmosphere is dependent on mass condensation onto cool surfaces, predominantly the walls inside containment. Given a severe accident, the long-term buildup and distribution of non-condensible gases within containment and their effects (due to stratification and increasing concentration gradients within the inner containment boundary layer) cannot be accurately assessed with existing analytical tools. In view of the uncertainties associated with the reliance on passive systems in mitigating severe accidents and the advantages of having operator intervention as part of the design's accident management strategy, the staff recommends that additional severe accident mitigation features be provided in the AP600 design.

DISCUSSION:

In SECY-96-128, the staff provided positions for the Commission's approval on policy issues pertaining to the Westinghouse AP600 standardized passive reactor design certification. Under the topic of "Prevention and Mitigation of Severe Accidents," the staff recommended that the Commission approve the following underlined position:

> Therefore, in light of the enhanced safety that is expected from the AP600 design, the staff recommends that the Commission approve for the AP600 the use of non-safety-related system(s) to address the uncertainties associated with the passive natural fission product removal mechanisms for design basis analysis and for balance between prevention and mitigation of severe accidents.

On the basis of an evaluation of comments received from and discussions with Westinghouse, the Electric Power Research Institute, the Advisory Committee on Reactor Safeguards, and the Commissioners' Technical Assistants, the staff has reworded the recommended position for the Commission's approval as follows:

> The staff recommends that the Commission approve the following positions for the AP600 design:
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> (1) The AP600 design should include additional system(s) for accident management and long term mitigation following a severe accident.
>
> (2) Contingent upon inclusion of the additional system(s) for severe accidents, the staff will consider and approve the use of realistic passive natural fission product removal coefficients for analyzing the consequences of design basis accidents to meet the provisions of the proposed revision to 10 CFR Parts 50 and 100. Direct credit for activation or use of such additional system(s) would not be granted in evaluating design basis accident analyses. Mitigation of design basis accidents would be accomplished solely through the use of safety-related systems.

The staff believes that the reworded position is a substantial clarification and is consistent with the previous underlined position and supporting text. It is not the intent of the staff to dictate particular AP600 design features and systems; nevertheless, the staff has concluded that one way this position can be met within the current schedule for certification of the AP600 design is through incorporation of a containment spray system that injects internally to the containment. Whether the additional system is a containment spray system or not, the staff believes the additional system(s) should provide fission product removal, pressure control, temperature control, and mixing for the containment atmosphere following a severe accident.

The staff's emphasis in this policy issue is on the need for additional system(s) for accident management and mitigation following a severe accident. The staff believes that providing reactor operators with the capability to intervene in the course of a severe accident has significant merit. These additional systems(s) alone or in combination with existing systems will provide long-term accident management control. These additional system(s) will reduce the consequences of stratification and provide long-term pressure control. This argument is based on the staff's experience and continued belief that the public would be better served in allowing for active intervention to quickly mitigate the consequences of a severe accident through the use of systems such as containment sprays, than by waiting for the slower, passive natural removal mechanisms to follow their course. This is the first design to rely solely on natural removal mechanisms.

SECY-96-128 discusses such terms as "safety-related," "non-safety-related," "passive," and "active" in describing systems, structures, and components (SSCs). Consistent with previous Commission positions, the staff would find acceptable any combination of such SSCs for severe accidents. In effect, for severe accident mitigation and accident management, licensees are expected to make use of any and all available resources. The staff expects that the SSCs needed for severe accidents will be included in the Reliability Assurance Program.

If the Commission does approve the first recommendation above, the staff proposes in the second recommendation to use realistic passive natural fission product removal coefficients for analyzing the consequences of design basis accidents to meet the provisions of the proposed revision to 10 CFR Parts 50 and 100. The staff believes that the use of realistic, as opposed to conservative, fission product removal coefficients for the AP600 can be found to be acceptable and meet Commission regulations. Within the framework outlined to the Commission on the proposed rule change to 10 CFR Parts 50, 52, and 100, "Reactor Site Criteria ..." (59 FR 52255), the concept of enhanced safety features is introduced. The proposed rule change had not been approved by the Commission when SECY-96-128 was sent to the Commission; however, the Commission recently approved issuance of the proposed rule change in a Staff Requirements Memorandum dated October 11, 1996. The proposed rule change indicates that "the extent to which the reactor incorporates unique, unusual, or enhanced safety features having a significant bearing on the probability or consequences of accidental release of radioactive materials" (emphasis added) can be taken into consideration by the Commission. The addition of the enhanced safety clause is intended to allow consideration of safety

enhancements in the assessment of the consequences of accidents. The AP600 design already includes numerous safety features that lower the probability and consequences of accident releases. Moreover, if Westinghouse adds system(s) for severe accident mitigation and management as discussed above, the staff believes the enhanced safety clause would allow the use of realistic fission product removal coefficients for the design basis accident analysis. The staff does not interpret the enhanced safety clause as pertaining to any one system but rather the entire collection of systems and features that contribute to lowering the probability and consequences of accidental releases and provide for long-term accident management.

If the Commission does not approve this part of the policy issue, the AP600 design may still meet the provisions of the proposed revision to 10 CFR Parts 50 and 100 without invoking the enhanced safety clause. Westinghouse can: (1) continue the dialogue with the staff in an attempt to reach agreement on acceptable fission product removal coefficients, which could have a significant impact on schedule, (2) decrease the design basis allowable containment leakage rate, or (3) increase the exclusion area boundary. However, these options do not provide the overall benefit to safety afforded by adding a containment spray system.

This policy issue is not intended to give the staff permission to incorporate direct credit for the use of non-safety grade systems in design basis accident analyses. For example, the removal of airborne radionuclides by a non-safety grade containment spray system would not be included in the design basis accident dose analyses.