November 24, 2004

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: FINAL SAFETY EVALUATION FOR TOPICAL REPORT WCAP-15996-P, "TECHNICAL DESCRIPTION MANUAL FOR CENTS CODE" TAC NO. MB6982)

Dear Mr. Bischoff:

On December 13, 2002, the Westinghouse Owners Group (WOG) submitted Topical Report (TR) WCAP-15996-P, "Technical Description Manual for CENTS Code" to the staff for review. On September 15, 2004, an NRC draft safety evaluation (SE) regarding our approval of WCAP-15996-P was provided for your review and comments. By e-mail dated September 28, 2004, Mr. Virgil Paggen of the WOG commented on the draft SE. The WOG comments on the draft SE were discussed in conference calls on September 29-30, 2004, and no changes were required to the final SE enclosed with this letter. By letter dated October 15, 2004, the WOG confirmed that they did not have any suggested modifications to the draft SE.

The staff has found that WCAP-15996-P is acceptable for referencing in licensing applications for both Combustion Engineering (CE) and Westinghouse-designed pressurized water reactors to the extent specified and under the limitations delineated in the TR and in the enclosed SE. The SE defines the basis for acceptance of the TR.

Our acceptance applies only to material provided in the subject TR. We do not intend to repeat our review of the acceptable material described in the TR. When the TR appears as a reference in license applications, our review will ensure that the material presented applies to the specific plant involved. License amendment requests that deviate from this TR will be subject to a plant-specific review in accordance with applicable review standards.

In accordance with the guidance provided on the NRC website, we request that the WOG publish accepted proprietary and non-proprietary versions of this TR within three months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed SE between the title page and the abstract. They must be well indexed such that information is readily located. Also, they must contain historical review information, such as questions and accepted responses, draft SE comments, and original TR pages that were replaced. The accepted versions shall include a "-A" (designating accepted) following the TR identification symbol.

If future changes to the NRC's regulatory requirements affect the acceptability of this TR, the WOG and/or licensees referencing it will be expected to revise the TR appropriately, or justify its continued applicability for subsequent referencing.

Sincerely,

/RA/

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Safety Evaluation

cc w/encl:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

November 24, 2004

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

WCAP-15996-P, "TECHNICAL DESCRIPTION MANUAL FOR CENTS CODE"

WESTINGHOUSE OWNERS GROUP

PROJECT NO. 694

1.0 INTRODUCTION

By letter dated December 13, 2002, the Westinghouse Owners Group (WOG) submitted WCAP-15996-P to the NRC for review and approval of the transient analysis methodology described therein for licensing applications with regard to both Combustion Engineering (CE) and Westinghouse-designed pressurized water reactors. The WOG, as part of its request for review and approval by the NRC of WCAP-15996-P, requested a clarification with regard to the restriction on the use of the CENTS code for application to control element assembly (CEA) ejection licensing analyses. At issue is the statement in the safety evaluation for CENPD-282-P-A, "... CENTS is not approved for performing CEA ejection licensing analyses." The rationale for this restriction is stated as, "Benchmarking for the CEA ejection transient has not been provided...." The basis for these statements is that the validated neutronic core modeling capability of CENTS as described in CENPD-282-P-A, is limited to the point kinetics approximation. The NRC-approved methodology for CEA ejection analysis is specified in CENPD-190-A. The current review has revisited the CENPD-190-A methodology and has verified that there are two distinct end-points of the methodology: the evaluation of the fuel failure aspects of the CEA ejection, and the evaluation of the nuclear steam supply system (NSSS) thermal-hydraulic response aspects. The former requires that space-time kinetics effects be explicitly taken into account in the CEA ejection; the latter is bounded by a point-kinetics evaluation of the energy deposition in the reactor coolant.

2.0 REGULATORY EVALUATION

The methodology presented in WCAP-15996-P, as applied to the issue addressed in this addendum, concerns the computational issues associated with demonstrating compliance with the requirements for a reactor coolant pressure boundary set forth in General Design Criterion (GDC) 14. In particular, the numerical values computed with this methodology may be used to support the demonstration that the reactor coolant boundary is designed to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. The approval of the computational methodology in WCAP-15996-P is consistent with the requirements set forth in Appendix B to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 50), "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants." WCAP-15996-P describes a pressurization calculation necessary to provide adequate confidence that the reactor coolant pressure boundary will perform satisfactorily under a postulated CEA ejection event.

3.0 TECHNICAL EVALUATION

The NRC-approved CEA ejection analysis methodology, as described in CENPD-190-A, consists of a synthesis method that utilizes zero, one, and two dimensional calculations. These calculations are used to determine the maximum total fuel energy content and the fuel and clad temperatures during a CEA ejection accident. The former is an integral quantity and governs the total energy deposition in the coolant; the latter are local values and are governed by the peak local deposition of energy in the fuel and cladding. Key to the distribution of the energy deposition during a CEA ejection transient and the termination of the transient is the Doppler reactivity feedback effect. The synthesis methodology quantifies the space-time effects, that determine local energy deposition, via a core-and transient-specific Doppler weight. Since the magnitude of the Doppler feedback is directly proportional to the Doppler weighting factor, the normalized net energy rise decreases as the weighting factor increases (i.e., space-time effects become more important). Parametric analyses, in CENPD-190-A, show that the normalized energy rise increases monotonically as the Doppler weighting factor goes to one (i.e., point kinetics). Thus, for the computation of an integral value such as the energy deposition in the coolant, the point-kinetics calculation is bounding. Therefore, the system pressure computed on the basis of the energy deposition in the coolant is also bounding.

4.0 CONCLUSION

The staff has considered the request for a clarification with regard to the application of the CENTS code to the analysis of the NSSS thermal-hydraulic response aspects of a CEA ejection transient. In view of the fact that the NSSS thermal-hydraulic response to a CEA ejection transient is completely dependent on the total energy deposition in the coolant, and that this total energy deposition is bounded when the deposited energy is computed in the point kinetics approximation, the computed NSSS pressure is also bounding. The NRC staff concurs that the approved CENTS code is applicable to the computation of the NSSS pressure response due to a CEA ejection transient. This conclusion, however, only holds provided all parameters necessary for a point-kinetics calculation of the energy deposited in the coolant, during the transient of the reactor system at hand, are computed based on the approved methodology specified in CENPD-190-A.

Principal Contributor: Yuri Orechwa

Date: November 24, 2004