

July 12, 2000

Mr. H. A. Sepp, Manager
Regulatory and Licensing Engineering
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: REVIEW OF WESTINGHOUSE TOPICAL REPORTS WCAP-13877,
REVISION 2-P AND WCAP-13878-P, REVISION 2 ON SOLID STATE
PROTECTION SYSTEM (SSPS) SLAVE RELAYS (TAC NO. MA7264)

Dear Mr. Sepp:

The NRC staff has completed its review of the subject Westinghouse Electric Company (WEC) topical reports (TRs) which were submitted by letter dated November 5, 1999. The NRC staff had previously reviewed and approved Revision 1 of these TRs. A May 31, 1996, letter from Bruce A. Boger of the NRC to Tom Green, Chairman of the Westinghouse Owners Group (WOG), documents the NRC's acceptance of WCAP-13878, Revision 1, and an October 26, 1998, letter from Thomas E. Essig of the NRC to Louis F. Liberatori of the WOG documents the NRC acceptance of WCAP-13877, Revision 1. However, WEC subsequently discovered certain errors in the TRs and therefore submitted Revision 2 of these TRs to the NRC for review and approval. WEC has further determined that the changes do not affect the conclusions of the WCAPs and the NRC safety evaluations. The NRC staff has reviewed the changes and finds them acceptable. The enclosed safety evaluation (SE) confirms the acceptability of the proposed changes.

Pursuant to 10 CFR 2.790, we have determined that the enclosed SE does not contain proprietary information. However, we will delay placing the SE in the public document room for a period of ten (10) working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in the enclosure is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

We do not intend to repeat our review of the matters described in the reports, and found acceptable, when the reports appear as references in license applications, except to assure that the material presented is applicable to the specific plant involved. Our acceptance applies only to matters described in the reports.

In accordance with procedures established in NUREG-0390, "Topical Report Review Status," we request that Westinghouse Electric Company publish accepted versions of the topical reports, proprietary and non-proprietary, within 3 months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed SE between the title page and the abstract. It must be well indexed such that information is readily located. Also, it must contain in appendices historical review information, such as questions and accepted responses, and

original report pages that were replaced. The accepted versions shall include an "-A" (designating accepted) following the report identification symbol.

Should our criteria or regulations change so that our conclusions as to the acceptability of the reports are invalid, Westinghouse Electric Company and/or the applicants referencing the topical reports will be expected to revise and resubmit their respective documentation, or submit justification for the continued applicability of the topical reports without revision of their respective documentation.

Sincerely,

/RA/

Stuart A. Richards, Director
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Safety Evaluation

cc w/encl:
Mr. Andrew Drake, Project Manager
Westinghouse Owners Group
Westinghouse Electric Company
Mail Stop ECE 5-16
P.O. Box 355
Pittsburgh, PA 15230-0355

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

WESTINGHOUSE ELECTRIC COMPANY TOPICAL REPORTS

WCAP-13877 AND WCAP-13878

RELIABILITY ASSESSMENT OF WESTINGHOUSE TYPE AR RELAYS

USED AS SSPS SLAVE RELAYS

1.0 INTRODUCTION

By letter dated November 5, 1999, Westinghouse Electric Company (WEC) submitted Topical Reports (TRs) WCAP-13877, Revision 2-P, "Reliability Assessment of Westinghouse Type AR Relays Used as SSPS Slave Relays," and WCAP-13878-P, Revision 2, "Reliability Assessment of Potter & Brumfield MDR Series Relays." The NRC staff had previously reviewed and accepted Revision 1 of these TRs. A May 31, 1996, letter from Bruce A. Boger of the NRC to Tom Green, Chairman of the Westinghouse Owners Group (WOG), documents the NRC acceptance of WCAP-13878-P, Revision 1, and an October 26, 1998, letter from Thomas E. Essig of NRC to Louis F. Liberatori of WOG documents the NRC acceptance of WCAP-13877, Revision 1-P. However, WEC subsequently discovered certain errors in the TRs and therefore revised these TRs and submitted the revisions to NRC for review and approval. The revisions (1) use the correct Arrhenius equation to calculate the total service life for the relays energized 20 percent of the time (Section 8.2.2 and Appendix C of WCAP-13878-P, Revision 2, and Appendix D of WCAP-13877 Revision 2-P), and (2) change the aging reference temperature of nylon Zytel 101 from 160°C to 175°C and the activation energy from 1.37 eV to 0.8787 eV. The revisions also correct typographical and numerical errors in the text associated with the changes in the tables.

2.0 EVALUATION

The proposed changes to the TRs and the staff's evaluation of the changes are discussed below:

1. Proposed change

Correct Arrhenius equation to calculate the service lives of slave relays energized 20 percent of the time.

Evaluation

The original aging assessment of solid state protection system (SSPS) slave relays used a non-conservative Arrhenius equation for calculating the service life for a defined duty cycle other than 0 percent and 100 percent. The original equation assumed that when a device is energized for a certain fraction of its calculated service life, the

remaining fraction of the energized condition can then be expanded into a much longer time in a de-energized condition. These two times are not related to the duty cycle which is a fraction of the total service. For example, a relay with 20 percent duty cycle is energized for 20 percent of its total service life and de-energized for 80 percent. Revision 2 of the WCAPs use the correct Arrhenius equation to calculate the total service life of the SSPS slave relays for any defined duty cycle. This results in shorter service lives of all materials at a 20 percent duty cycle. The staff's evaluation of this change is discussed in items 3 and 4 below. Small numerical differences appear in the TRs for the 0 percent and 10 percent duty cycles because of rounding off of numbers and differences in calculation software. The staff finds the application of the revised more conservative Arrhenius equation acceptable.

2. Proposed change

The aging reference temperature and activation energy of nylon Zytel 101.

Evaluation

In Revision 1 (Table 8-1), both TRs use the incorrect aging reference temperature of 160°C, instead of 175°C. The correction lengthens the service life of nylon Zytel 101. However, WCAP-13878P, Revision 1 also uses the incorrect activation energy of 1.37 eV, instead of 0.8787 eV. This correction will shorten the service life of the nylon Zytel 101 for all duty cycles. WCAP-13877, Revision 1-P uses the correct activation energy. The staff finds the corrections acceptable. The staff's evaluation of this change is discussed in items 3 and 4 below.

3. Specific Changes to WCAP-13878-P

The changes discussed in items (1) and (2) affect WCAP-13878-P, Revision 2, and the staff's corresponding evaluation as follows:

The service life of materials is significantly shortened for a 20 percent duty cycle, but the affected materials are not essential for operation of the relay.

The service life of neoprene rubber (Tables 8-4, 8-4a, 8-4b, 8-5, 8-5a and 8-5b, Section 8.3.1) and polyvinyl chloride (PVC) (Tables 8-8, 8-8a, and 8-8b, Section 8.1.2.2) is considerably shortened for a 20 percent duty cycle. However, PVC has not been used in motor-driven rotary (MDR) relays used as slave relays in the WEC SSPS, and the failure of the neoprene rubber will likely not result in the failure of MDR relays. Neoprene rubber has been used in lead wire grommets for MDR relays manufactured up to December 1988. The purpose of the rubber grommets is to minimize abrasion of the lead wire during handling and installation. The grommets are not essential for the operation of the relay and WEC has determined that even after complete disintegration of the grommets, failure of the MDR relay is neither expected nor likely and therefore the shortened service life of neoprene rubber does not affect the conclusions of the WCAP and the staff's SEs. Therefore, the staff finds it acceptable.

The recalculated service life values are greater than 40 years for a 20 percent duty cycle.

WCAP Tables 8-6, 8-7, 8-9, 8-9a, 8-9b, 8-12, 8-13, 8-14, 8-14a, 8-14b, 8-15, 8-15a, 8-15b, 8-16, 8-16a, 8-18, 8-20, 8-20a, 8-21, 8-21a, 8-21b, 8-22, and 8-23 have been revised to give new calculated service lives. However, since the new calculated service lives in these tables are all greater than 40 years, the revision does not affect the conclusions of the staff's previous SE.

The service life of nylon Zytel 101 is significantly shortened for all duty cycles.

WCAP Tables 8-10, 8-10a, and 8-10b have been revised to give the new calculated service lives of the MDR relays based on 50 percent retention of tensile strength. The recalculated service lives are all less than the original calculated service lives. The MDR relay cam is made of nylon Zytel 101. The total force applied to all four lobes of a cam would not exceed 400 grams. The 50 percent retention of tensile strength reduces the tensile strength to a value of approximately 1350 psi. Based on the engineering judgement, WEC has determined, because of the low cam loads and the absence of reported cam failures, the recalculated service lives do not change the conclusions of the WCAP and the staff's SE. Therefore, the staff finds it acceptable.

Tables are intentionally left blank.

WCAP Tables 8-11, 8-11a, 8-11b, 8-17, 8-17a, 8-17b, 8-19, 8-24, 8-24a, and 8-24b are intentionally left blank either because the service lives are accurately given in other tables or because the properties of the materials are not critical for the operation of the relay. Therefore, this change has no impact on the conclusions of the WCAP or the staff's SE.

4. Specific changes to WCAP-13877

The changes discussed in items (1) and (2) affect WCAP-13877, Revision 2-P as follows:

Changes in the calculated service lives of ARD relays.

Section 8.3.3 of WCAP-13877 discuss the service life values of the ARD relay that failed at North Anna. The recalculated service lives are more conservative than the actual time the ARD relay was in service. Therefore, the recalculated service lives of the ARD relays do not change the conclusions of the WCAP or the staff's SE.

Recalculated service lives of AR relay based on nylon Zytel 101.

Tables 8-3 and 8-4 have been revised to give the new calculated service lives of AR relays. The recalculated service lives are greater than the original calculated values. This change is discussed in Section 8.3.4 and does not affect the WCAP recommendations or the staff's SE.

Recalculated service lives > 40 years.

Tables 8-6 through 8-15 were revised to give new calculated service lives. However, since the recalculated service lives are > 40 years, the revision does not affect the conclusions of the staff's SE.

Small decreases in service lives.

Tables 8-16 and 8-17 were revised to give new calculated service lives. According to the revised calculation, a 5°C temperature rise results in a small decrease (5.1 percent maximum) in the service lives of the relays with a 20 percent duty cycle. Since the staff's previous SE requires each plant to determine the qualified life of the relays based on the plant-specific environmental conditions, the revision does not affect the conclusions of the staff's SE.

3.0 CONCLUSION

On the basis of the staff's review of WCAP-13878-P, Revision 2 and WCAP-13877, Revision 2-P, the staff concludes that the changes do not affect the conclusions of the staff's safety evaluations of Revision 1 of the WCAPs. The previous safety evaluations are still applicable to Revision 2 of the WCAPs, and the plant-specific TS change request for an extended surveillance test interval should meet the requirements identified in the previous staff safety evaluations.

Principal Contributor: Hukam Garg

Date: July 12, 2000