ABB
ASEA BROWN BOVERI

January 13, 1993
LD-93-003

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: 10 CFR Part 21 Report on Potter & Brumfield MDR Model 170-1, 7032, 7033, and 7034 Relays

Dear Sir:

Pursuant to the requirements of 10 CFR Part 21, the purpose of this letter is to notify the Nuclear Regulatory Commission of a defect in motor-driven relays (MDRs) supplied by ABB Combustion Engineering (C-E) to Entergy Operation's Waterford Steam Electric Station, Unit 3 (WSES-3).

On November 18, 1992, a Potter & Brumfield MDR model 170-1 relay in a pressurizer heater control circuit failed while in service at WSES-3. Originally, utility personnel had estimated that the failure of the relay had occurred after approximately fifty (50) cycles. Potter & Brumfield qualifies these relays to 100,000 cycles. Subsequently, however, Entergy Operations concluded that, due to a circuit board failure elsewhere in the system, the relay was chattering and could have been cycling at a high rate for up to two weeks before detection. Therefore, the failed relay could have had hundreds of thousands of cycles on it when it failed.

Unaware of the relationship between the circuit board failure and the relay failure, C-E initiated an investigation, through Potter & Brumfield, of the failed MDR model 170-1 relay. The failure analysis showed that one of two rotor return springs had broken and a portion of the spring had lodged between the rotor and stator, preventing the relay from actuating. The presence of chlorine, combined with the fracture surface pattern, suggested that the failure could have been the result of stress corrosion cracking which either occurred during the wire manufacturing process or as a result of improper passivation (a process to remove surface contamination). Subsequent testing and analysis of other spring samples from the same lot verified this conclusion.

The rotor return springs subject to the described failure mechanism were supplied by the Lewis Spring Company and installed by Potter & Brumfield in one hundred and seventy-two (172) MDR relays, models 170-1, 7032, 7033, and 7034, all with date codes between 9228 (the 28th week of 1992) and 9251. C-E provided relays from this

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specific lot to WSES-3. Failure of these relays could prevent actuation of an engineered safety feature in the Engineered Safety Features Actuation System and/or actuation of the Reactor Trip Switchgear in the event of a trip condition detected by the Plant Protection System.

C-E is supporting the replacement of all affected relay springs supplied to WSES-3, and it is our understanding that the affected springs will be replaced as soon as is practicable. Although we have determined that this is a defect reportable under Part 21, it is our judgement that an immediate safety concern does not exist because 1) the relays from the affected lot, qualified by C-E for shipment to WSES-3, were aged prior to qualification testing to their respective 40-year life expectation (i.e., 7,000 cycles for the model 170-1 relays and 3,000 cycles for the model 7032, 7033, and 7034 relays), 2) of the three springs which failed, there is evidence of only one failing under 100,000 cycles, 3) the utility performs surveillance testing on these relays, and 4) these relays are cycled relatively infrequently (i.e., approximately 6-14 cycles per month in the Plant Protection System and Engineered Safety Features Actuation System). C-E, concurrent with this Part 21 report, is preparing a *Combustion Engineering Infobulletin* for distribution to all C-E NSSS plants describing this situation.

The enclosure summarizes the information available to us at this time. If you have any questions, please contact me at (203) 285-5213.

Very truly yours,

S. A. Toelle

S. A. Toelle
Manager
Nuclear Licensing

llj/lw

Enclosure: As Stated

(i) **Name and address of the individual or individuals informing the Commission.**

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Manager, Nuclear Licensing
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(ii) **Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.**

Potter & Brumfield MDR relays, models 170-1, 7032, 7033, and 7034 with date codes between 9228 (the 28th week of 1992) and 9251, used to 1) actuate the Reactor Trip Switchgear in the event of a trip condition detected by the Plant Protection System and 2) actuate engineered safety features in the Engineered Safety Features Actuation System.

(iii) **Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.**

C-E purchased the subject component from:

Potter & Brumfield Inc.
200 S. Richland Creek Dr.
Princeton, Indiana 47671-0001

(iv) **Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.**

The failure analysis of the model 170-1 relay, which failed while in service at Waterford Steam Electric Station Unit 3 (WSES-3) on November 18, 1992, showed that one of two rotor return springs had broken and a portion of the spring had lodged between the rotor and stator, preventing the relay from actuating. The function of these springs is to insure return of the rotor to the non-actuated state after an actuation. One end of the spring is hooked through a hole on the rotor and the other end is fixed to the stator. The fracture surfaces of the broken spring were examined under the scanning

electron microscope (SEM) to determine the fracture pattern and energy dispersive x-ray spectroscopy (EDS) was performed to determine the chemical elements present. The presence of chlorine combined with the fracture surface pattern suggested that the failure could have been the result of stress corrosion cracking which either occurred during the wire manufacturing process or as a result of improper passivation (a process to remove surface contamination).

As part of the investigation as to the cause of the failed relay, a sample of twenty (20) additional return springs were subjected to a life test. Of the twenty springs tested, two failed. The first spring failed between 6,000 and 16,000 cycles and the second spring failed between 120,000 and 142,000 cycles. Both failures occurred at a time when the tests were unattended, thus an exact cycle count at the time of failure was not recorded. An SEM/EDS analysis verified the conclusions reached by the analysis of the original failed spring taken from WSES-3.

The subject relays are used as the final initiating device to 1) actuate the Reactor Trip Switchgear in the event of a trip condition detected by the Plant Protection System and 2) actuate engineered safety features in the Engineered Safety Features Actuation System. Failure of these relays could prevent actuation of an engineered safety feature and/or a valid reactor trip.

(v) **The date on which the information of such defect or failure to comply was obtained.**

Initial C-E determination: January 5, 1993.

(vi) **In the case of a basic component which contains a defect or fails to comply, the number and location of all such components in use at, supplied for, or being supplied to one or more facilities or activities subject to the regulations in this part.**

The rotor return springs subject to the described failure mechanism were supplied by the Lewis Spring Company and installed by Potter & Brumfield in one hundred and seventy-two (172) MDR relays, models 170-1, 7032, 7033, and 7034, all with date codes between 9228 (the 28th week of 1992) and 9251. C-E provided thirteen (13) model 170-

1, nineteen (19) model 7032, seventeen (17) model 7033, and fifty-six (56) model 7034 relays manufactured with these springs to WSES-3 for use in their Plant Protection System Cabinet and Engineered Safety Features Actuation Auxiliary Relay Cabinet. C-E also provided Potter & Brumfield model MDR 170-1, 7032, 7033, and 7034 relays with earlier date codes as part of the original equipment Plant Protection System and Engineered Safety Features Actuation System to ANO Unit 2, SONGS Units 2 and 3, and Palo Verde Units 1, 2, and 3.

(vii) **The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.**

C-E is supporting the replacement of all affected relay springs supplied to WSES-3 and it is our understanding that those springs will be replaced as soon as is practicable. Although we have determined that this is a defect reportable under Part 21, it is our judgement that an immediate safety concern does not exist because 1) the relays from the affected lot, qualified by C-E for shipment to WSES-3, were aged prior to qualification testing to their respective 40-year life expectation (i.e., 7,000 cycles for the model 170-1 relays and 3,000 cycles for the model 7032, 7033, and 7034 relays), 2) of the three springs which failed, there is evidence of only one failing under 100,000 cycles, 3) the utility performs surveillance testing on these relays, and 4) these relays are cycled relatively infrequently (i.e., approximately 6-14 cycles per month in the Plant Protection System and Engineered Safety Features Actuation System).

(viii) **Any advise related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.**

C-E, concurrent with this Part 21 report, is preparing a *Combustion Engineering Infobulletin* for distribution to all C-E NSSS plants. This Infobulletin will recommend that utilities determine if relays from the subject lot were procured directly from Potter & Brumfield or from other suppliers of Potter & Brumfield relays. It is also our understanding that Potter & Brumfield is preparing a notice to issue to potentially affected customers advising them of this situation.