WCAP-13900

EXTENSION OF SLAVE RELAY SURVEILLANCE TEST INTERVALS

WOG SRT Subgroup Program
MUHP-7040 Revision 0

April 1994

Westinghouse Safety System Operations

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ACKNOWLEDGEMENTS

The following personnel are recognized for their extensive efforts in preparing this report; and, for their support in the initial site- specific quantifying and validation of material referenced herein.

Westinghouse Electric Corporation

Chris Morgan & Bob Howard- authors

contributors

Bernie Metro
Chris Peta
Rich Span
Tony Baker

ABSTRACT

NUREG-1366, "Improvements to Technical Specifications Surveillance Requirements" (Ref. 1) was published in December 1992. This NUREG contains the combined results and recommendations from a 1983 NRC task group formed to investigate problems with surveillance testing required by Technical Specifications, NUREG-1024, "Technical Specifications-Enhancing Safety Impact"(Ref. 2), and from the Technical Specifications Improvement Program (TSIP) established in December 1984. The objective of these projects was to review the basis for test frequencies; to ensure that the tests promote safety and do not degrade equipment; and to review surveillance tests so that they do not unnecessarily burden personnel. The studies found that while some testing at power is essential to verify equipment and system operability, safety can be improved, equipment degradation decreased, and unnecessary personnel burden relaxed by reducing the amount of testing at power. This WCAP combines the recommendations of NUREG-1366 with additional studies performed by Westinghouse to provide specific recommendations for relaxation of slave relay surveillance testing at selected Westinghouse plants.

CONTENTS

ABBREVIATIONS

ARC	Auxiliary Relay Cabinet
BNL	Brookhaven National Laboratory
ESF	Engineered Safety Features
ESFAS	Engineered Safety Features Actuation System
FMEA	Failure Modes and Effects Analysis
IPRDS	In-Plant Reliability Data System
LER	Licensing Event Report
NPAR	Nuclear Plant Aging Research
NPRDS	Nuclear Plant Reliability Data System
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission Report
PWR	Pressurized Water Reactor
SSPS	Solid State Protection System
STC	Safeguards Test Cabinet
STI	Surveillance Test Interval
WOG	Westinghouse Owners Group

EXECUTIVE SUMMARY

This WOG Program, MUHP-7040 Revision 0, is an effort by a subgroup of the WOG to extend the surveillance test interval for slave relays in the Westinghouse Solid State Protection System (SSPS) to an interval coincident with the refueling outage. The slave relay test requirements are delineated in the plant Technical Specifications and are quarterly, bi-monthly, or monthly depending on the format and version of the plant Technical Specifications.

MUHP-7040 has specifically completed:

- a review of industry research regarding reliability of relays in use at nuclear power plants.

- a Failure Modes and Effects Analysis (FMEA) and aging assessment on the models of relays used as slave relays in the Westinghouse SSPS (Westinghouse AR and Potter & Brumfield MDR) to establish the relay reliability.

- a review of actual slave relay failure history to show that there is an insignificant increase in function unavailability when relays are tested at less frequent intervals.

The program has concluded that the slave relays used in the SSPS are highly reliable and that testing at a frequency coincident with the refueling interval, instead of the more frequent intervals currently required, does not significantly decrease any margin of safety assumed in the plant safety analysis.

To assure the reliability of the few normally energized SSPS slave relays, it is recommended that a replacement interval be determined in accordance with guidelines given in WCAP-13877 (Ref. 3) for Westinghouse AR series relays, and WCAP-13878 (Ref. 4) for Potter & Brumfield MDR series relays.

1 INTRODUCTION

1.1 Background

The Standard Technical Specifications for Westinghouse Pressurized Water Reactor (PWR) plants, both NUREG-0452, Rev. 4 and 5, and NUREG-1431, the new improved standard, require quarterly testing of slave relays in the Engineered Safety Features Actuation System (ESFAS). This requirement involves testing the relays at power, with the attendant risk of inadvertent actuation of the Engineered Safety Features (ESF) equipment. In addition, the on-line testing of slave relays requires significant plant manipulation, abnormal configurations, and removes from service various equipment making it unavailable to perform its intended safety function.

Several evaluations regarding the effects of aging on relays used in safety-related systems in nuclear power plants have been recently undertaken. One such study, the U.S. Nuclear Regulatory Commission's Nuclear Plant Aging Research (NPAR) Program, contracted with Brookhaven National Laboratories (BNL) to perform a task titled "Nuclear Plant Aging Research - Operating Experience and Aging Assessment of Circuit Breakers and Relays." The Phase I report, NUREG/CR-4715, "An Aging Assessment of Relays and Circuit Breakers and System Interactions" was subsequently published. Excerpts from this report with regards to relays are provided below:

> "The predominant failure mechanisms identified through LER, NPRDS, and IPRDS failure data evaluation relate to setpoint drift for protective and timing relays, coil burnout, binding and contact problems for control and timing relays. The evaluation of NPRDS data indicated that normally energized relays fail approximately 60 percent more often than normally de-energized relays. The failure mechanism associated with normally energized relays is thermally induced damage of organic coil and of housing components. As these problems are recognized, relay manufacturers change materials of these components so that they are less sensitive to thermal effects."
>
> "The requirements for maintenance, testing, and monitoring of relays depend on the type and the application of the relay. The manufacturers of control and timing relays require little, if any, maintenance for their products."
>
> "The techniques that are presently in use for monitoring relays (i.e., functional system checks for control, auxiliary, and timing relays and periodic calibration for protective relays) do not provide specific predictive information regarding the continued ability of the devices to perform their function. The periodic calibration of protective relays provides some qualitative indication that the relays are performing properly and should continue to do so during the next interval before calibration. Functional tests of control, auxiliary, and timing relays provide indication that the relays are working and identify those which have failed. These tests do not provide data regarding the degree of deterioration."

The Phase II report for the NPAR Program was completed by Wyle Laboratories and resulted in the issuance of NUREG/CR-5762, "Comprehensive Aging Assessment of Circuit Breakers and Relays." One key observation made in this report is stated below:

"A model of the factors which determine service life could form the basis of a condition based maintenance program. The model could predict the rate of change in parameters with respect to time. Maintenance would be scheduled when necessary based on the condition of the device rather than at some arbitrary time."

1.2 Program Objective

This WOG Program, MUHP-7040 Revision 0, is an effort by a subgroup of the WOG to extend the surveillance test interval for slave relays in the Westinghouse Solid State Protection System (SSPS) to an interval coincident with the refueling outage. The slave relay test requirements are delineated in the plant Technical Specifications as quarterly, bi-monthly, or monthly depending on the format and version of the plant Technical Specifications. The plants listed below are members of the WOG subgroup participating in the program:

Beaver Valley 1 & 2
Braidwood 1 & 2
Byron 1 & 2
Callaway 1
Catawba 1 & 2
Comanche Peak 1 & 2
Diablo Canyon 1 & 2
McGuire 1 & 2
Millstone 3
Salem 1 & 2
Shearon Harris
South Texas 1 & 2
V. C. Summer
Vogtle 1 & 2
Watts Bar 1 & 2
Zion 1 & 2

These plants currently are required to perform testing on most of the Engineered Safety Features Actuation System functions during power operation. A major portion of this testing involves actuation of relays in the Westinghouse SSPS, the Auxiliary Relay Cabinets (ARC) and the Westinghouse Safeguards Test Cabinet (STC).

(Note - some plants did not purchase the Westinghouse STC, but developed and included an alternate system that performs the same function as the Westinghouse STC. Where STC is used in the following discussion, it generally applies to these alternate designs also.)

The Safeguards Test Cabinets are used to test the integrity of the Engineered Safeguards Actuation Features System (ESFAS). This is accomplished, without disturbing normal plant operation, by energizing various protection system relays and utilizing the test circuits of the STC to verify that certain protection relays have been energized and that their contacts are opening and closing properly. Two basic types of testing are performed: GO testing, in which the protection end device is actuated and its operation verified by observation; and, BLOCK testing, in which actuation of the end device is blocked, and circuit integrity is

verified by continuity testing. In each of these types of tests all slave relay contacts are tested, as is the wiring, out to the final actuation device. Only in the GO test is the final device itself tested.

In addition to the slave relays in the SSPS, the protection system relays actuated as part of the test initiated from the STC may include other auxiliary relays. The surveillance is essentially confirming the proper operation of these relays also. This program, however, only addresses the reliability and aging effects of Westinghouse AR and Potter & Brumfield MDR type relays; and generally, its objective is to relax only the testing interval for the Westinghouse AR and Potter & Brumfield MDR relays used as slave relays in the Westinghouse SSPS. Therefore, where auxiliary relays, or other interposing devices, other than Westinghouse AR and Potter & Brumfield MDR type relays in a clean controlled environment similar to that of the SSPS, are tested as part of the slave relay test, they must continue to be tested on the existing schedule until such time as relaxation in their surveillance frequency is likewise justified by some other program.

Testing of the protection system relays places a substantial burden on the plant operating staff and sometimes results in plant trips or transients which reduce the overall reliability and safety of the plant. While the STC is made to high standards, failures in the STC circuitry can be a contributor to the increase in plant trips due to relay testing. Failures in the BLOCK testing circuits, in particular, can lead to actuation of final devices which were not intended to actuate during the test. The objective of this program is to eliminate slave relay testing with the reactor at power for those plants utilizing the Westinghouse SSPS. In those cases where no additional auxiliary relays are in the circuit, implementing this program will substantially reduce the potential for plant upsets due to relay testing.

2. PROGRAM DESCRIPTION AND RESULTS

The scope of this WOG Program, its benefits and conclusions, and a safety assessment follow.

2.1 Program Scope

The program applies to the Westinghouse AR and Potter & Brumfield MDR relays used in the Westinghouse SSPS as slave relays. The program was conducted in three parts, each of which is briefly described below:

> Part 1, Generic Industry Review, was a review of existing industry information on generic relay aging and reliability to establish a basic understanding of industry experience with relays in general. Thus, it was not limited to the Westinghouse AR and Potter & Brumfield MDR relays, but covered general industry experience with relays of that type. Applications of this type of relay cover control, buffer and others that we refer to generally as auxiliary relay applications.
>
> Part 2, Slave Relay Surveillance Test Failure Study, was a relay failure study specific to the slave relay surveillance test for each plant of the participating utilities in the WOG subgroup. This failure study determined the specific failure history of the two relay types used in the Westinghouse SSPS as slave relays in the as-installed environment.
>
> Part 3, Failure Modes and Effects Analysis, was specific to the Westinghouse AR and Potter & Brumfield MDR relays to provide an insight into the potential reliability of these relays, and to provide a basis for determining if any preventative maintenance is required, or warranted, when they are used in the ESFAS application.

The results of these studies are documented in WCAP-13877 (Ref. 3) for the Westinghouse AR series relay, and WCAP-13878 (Ref. 4) for the Potter & Brumfield MDR series relay. This document, WCAP-13900, summarizes the program and its conclusions, and provides the Safety Evaluation and marked-up Technical Specifications for implementation of the recommended changes to the current slave relay surveillance testing requirements.

2.2 Program Benefits

Extension of the slave relay surveillance test interval to refueling from bi-monthly or quarterly will provide plants qualified to implement the suggested Technical Specifications with the following benefits:

a. Cost reduction from reduced manpower necessary to conduct the reduced frequency testing, and the attendant reductions in the costs associated with the review, approval and storage of test data. Assuming an 18 month surveillance interval, utilities estimate this benefit to be $20,000 per year as a minimum, and $40,000 per year where plant design and testing require special efforts.

b. Reduced potential for inadvertent actuation of the ESF while at power and the consequential licensing costs associated with such events; and, increased plant safety by reducing challenges to the safety systems, and reducing thermal cycling stress from spurious ESF actuation.

c. Increased availability of tested systems. Since slave relay testing normally removes safety related systems and components from service, they are unavailable to perform their safety function during testing.

2.3 Program Results

As reported in References 3 and 4, the study considered each relay type used as slave relays in the SSPS to have two operating modes, normally energized and normally de-energized. A relay is considered to be normally energized if its coil is continuously energized to maintain a desired contact position under normal plant operating conditions. A relay is considered normally de-energized if its coil is de-energized under normal plant operating conditions. The calculation of the expected service life of each relay type was then based on the portion of time that its coil is energized, i.e., its duty cycle.

a. Normally De-energized Applications (0% Duty Cycle)

The majority of the slave relays covered by this program are normally de-energized and must, therefore, be energized to actuate the ESF components driven directly by them. In some cases the ESF components may be driven by the slave relays via auxiliary relays which are also Westinghouse AR or Potter & Brumfield MDR series relays. The STI relaxation justified by the relay reliability demonstrated in this program applies in all cases to these relay types, both in slave and auxiliary applications, where they are in a clean, environmentally controlled cabinet. The reliability of other relay types, however, has yet to be evaluated. Thus, the conclusions of this program do not extend to any other relay types; nor, for that matter, to any other devices in the circuit (e.g., limit switches, etc.) normally tested during the slave relay testing. Surveillance testing of ESFAS circuits containing such devices and relay types other than the Westinghouse AR and Potter & Brumfield MDR must, therefore, continue at currently licensed intervals.

As is concluded in References 3 and 4, the reliability of these relays precludes the need for frequent periodic testing to verify operability. Once these actuation schemes have been verified to function correctly by preoperational testing, they should continue to perform properly for their service life which is considerably longer than the life of the nuclear power plant.

The wiring which is tested with the slave relays is also inherently reliable so that the reduction in its test frequency likewise has no adverse impact on ESF availability. Therefore, testing these actuation schemes only when the plant is shutdown for refueling, instead of more frequently and at power, actually enhances the total safety of the plant by reducing both the time that safety systems are out of service for testing, and the potential for their inadvertent actuation.

b. Normally Energized Applications (100% Duty Cycle)

The reliability assessment of the Westinghouse AR and Potter & Brumfield MDR series relays is also valid for applications where they are utilized as slaves or as interposing auxiliary relays and are normally energized, or energized for a significant period of time. Again, the STI relaxation justified by the relay reliability demonstrated in this study applies in all cases to these relay types, both in slave and auxiliary applications, where they are in a clean, environmentally controlled cabinet. The reliability of other relay types has yet to be evaluated, however. Thus, the conclusions of this program do not extend to any other relay types; nor, for that matter, to any other devices in the circuit (e.g., limit switches, etc.) normally tested during the slave relay testing. Surveillance testing of ESF circuits containing such devices and relay types other than the Westinghouse AR and Potter Brumfield MDR must, therefore, continue at currently licensed intervals.

As is concluded in References 3 and 4, the reliability of these relays precludes the need for frequent periodic testing to verify operability. Once these actuation schemes have been verified to function correctly by preoperational testing, they should continue to perform properly for their service life. However, because normally energized relays have a shorter service life than normally de-energized relays, some may need to be replaced before the end of plant life. References 3 and 4 include an aging assessment, and an example calculation of relay service life for a normally energized relay. It should be noted that for normally energized Potter & Brumfield MDR relays manufactured before June, 1989 the service life is significantly shorter than for those manufactured after June, 1989. Furthermore, only Potter & Brumfield MDR relays manufactured after May, 1990 should be used in normally energized applications.

The wiring which is tested with the slave relays is also inherently reliable so that the reduction in its test frequency likewise has no adverse impact on ESF availability. Therefore, testing these actuation schemes only when the plant is shutdown for refueling, instead of more frequently and at power, actually enhances the total safety of the plant by reducing both the time that safety systems are out of service for testing, and the potential for their inadvertent actuation.

c. Normally Energized $\leq$20% of the Time (Low Duty Cycle)

As with the Normally De-energized applications (2.3.a, above), a Low Duty Cycle application in the SSPS of these relay types (i.e., normally energized $\leq$20% of the time), is likewise shown to result in no appreciable age-related degradation; and, as discussed in references 3 and 4, an estimated service life greater than the 40 year life of the plant is also calculated for this Low Duty Cycle application. So, for purposes of this study, Low Duty Cycle applications are equivalent to normally De-energized applications.

2.4 Safety Assessment of Technical Specification Surveillance Requirements

For the purposes of the NRC's evaluation of Technical Specification surveillance requirements documented in NUREG 1366 (Ref. 1), Science Applications International Corporation (SAIC) was contracted to develop a procedure for evaluating surveillance requirements of Technical Specifications. Six review criteria for evaluating the surveillance test interval (STI) were proposed:

i) Direct safety impact

ii) Indirect safety impact

iii) Reliability

iv) Occupational exposure

v) Operator burden

vi) NRC burden

A review of the slave relay testing STI against these criteria has determined that the reliability of these relays used in the ESFAS application is so high that elimination of the routine testing of slave relays when the reactor is at power will have a positive impact on ESFAS availability and, therefore, plant safety. There is no decrease in relay reliability from the reduced testing but there is a significant reduction in operator burden, and the potential for challenges to the safety systems coupled with less time that the safety systems are unavailable. Furthermore, reduced plant testing could reduce occupational exposure, and potentially, the NRC regulatory burden as well. There is no significant negative impact from the reduced testing.

A safety evaluation of the proposed amendment to the standards for a determination of no significant hazard as defined in 10 CFR 50.92 is included in Appendix B.

3. TECHNICAL SPECIFICATIONS

3.1 Recommended Technical Specification Changes

For those actuation schemes with normally de-energized, or normally energized, Westinghouse AR and/or Potter & Brumfield MDR relays that either directly operate the actuated equipment, or do so through interposing auxiliary relays of this same relay type, the Technical Specifications of each of the plants listed below may be revised to extend the slave relay surveillance test interval to an interval coincident with refueling

Applicable Plant List

Beaver Valley 1 & 2
Braidwood 1 & 2
Byron 1 & 2
Callaway 1
Catawba 1 & 2
Comanche Peak 1 & 2
Diablo Canyon 1 & 2
McGuire 1 & 2
Millstone 3
Salem 1 & 2
Shearon Harris
South Texas 1 & 2
V. C. Summer
Vogtle 1 & 2
Watts Bar 1 & 2
Zion 1 & 2

A sample marked up Technical Specification using both the NUREG-0452, and NUREG - 1431 formats is included in Appendix A. A No Significant Hazards Evaluation for plants following the lead plant submittal is included in Appendix B.

4. REFERENCES

4.1 NUREG-1366, "Improvements to Technical Specifications Surveillance Requirements".

4.2 NUREG-1024, "Technical Specifications-Enhancing Safety Impact".

4.3 WCAP-13877, "RELIABILITY ASSESSMENT OF WESTINGHOUSE TYPE AR RELAYS USED AS SSPS SLAVE RELAYS"

4.4 WCAP-13878, "RELIABILITY ASSESSMENT OF POTTER & BRUMFIELD MDR SERIES RELAYS"

APPENDIX A

TABLE 4.3-2

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
1. Safety Injection (ECCS, Reactor Trip, Feedwater Isolation, Control Room Emergency Recirculation, Emergency Diesel Generator Operation, Containment Vent Isolation, Station Service Water, Phase A Isolation, Auxiliary Feedwater-Motor Driven Pump, Turbine Trip, Component Cooling Water, Essential Ventilation Systems, and Containment Spray Pump).								
a. Manual Initiation	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	1, 2, 3, 4
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q (5)	1, 2, 3, 4
c. Containment Pressure--High-1	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
d. Pressurizer Pressure--Low	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
e. Steam Line Pressure--Low	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
2. Containment Spray								
a. Manual Initiation	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	1, 2, 3, 4
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q (5)	1, 2, 3, 4
c. Containment Pressure--High-3	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
3. Containment Isolation								
a. Phase "A" Isolation								
1) Manual Initiation	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	1, 2, 3, 4
2) Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q (5)	1, 2, 3, 4
3) Safety Injection	See Item 1. above for all Safety Injection Surveillance Requirements.							

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
3. Containment Isolation (Continued)								
b. Phase "B" Isolation								
1) Manual Initiation	See Item 2.a above. Phase "B" isolation is manually initiated when containment spray function is manually initiated.							1, 2, 3, 4
2) Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q (5)	1, 2, 3, 4
3) Containment Pressure--High-3	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
c. Containment Vent Isolation								
1) Manual Initiation	See Items 3.a.1 and 2.a above. Containment vent isolation is manually initiated when Phase "A" isolation function or containment spray function is manually initiated.							1, 2, 3, 4
2) Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q (5)	1, 2, 3, 4
3) Safety Injection	See Item 1. above for all Safety Injection Surveillance Requirements.							

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
4. Steam Line Isolation								
a. Manual Initiation	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	1, 2, 3
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q(5)	1, 2, 3
c. Containment Pressure--High-2	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
d. Steam Line Pressure--Low	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
e. Steam Line Pressure--Negative Rate-High	S	R	Q	N.A.	N.A.	N.A.	N.A.	3
5. Turbine Trip and Feedwater Isolation								
a. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q(5)	1, 2
b. Steam Generator Water Level--High-High	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2
c. Safety Injection	See Item 1. above for all Safety Injection Surveillance Requirements.							

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
6. Auxiliary Feedwater								
a. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q(5)	1, 2, 3
b. Steam Generator Water Level--Low-Low	S	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
c. Safety Injection	See Item 1. above for all Safety Injection Surveillance Requirements.							
d. Loss-of-Offsite Power	N.A.	R	N.A.	M(3, 4)	N.A.	N.A.	N.A.	1, 2, 3
e. Trip of All Main Feedwater Pumps	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	1, 2
7. Automatic Initiation of ECCS Switchover to Containment Sump								
a. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	M(1)	M(1)	Q(5)	1, 2, 3, 4
b. RWST Level--	S	SR	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3, 4
Low-Low Coincident With Safety Injection	See Item 1. above for all Safety Injection Surveillance Requirements.							

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
8. Loss of Power (6.9kV & 480V Safeguards System Undervoltage)								
a. 6.9kV Preferred Offsite Source Undervoltage	N.A.	R	N.A.	(3, 2)	N.A.	N.A.	N.A.	1, 2, 3, 4
b. 6.9kV Alternate Offsite Source Undervoltage	N.A.	R	N.A.	(3, 2)	N.A.	N.A.	N.A.	1, 2, 3, 4
c. 6.9kV Bus Undervoltage	N.A.	R	N.A.	(3, 2)	N.A.	N.A.	N.A.	1, 2, 3, 4
d. 6.9kV Degraded Voltage	N.A.	R	N.A.	(3, 2)	N.A.	N.A.	N.A.	1, 2, 3, 4
e. 480V Degraded Voltage	N.A.	R	N.A.	(3, 2)	N.A.	N.A.	N.A.	1, 2, 3, 4
f. 480V Low Grid Undervoltage	N.A.	R	N.A.	(3, 2)	N.A.	N.A.	N.A.	1, 2, 3, 4
9. Control Room Emergency Recirculation								
a. Manual Initiation	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	All
b. Safety Injection	See Item 1. above for all Safety Injection Surveillance Requirements.							

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

CHANNEL FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	ANALOG CHANNEL OPERATIONAL TEST	TRIP ACTUATING DEVICE OPERATIONAL TEST	ACTUATION LOGIC TEST	MASTER RELAY TEST	SLAVE RELAY TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
10. Engineered Safety Features Actuation System Interlocks								
a. Pressurizer Pressure, P-11	N.A.	R	Q	N.A.	N.A.	N.A.	N.A.	1, 2, 3
b. Reactor Trip, P-4	N.A.	N.A.	N.A.	R	N.A.	N.A.	N.A.	1, 2, 3
11. Solid State Safeguards Sequencer (SSSS)								
a. Safety Injection Sequence	N.A.	R	N.A.	M(1, 3, 4)	N.A.	N.A.	N.A.	1, 2, 3, 4
b. Blackout Sequence	N.A.	R	N.A.	M(1, 3, 4)	N.A.	N.A.	N.A.	1, 2, 3, 4

TABLE 4.3-2 (Continued)

TABLE NOTATIONS

(1) Each train shall be tested at least every 62 days on a STAGGERED TEST BASIS.

(2) Whenever the plant is in COLD SHUTDOWN for 72 hours or more and if this surveillance testing has not been performed in the previous 92 days.

(3) Setpoint verification is not applicable.

(4) Actuation of final devices not included.

(5) For ESFAS functional units with only Westinghouse AR series relays or Potter & Brumfield MDR series relays used in a clean, environmentally controlled cabinet, as discussed in WOG Report WCAP 13900, the surveillance test interval for the slave relay is R.

SURVEILLANCE REQUIREMENTS

-----NOTE-----
Refer to Table 3.3.2-1 to determine which SRs apply for each ESFAS Function.

SURVEILLANCE		FREQUENCY
SR 3.3.2.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.2.2	Perform ACTUATION LOGIC TEST.	31 days on a STAGGERED TEST BASIS
SR 3.3.2.3	-----NOTE----- The continuity check may be excluded. ----- Perform ACTUATION LOGIC TEST.	31 days on a STAGGERED TEST BASIS
SR 3.3.2.4	Perform MASTER RELAY TEST.	31 days on a STAGGERED TEST BASIS
SR 3.3.2.5	Perform COT.	92 days
SR 3.3.2.6	Perform SLAVE RELAY TEST.	[92] days OR 18 months for only Westinghouse AR and Potter & Brumfield MDR relay types

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.6

SR 3.3.2.6 is the performance of a SLAVE RELAY TEST. The SLAVE RELAY TEST is the energizing of the slave relays. Contact operation is verified in one of two ways. Actuation equipment that may be operated in the design mitigation MODE is either allowed to function, or is placed in a condition where the relay contact operation can be verified without operation of the equipment. Actuation equipment that may not be operated in the design mitigation MODE is prevented from operation by the SLAVE RELAY TEST circuit. For this latter case, contact operation is verified by a continuity check of the circuit containing the slave relay. This test is performed every [92] days. The time allowed for the testing (4 hours) and the Frequency are justified in Reference 8.

For slave relays, or any auxiliary relays in the ESFAS circuit, that are of the type Westinghouse AR or Potter & Brumfield MDR the SLAVE RELAY TEST is performed every 18 months. This test frequency is based on the relay reliability assessments presented in References 9, 10 and 11. These reliability assessments are relay specific and apply ONLY to the Westinghouse AR and Potter & Brumfield MDR type relays. Note that for normally energized applications, the relays may have to be replaced periodically in accordance with the guidance given in References 9 and 10 for the AR and MDR relay types, respectively.

SR 3.3.2.7

SR 3.3.2.7 is the performance of a TADOT every [92] days. This test is a check of the Loss of Offsite Power, Undervoltage RCP, and AFW Pump Suction Transfer on Suction Pressure – Low Functions. Each Function is tested up to, and including, the master transfer relay coils.

The test also includes trip devices that provide actuation signals directly to the SSPS. The SR is modified by a Note that excludes verification of setpoints for relays. Relay setpoints require elaborate bench calibration and are verified during CHANNEL CALIBRATION. The Frequency is justified in Reference 8.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.8

SR 3.3.2.8 is the performance of a TADOT. This test is a check of the Manual Actuation Functions and AFW pump start on trip of all MFW pumps. It is performed every [18] months. Each Manual Actuation Function is tested up to, and including, the master relay coils. In some instances, the test includes actuation of the end device (i.e., pump starts, valve cycles, etc.). The Frequency is justified in Reference 8.

SR 3.3.2.9

SR 3.3.2.9 is the performance of a CHANNEL CALIBRATION.

A CHANNEL CALIBRATION is performed every [18] months, or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to measured parameter within the necessary range and accuracy.

CHANNEL CALIBRATION measurement and setpoint error determination and readjustment must be performed consistent with the assumptions of the unit specific setpoint methodology. The difference between the current "as found" values and the previous test "as left" values must be consistent with the drift allowance used in the setpoint methodology.

The Frequency of [18] months is based on the assumption of an [18] month calibration interval in the determination of the magnitude of equipment drift in the setpoint methodology.

This SR is modified by a Note stating that this test should include verification that the time constants are adjusted to the prescribed values where applicable.

SR 3.3.2.10

This SR ensures the individual channel ESF RESPONSE TIMES are less than or equal to the maximum values assumed in the accident analysis. Response Time testing acceptance

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.2.10 (continued)

criteria are included in Technical Requirements Manual, Section 15 (Ref. 12). Individual component response times are not modeled in the analyses. The analyses model the overall or total elapsed time, from the point at which the parameter exceeds the Trip Setpoint value at the sensor, to the point at which the equipment in both trains reaches the required functional state (e.g., pumps at rated discharge pressure, valves in full open or closed position).

For channels that include dynamic transfer functions (e.g., lag, lead/lag, rate/lag, etc.), the response time test may be performed with the transfer functions set to one with the resulting measured response time compared to the appropriate FSAR response time. Alternately, the response time test can be performed with the time constants set to their nominal value provided the required response time is analytically calculated assuming the time constants are set at their nominal values. The response time may be measured by a series of overlapping tests such that the entire response time is measured.

ESF RESPONSE TIME tests are conducted on an [18] month STAGGERED TEST BASIS. Testing of the final actuation devices, which make up the bulk of the response time, is included in the testing of each channel. The final actuation device in one train is tested with each channel. Therefore, staggered testing results in response time verification of these devices every [18] months. The [18] month Frequency is consistent with the typical refueling cycle and is based on unit operating experience, which shows that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequent occurrences.

This SR is modified by a Note that clarifies that the turbine driven AFW pump is tested within 24 hours after reaching [1000] psig in the SGs.

SR 3.3.2.11

SR 3.3.2.11 is the performance of a TADOT as described in SR 3.3.2.8, except that it is performed for the P-4 Reactor

(continued)

BASES

REFERENCES

1. FSAR, Chapter [6].
2. FSAR, Chapter [7].
3. FSAR, Chapter [15].
4. IEEE-279-1971.
5. 10 CFR 50.49.
6. RTS/ESFAS Setpoint Methodology Study.
7. NUREG-1218, April 1988.
8. WCAP-10271-P-A, Supplement 2, Rev. 1, June 1990.
9. WCAP 13877, "Reliability Assessment of Westinghouse Type AR Relays Used As Slave Relays"
10. WCAP 13878, "Reliability Assessment of Potter & Brumfield MDR Series Relays"
11. WCAP 13900, "Extension of Slave Relay Surveillance Test Intervals"
12. Technical Requirements Manual, Section 15, "Response Times."

(continued)

APPENDIX B

APPENDIX B

PLANT NAME
SLAVE RELAY SURVEILLANCE TEST INTERVAL EXTENSION
SIGNIFICANT HAZARDS CONSIDERATION ANALYSIS

INTRODUCTION

The Standard Technical Specifications for Westinghouse Pressurized Water Reactor (PWR) plants, both NUREG-0452, Rev. 4 and 5, and NUREG-1431, the new improved standard, specifically require quarterly testing of slave relays in the Engineered Safety Features Actuation System (ESFAS). This requirement involves testing the relays at power, with the attendant risk of inadvertent actuation of the Engineered Safety Features (ESF) equipment. In addition, the on-line testing of slave relays requires significant plant manipulation, abnormal configurations, and removes from service various equipment making it unavailable to perform its intended safety function.

Recently a Subgroup of the Westinghouse Owners Group sponsored a reliability assessment of specific relay types to establish a slave relay surveillance test interval based on relay reliability. The study is documented in WCAPs 13877 and 13878 and addresses Westinghouse AR Series and Potter & Brumfield MDR Series relays. PG&E Diablo Canyon acting as Lead Plant for this WOG program referenced it in their plant license amendment request to extend the slave relay surveillance test interval to the refueling interval. The license amendment was approved by NRC SER, transmitted by NRC letter from ______ to ________, dated xx-xx-94. (*Note: At the time of the writing of this report, WCAP 13900, the NRC SER had not been published since the Lead Plant submittal - anticipated for mid-summer, 1994 - had not yet been made. It is therefore suggested that WOG members contact the Westinghouse WOG Project Office for this reference.*)

DESCRIPTION OF THE AMENDMENT REQUEST

As required by 10 CFR 50.91 (a)(1), an analysis is provided to demonstrate that the proposed license amendment to increase the slave relay surveillance test interval from quarterly to refueling involves no significant hazards consideration. The proposed amendment changes the Technical Specification Surveillance Frequency Requirement for slave relays, of the type Westinghouse AR and Potter & Brumfield MDR series, from "92 days" ("Q"), to "18 months" ("R").

APPENDIX B

EVALUATION

WCAPs-13877 & 13878 provide the technical justification for relaxing the slave relay surveillance test interval from quarterly to the refueling interval (18 or 24 months) for Westinghouse AR type and Potter & Brumfield MDR series slave relays only. The basis for relaxing the surveillance interval is the reliability assessment, which establishes that for normally de-energized relays of these two types, the reliability is invariant with time and there are no significant factors that will cause the relays to age or wear out within the plant lifetime. Aging will, however, affect the reliability of these relays in normally energized applications within the plant lifetime. So, to assure the original relay reliability a replacement interval for these relays has been determined in accordance with the guidelines provided in the above mentioned WCAP Reports. (***Note: For normally energized relays licensees must commit to a program by which their replacement interval is established, and they are, indeed, replaced.***)

ANALYSIS

Conformance of the proposed amendment to the standards for a determination of no significant hazard as defined in 10 CFR 50.92 is argued as follows:

1) The proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

This change to the Technical Specifications does not result in a condition where the design, material, and construction standards that were applicable prior to the change are altered. The same ESFAS instrumentation is being used and the same ESFAS system reliability is expected. The proposed change will not modify any system interface and could not increase the likelihood of an accident since these events are independent of this change. The proposed activity will not change, degrade or prevent actions or alter any assumptions previously made in evaluating the radiological consequences of an accident described in the SAR. Therefore, the proposed amendment does not result in any increase in the probability or consequences of an accident previously evaluated.

2) The proposed license amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated. This change does not alter the performance of the ESFAS mitigation systems assumed in the plant safety analysis. Changing the interval for periodically verifying ESFAS slave relays (assuring equipment operability)

will not create any new accident initiators or scenarios. Implementation of the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3) The proposed license amendment does not involve a significant reduction in margin of safety.

This change does not affect the total ESFAS system response assumed in the safety analysis. The periodic slave relay functional verification is relaxed because of the demonstrated high reliability of the relay and its insensitivity to any short term wear or aging effects. It is thus concluded that the proposed license amendment request does not result in a reduction in margin with respect to plant safety.

CONCLUSION

Based on the preceding evaluation, it is concluded that relaxing the slave relay test interval from quarterly, Q, to the refueling interval, R, is acceptable for Westinghouse AR and Potter & Brumfield MDR type relays, and the proposed license amendment does not involve a Significant Hazards Consideration Finding as defined in 10 CFR 50.92.