CEOG COMBUSTION ENGINEERING OWNERS GROUP

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Arizona Public Service Co. Palo Verde 1, 2, 3	Consumers Energy Co. Palisades	Florida Power & Light Co. St. Lucie 1, 2	Northeast Utilities Service Co. Millstone 2	Southern California Edison SONGS 2, 3

May 12, 2000
CEOG-00-144

NRC CEOG Project Number 692

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Submittal of CE NPSD-1167, Rev 02 for Staff Review (Non-Proprietary)

References:

1: CEOG Letter, R. Phelps to U.S. NRC, "Transmittal of RTT Elimination Topical Report CE NPSD-1167, Rev 01," CEOG-99-304, 9/30/99.

2: CEOG letter, R. Phelps to U.S. NRC, "NRC Review of Topical Report CE NPSD-1167," CEOG-00-096, 4/07/00.

3: ABB/CEOG Letter, S. Lurie to NRC, "Resolution of Errors Identified in Topical Report CE NPSD-1167 Concerning Elimination of Response Time Testing Requirements in CEOG Plants," CEOG-00-108, 4/21/00.

The CE Owners Group submitted non-proprietary topical report CE NPSD-1167, Rev 01 for NRC review and approval via Reference 1. In response to an NRC request for additional information, the CEOG provided historical calibration data for certain transmitters with variable damping installed at one plant, Reference 2. Subsequent to the submittal of Reference 2, review by CENP and the utility determined that the response data for one transmitter was inaccurate since it principally represented a transmitter with fixed rather than variable damping. Because of this and several other minor errors found in the report, the CEOG undertook a thorough review and confirmation, Reference 3, of all data contained in CE NPSD-1167.

This review has been completed, all transmitter response time data confirmed, and the topical report updated to Revision 02. Pursuant to NUREG-0390, twelve (12) copies of non-proprietary report CE NPSD-1167, Revision 2, are submitted herewith for staff review.

If you have any questions, please contact me.

Very truly yours,

R J Phelps

Ralph Phelps, Chairman
CE Owners Group

Attachment:

cc: J. S. Cushing (NRC) w/ 2 copies
G. C. Bischoff (W)

DO47 1/12

CEOG COMBUSTION ENGINEERING OWNERS GROUP

CE NPSD-1167
Rev. 02

Elimination of Pressure Sensor Response Time Testing Requirements

CEOG Task 1070
Final Report

Prepared for the
CE Owners Group
MAY 2000

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Record of Revisions

Rev No	Description of Change	Date
00	Original Issue	June 1999
01	Revised to include vendor data in allocated transmitter values	September 1999
02	Revised to incorporate NRC reviewer and utility comments. Revised Appendix C calculated values per NRC comments	May 2000

ABSTRACT

Current Technical Specifications require utilities to validate the RPS and ESFAS response time to ensure that the protective function performance is consistent with assumptions used in plant safety analyses. This report provides justification for eliminating the requirement to perform response time testing of pressure and differential pressure transmitters used in the reactor protection and engineered safeguards systems.

Phase One of this effort involved a detailed review of response time data from tests performed at eleven CEOG plants. Phase One results are documented in CE NPSD-1135 Revision 1, "Review of Utility Response Time Test Results;" these results validate the findings of EPRI Report NP-7243, Rev 01, "Investigation of Response Time Testing Requirements" as it pertains to the participating CEOG utilities. Based on an evaluation of response time measurements performed and a failure modes analysis of qualified pressure transmitters used in US nuclear plants, EPRI concluded that "...response time testing is redundant to other periodic testing for all cases except slow loss of fill fluid and variable damping potentiometer misadjustment."

Approximately 1400 data points comprising all the available response time test data for the participating CEOG plants were reviewed during this study. This review verified that none of the tested pressure and differential pressure transmitters had failed a response time test. This review also confirmed that all of the presently installed reactor protection and engineered safety features transmitters that currently require response time testing were evaluated by the EPRI report. The test methodology employed by the CEOG plants to perform response time tests is consistent with the test methodologies evaluated by EPRI.

Based on the above, it is concluded that the results and recommendations of EPRI report NP-7243, Rev 01 are applicable to the participating CEOG plants. The EPRI report provides the basis for the participating CEOG plants to justify eliminating the requirement to perform response time testing of selected reactor protection system and engineered safety features actuation system pressure and differential pressure transmitters.

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Elimination of Pressure Sensor Response Time Testing Requirements

1.0 INTRODUCTION

EPRI Report NP-7243, "Investigation of Response Time Testing Requirements," (Ref 1)[1] evaluated the response time test data for various pressure sensors to determine whether such testing is needed to justify assumptions used in Final Safety Analysis Report (FSAR) Chapter 15 safety analyses. EPRI concluded, "...response time testing is not a concern but that overall sensor degradation is important. In reviewing approximately 4200 response time testing data points, the EPRI researchers did not identify any response time failures."

Technical Specifications for all Combustion Engineering Owners Group (CEOG) plants licensed after 1975 currently require that response time testing be performed on safety systems to ensure system response times are within the limits assumed in the plants safety analysis. For safety system pressure and differential pressure transmitters located in the containment building this testing has proven to be a resource burden while also presenting ALARA concerns for the utilities.

EPRI report NP-7243 serves as the technical basis for elimination of these RTT requirements by performing an evaluation of the expected performance of pressure sensors used in response time applications. The results demonstrate that overall sensor performance rather than individual failure modes, such as response time, should be the primary acceptance criterion. This report provides the basis for eliminating response time test requirements for selected safety system pressure and differential pressure transmitters in use at the participating CEOG plants.

The Westinghouse Owners Group submitted topical report WCAP-13787, Rev 02, "Elimination of Pressure Sensor Response Time Testing Requirements" (Ref 2) for NRC review in August 1995, with NRC approval received in September 1995 (Ref 3). In their approval, the NRC stated, "...any sensor failure that significantly degrades sensor response time can be detected during the performance of other surveillance tests, principally calibration." The NRC further stated that, "...the performance of periodic RTT for the selected pressure and differential pressure sensors identified in the topical report can be eliminated from Technical Specifications (TS) and that allocated sensor response times may be used to verify acceptable RTS and ESFAS channel response times." Similarly, the B&W Owners Group submitted a topical report (Ref 4) to the NRC in January 1994 justifying the elimination of selected response time testing requirements; the NRC approved this report in December 1994.

2.0 BACKGROUND

Response Time Testing (RTT) of reactor trip systems has been required since 1975. The requirements for this testing were established by IEEE Standard 338-1975, "Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems". The guidelines for periodic testing of safety system response times established by this standard were endorsed by the NRC in Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems," Revision 1, November 1977.

[1] Refer to Section 7.0 for References.

In 1998 the CEOG authorized a Task to eliminate the requirement to perform response time testing (RTT) of reactor trip and engineered safeguards system pressure and differential pressure transmitters located in the reactor containment building. Response time testing has proven to be costly in resource requirements, radiation exposure and critical schedule during plant outages. In response to industry feedback that questioned the benefit of RTT, EPRI initiated a program to study the benefits of RTT and to investigate if this testing requirement could be eliminated. The results of this EPRI program were published in report NP-7243 (Ref 1). EPRI updated this report in 1994, however, the conclusions remained unchanged.

In the discussion on response time in IEEE Std 338-1987 the case is made for not performing response time testing if an alternate means of verifying equipment response time can be shown. The IEEE standard states "response time testing of all safety-related equipment is not required if, in lieu of response time testing, the response time of safety system equipment is verified by functional testing calibration checks or other test, or both. This is acceptable if it can be demonstrated that changes in response time beyond acceptable limits are accompanied by changes in performance characteristics that are detectable during routine periodic test."

The EPRI project studied the RTT programs of 39 participating plants. Areas examined by EPRI included test methodology, including test equipment and setup, historical data results of RTT and cost in resources and exposure of performing the required testing. EPRI also performed failure modes and effects analysis (FMEA) on a variety of pressure and differential pressure transmitters. The transmitters evaluated by the FMEAs were supplied by six vendors. The transmitters evaluated are as follows:

Sensor Types Covered by EPRI Report NP-7243

Barton 288/289 Differential Pressure Indicating Switches

Barton 763 Gage Pressure Electronic Pressure Transmitter

Barton 764 Differential Pressure Electronic Transmitter

Foxboro N-E11DM Differential Pressure Transmitter

Foxboro N-E13DM Differential Pressure Transmitter

Foxboro N-E13DH Differential Pressure Transmitter

Foxboro N-E11GH Gage Pressure Transmitter

Foxboro N-E11GM Gage Pressure Transmitter

Tobar 32PA1 Absolute Pressure Transmitter

Tobar 32PG1 Gage Pressure Transmitter

Tobar 32DP1 Differential Pressure Transmitter

Rosemount Differential Pressure Transmitter Models 1151,1152,1153,1154

Rosemount Pressure Transmitter Models 1151,1152,1153,1154

Statham PD-3200 Differential Pressure Transmitter

Statham PG-3000 Pressure Transmitter

SOR Differential Pressure Switch

SOR Pressure Switch

These transmitters were selected for evaluation because they represent the majority of safety related transmitters currently being used by the industry. The transmitter vendors contributed to the FMEAs by supplying technical information on their products; these vendors also reviewed the completed FMEAs and agreed with EPRI's conclusions.

In summary, the EPRI study reached the following conclusions:

- Based on a review of historical data provided by the participating plants, RTT did not identify any transmitters that failed response time requirements. It was established that calibrations and other tests would detect transmitters with excessive response times.
- The limited amount of data generated and the variance in test conditions associated with RTT minimize the usefulness of the data for trending degrading response times and general sensor health.
- Current RTT methodology may not detect response time degradation due to the slow loss of fill fluid in some sensors.

Based on the above findings, the CEOG initiated a program to eliminate the requirement to perform response time testing of safety-related pressure and differential pressure transmitters. This program was conducted in two phases; Phase 1 consisted of reviewing and evaluating the participating plants RTT program. Phase 2 is the utilization of the findings of Phase 1 as the basis for a Topical Report to eliminate the requirement to perform response time testing of selected pressure and differential pressure transmitters. The Phase 2 effort included the evaluation of vendor specifications for response time as well as evaluations of the historical data supplied by the utilities in Phase 1 for cases where vendor data is not available.

The purpose of the Phase 1 review was to validate that the RTT programs at the participating plants were consistent with those evaluated by EPRI and that the conclusions of EPRI report NP-7243, Rev. 1 are applicable to the participating CEOG plants. Phase 1 was completed in December of 1998 with the issuance of CE NPSD-1135, "Review of Utility Response Time Test Results." This report was subsequently revised in May 1999 (Ref 5) to incorporate additional utility comments. The conclusions reached by the Phase 1 effort can be summarized as follows:

- A review of approximately 1400 data points supplied by the eleven participating plants indicated that no failures of RTT occurred. This review also verified that trending of sensor performance utilizing RTT data does not appear to provide dependable information for predicting future sensor performance. This is a result of the variance in test condition and methods at the time the data is collected as well as the limited number of data points available for each individual sensor due to only testing each sensor once every four cycles.
- The FMEAs performed for the EPRI effort evaluated all of the sensors currently being used in safety applications by the participants with the exception of a Barton Model 763A transmitter utilized by APS. This exception is addressed in Section 3.2.
- The RTT methodologies currently utilized by the participants are in agreement with those evaluated by EPRI.

Based on the above it has been determined that the conclusions reached by EPRI in NP-7243 are applicable to the RTT program for the following CEOG plants that participated in this effort:

- Entergy, Arkansas Nuclear One, Unit 2 and Waterford SES, Unit 3;
- Arizona Public Service Company, Palo Verde Units 1, 2 & 3;

- Baltimore Gas & Electric, Calvert Cliffs Units 1 & 2;
- Florida Power & Light, St. Lucie Units 1 & 2; and
- Southern California Edison, SONGS Units 2 & 3.

3.0 DISCUSSION

A fixed response time will be allocated to each safety system pressure or differential pressure sensor for which the requirement to perform RTT has been eliminated. This allocated response time will in turn be added to the measured response time of the remainder of the processing loop to confirm that the overall response time for the particular function is still within the bounds of that assumed in the safety analysis. The allocated sensor response time must be shown to be conservative with respect to expected sensor performance.

There are several possible options for obtaining response times to allocate to the sensors whose RTT requirement is to be eliminated. These options include purchase order specifications; vendor published response times, and actual sensor response times as measured in the plant. As for purchase order specifications, these documents are usually written to provide instruments to be used in a variety of applications. Because of this, if a response time requirement is stated, it is usually a conservative number to encompass all of the intended applications for that particular type of transmitter. Due to the excess conservatism associated with these specifications, and the limited number of specifications that list response time requirements, this method will not be utilized in this report. Several vendors publish response time specifications for their transmitters. These published response time specifications have been reviewed for their applicability to the transmitters used by the participating utilities. In cases were it can be shown that the vendor published data is applicable for an installed transmitter, this published data may be used to allocate a response time for that transmitter. If a particular utility is utilizing a transmitter for which the vendor does not publish a response time specification, ABB will analyze the historical data from plant measurements and provide a recommended allocation for sensor response time based on the past performance of the sensor.

ABB has reviewed the RTT testing methodology used by the participating CEOG plants. This review determined that the plants could be separated into two groups based on the RTT test methodology used. One group, consisting of the Palo Verde and San Onofre plants, test their transmitters as stand alone instruments separate from the rest of the process loop. The remaining plants test their transmitters in conjunction with a portion of the process loop electronics. The technical approach for allocating a response time to a specific transmitter in lieu of testing is discussed below.

3.1 TECHNICAL APPROACH TO RTT ELIMINATION

A review of the participating utilities installed transmitters was conducted to determine what types and model numbers are utilized in the RPS and ESFAS. This review showed that all of the participating utilities use Rosemount, Barton or WEED/Foxboro transmitters in their RPS and ESFAS protection loops. All of these transmitters are candidates for response time testing elimination and as stated previously they were all evaluated by EPRI Report NP-7243 with the exception of the Barton model 763A used at APS's Palo Verde units. The transmitter specifications for these vendors were reviewed to determine if a specification for transmitter

response time was listed. From this review it was determined that both Rosemount and Barton do list a response time specification for their transmitters. Neither Foxboro nor WEED publishes a response time specification for their qualified transmitters. Table 3.1 below list the Rosemount and Barton pressure and differential pressure transmitters that were evaluated by EPRI and their vendor published response time specifications. For the Rosemount values listed below it should be noted that the response time values are for standard model and range offerings. Specific time response values for special options, ranges or variable damping electronics may vary. For such cases the vendor technical manual or test report should be consulted for the applicable response time.

Table 3.1

Manufactures Response Time Specifications

Manufacture	Model Number	Range Code	Description	Response Time Spec.
Rosemount	1152 (DP,HP,AP,GP)	3	Differential Pressure or Pressure Transmitter	0.3sec.
Rosemount	1152 (DP,HP,AP,GP)	4,5	Differential Pressure or Pressure Transmitter	0.2 sec.
Rosemount	1152 (DP,HP,AP,GP)	6,,7,8,9,0	Differential Pressure or Pressure Transmitter	0.1 sec.
Rosemount	1153 (D,H,A,G)	3	Differential Pressure or Pressure Transmitter	2.0 sec.
Rosemount	1153 (D,H,A,G)	4	Differential Pressure or Pressure Transmitter	0.5 sec.
Rosemount	1153 (D,H,A,G)	5,6,7,8,9	Differential Pressure or Pressure Transmitter	0.2 sec.
Rosemount	1154 (DP,HP,GP)	4	Differential Pressure or Pressure Transmitter	0.5 sec.
Rosemount	1154 (DP,HP,GP)	5,6,7,8,9,0	Differential Pressure or Pressure Transmitter	0.2 sec.
Rosemount	1154H (D,H,S)	4	Differential Pressure or Pressure Transmitter	0.5 sec.
Rosemount	1154H (D,H,S)	5,6,7,8,9	Differential Pressure or Pressure Transmitter	0.2 sec.
Barton	763	N/A	Pressure Transmitter	0.18 Sec.
Barton	763A	N/A	Pressure Transmitter	0.18 Sec.
Barton	764	N/A	Differential Pressure Transmitter	0.18 Sec.

The following is an evaluation of each participating utilities present RTT program and how it should be modified to incorporate the recommendations of this report.

Arizona Public Service (Palo Verde)

The procedures used by APS to perform RTT of their RPS and ESFAS functions were reviewed. When performing this testing, the sensors are tested as a stand-alone item from the rest of the process loop. As a part of their procedures, the sensor for each function tested is assigned an acceptance criteria for response time. A review of the sensors used in the RPS and ESFAS confirmed that with one exception all sensors are either Barton or Rosemount pressure or differential pressure transmitters, which were evaluated as candidates for elimination of response time testing by EPRI Report NP-7243. The one exception is the Barton model 763A sensors used to detect Pressurized Pressure – High in Unit 2. As discussed in section 3.2 the CEOG feels that this transmitter is also a candidate for elimination of response time testing. All of these sensors have specified response times as published by their manufacture. These response times are listed in Table 3.1.

It is recommended that APS revise their RTT test program as follows. The current procedure used to determine the response time of the RPS and ESFAS transmitters would be discontinued. In its place an allocated response time would be assigned to each sensor. This allocated response time may be obtained from either the vendor-published response time data as listed in Table 3.1 or from an analysis of the historical response time data for that sensor as utilized at APS. This allocated sensor response time would then be added to actual response time of the remainder of the RPS or ESFAS protection loop as measured by the current existing procedures. This will minimize the impact on the current APS test procedures and RTT methodology. Once this methodology has been implemented, further response time testing of these transmitters will not be required as long as the conditions of Section 3.4 of this topical report are met.

Should APS replace any of the existing RPS or ESFAS sensors with one of different manufacture or model number than that which is currently installed, they will need to revisit the sensor response time allocation. If the new sensor is one listed in Table 3.1 then the new sensor response time allocation can be made by utilizing the data available in Table 3.1. If the new sensor is not one of those listed in Table 3.1 then the utility must verify that the sensor is a candidate for response time elimination as defined in this report. Once this determination is made the utility may allocate a response time based on historical data for that transmitter type and model if sufficient historical data is available.

Southern California Edison (San Onofre)

The procedures used by SCE to perform RTT of their RPS and ESAS functions were reviewed. When performing this testing, the sensors are tested as a stand-alone item from the rest of the process loop. The measured response time of the sensor is then added to the measured response time of the processing electronics and trip breakers. The current SCE procedures do not assign an acceptance criteria to the sensor as a stand-alone item. The stated acceptance criteria are for the whole process loop through the actuating device.

A review of the sensors used in the RPS and ESFAS confirmed that all the sensors were reviewed and approved as candidates for elimination of response time testing by EPRI Report NP-7243. All sensors used in the RPS and ESFAS are Rosemount, Foxboro or WEED.

It is recommended that SCE revise their RTT test program as follows. The current procedure used to determine the response time of the RPS and ESFAS transmitters would be discontinued. In its place an allocated response time would be assigned to each sensor. For the Rosemount transmitters, this allocated value can be obtained from the information contained in Table 3.1 or by review and analysis of the available historical response time data for these sensors. For the Foxboro and WEED transmitters, the vendor does not publish a response time specification. ABB has analyzed the historical data SCE provided for these sensors and calculated a sensor response time to be allocated for each sensor type and model. A summary of this analysis is contained in Appendix C.

These allocated sensor response times would then be added to the actual response time of the remainder of the RPS or ESFAS protection loop as measured by the current existing procedures. This will minimize the impact on the current SCE test procedures and RTT methodology. Once this methodology has been implemented, further response time testing of these transmitters will not be required as long as the conditions of Section 3.4 of this topical report are met.

Table 3.1A below lists the recommended sensor response time allocations for the Foxboro and WEED transmitters utilized by SCE. The allocated values are listed by sensor make, model and function and are based on calculations which utilized historical data for the subject transmitters which was provided to ABB by SCE.

Table 3.1A
Calculated Transmitter Response Time Allocations for San Onofre-2 & 3

Transmitter Function	Transmitter Make and Model	Recommended Transmitter Allocation
Containment Pressure (High/High-High)	Foxboro N-E11DM	430 msec
RWT Level	Foxboro E13DM	610 msec
Pressurizer Press. – High	WEED N-E11GM	135 msec
SG Pressure	WEED N-E11GM	135 msec
SG Level	WEED/Foxboro N-E13DM	520 msec

Should SCE replace any of the existing RPS or ESFAS sensors with one of different manufacture or model number than that which is currently installed, they will need to revisit the sensor response time allocation. If the new sensor is one listed in Table 3.1 or 3.1A then the new sensor response time allocation can be made by utilizing the data available in Tables 3.1 and 3.1A. If the new sensor is not one of those listed in Table 3.1 or 3.1A then the utility must verify that the sensor is a candidate for response time elimination as defined in this report. Once this determination is made the utility may allocate a response time based on historical data for that transmitter type and model if sufficient historical data is available.

Baltimore Gas & Electric (Calvert Cliffs)

The procedures used by BGE to perform RTT of their RPS and ESAS functions were reviewed. For the RPS procedure, STP-M-511, the recorded response time is measured from the input of the sensor to the tripping of the associated K relay. For the ESFAS procedure, STP-M-521, the recorded response time is measured from the input of the sensor to the tripping of the associated function trip bistable. For the AFAS procedure, STP-M-526, the recorded response time is measured from the input of the sensor to the tripping of the associated function trip bistable. BGE has recently completed changing their installed RPS and ESFAS transmitters to Rosemount models. The Rosemount sensors presently installed have all been identified as candidates for elimination of response time testing by EPRI Report NP-7243. The data BGE supplied for CE NPSD-1135, Rev. 01 consisted only of historical RTT data for the newly installed Rosemount transmitters. A review of the supplied data verified that no failures of the RTT requirements have been observed. All of these sensors have specified response times as published by their manufacturer.

It is recommended that BGE revise their RTT test program as follows. The current test procedures used to determine RPS and ESFAS response times will need to be revised. The procedures should be revised to delete the response time testing of the sensors and rewritten such that the response time for the remainder of the RPS and ESFAS loops, minus the sensors, is measured and recorded. An allocated response time would then be assigned to the RPS and ESFAS sensors. This allocated response time may be obtained from either the vendor-published response time data as listed in Table 3.1 or from an analysis of the historical response time data for that sensor as utilized at BGE. This allocated sensor response time would then be added to the measured response time for the remainder of the RPS or ESFAS protection loop and verified to meet the assumptions of the safety analysis. Once this methodology has been implemented, further response time testing of these transmitters will not be required as long as the conditions of Section 3.4 of this topical report are met.

One exception to the above is the sensor utilized in the RCS Flow loop. This sensor is a Rosemount 1152 with a variable damping option. This variable damping is adjustable from 0.2 sec.to 1.67 sec. The sensor is supplied by Rosemount with the damping adjustment set to the minimum or 0.2 sec. setting. Discussions with personnel at BGE verified that this setting is left at the minimum setting and is sealed. A review of the historical data for these sensors as utilized at BGE shows that all the recorded response times for this sensor have been less that 200 msec with the longest response time recorded being 190 msec. Based on this it is recommended that BGE allocate a response time of 200 msec for the RCS Flow sensor. BGE must also put in place a method to control the setting of variable damping adjustment for these sensors as discussed in Section 3.4.

Should BGE replace any of the existing RPS or ESFAS sensors with one of different manufacture or model number than that which is currently installed, they will need to revisit the sensor response time allocation. If the new sensor is one listed in Table 3.1 then the new sensor response time allocation can be made by utilizing the data available in Table 3.1. If the new sensor is not one of those listed in Table 3.1 then the utility must verify that the sensor is a candidate for response time elimination as defined in this report. Once this determination is made the utility may allocate a response time based on historical data for that transmitter type and model if sufficient historical data is available.

Entergy (Waterford 3)

The procedures used by Waterford-3 to perform RTT on their RPS and ESAS functions were reviewed. One procedure is used to test both functions. The review of this procedure, MI-003-219, showed that the response time for these functions is measured from the input of the sensor to the output of the actuating bistable located in the Bistable Control Panel (BCP). A review of the supplied data verified that no failures of the RTT requirements have been observed. All of these sensors have specified response times as published by their manufacturer.

It is recommended that Waterford 3 revise their RTT test program as follows. The current test procedure used to determine RPS and ESFAS response times will need to be revised. The procedures should be revised to delete the response time testing of the sensors and rewritten such that the response time for the remainder of the RPS and ESFAS loops, minus the sensors, is measured and recorded. An allocated response time would then be assigned to the RPS and ESFAS sensors. This allocated response time may be obtained from either the vendor-published response time data as listed in Table 3.1 or from an analysis of the historical response time data for that sensor as utilized at Waterford 3. This allocated sensor response time would then be added to the measured response time for the remainder of the RPS or ESFAS protection loop and verified to meet the assumptions of the safety analysis. Once this methodology has been implemented, further response time testing of these transmitters will not be required as long as the conditions of Section 3.4 of this topical report are met.

Should Waterford 3 replace any of the existing RPS or ESFAS sensors with one of different manufacture or model number than that which is currently installed, they will need to revisit the sensor response time allocation. If the new sensor is one listed in Table 3.1 then the new sensor response time allocation can be made by utilizing the data available in Table 3.1. If the new sensor is not one of those listed in Table 3.1 then the utility must verify that the sensor is a candidate for response time elimination as defined in this report. Once this determination is made the utility may allocate a response time based on historical data for that transmitter type and model if sufficient historical data is available.

Florida Power & Light (St. Lucie-1 & 2)

The procedures used by Florida Power & Light to perform RTT on their RPS and ESG functions were reviewed. One procedure is used to test both functions. For St. Lucie 1, procedure 1-1400053 "Reactor Protective and Engineering Safeguards System Response Time Testing" is used and for St. Lucie 2 the procedure number is 2-1400053. . A review of the supplied data verified that no failures of the RTT requirements have been observed. All of these sensors have specified response times as published by their manufacturer.

It is recommended that St. Lucie 1 & 2 revise their RTT test program as follows. The current test procedures used to determine RPS and ESFAS response times will need to be revised. The procedures should be revised to delete the response time testing of the sensors and rewritten such that the response time for the remainder of the RPS and ESFAS loops, minus the sensors, is measured and recorded. An allocated response time would then be assigned to the RPS and ESFAS sensors. This allocated response time may be obtained from either the vendor published response time data as listed in Table 3.1 or from an analysis of the historical response time data for that sensor as utilized at St. Lucie 1 & 2. This allocated sensor response time would then be

added to the measured response time for the remainder of the RPS or ESFAS protection loop and verified to meet the assumptions of the safety analysis. Once this methodology has been implemented, further response time testing of these transmitters will not be required as long as the conditions of Section 3.4 of this topical report are met.

One exception to the above is the sensor utilized for RCS Flow in Unit 1. This sensor is a Rosemount 1154 with a variable damping option. The variable damping option was installed in this transmitter in 1996 and is adjustable from 0 to 0.8 sec. Due to the limited time these transmitters have been installed there is insufficient historical data for performing a statically valid analysis to determine a response time which could be allocated to these sensors. In light of this, the RCS flow function for St. Lucie Unit 1 will not be addressed in this report and an allocated response time for this function will not be established. At a later date when sufficient historical data for this transmitter has been collected, FP&L may choose to make a submittal for allocating a response time for this function based on a statistical analysis of the appropriate data.

Should St. Lucie 1 or 2 replace any of the existing RPS or ESFAS sensors with one of different manufacture or model number than that which is currently installed, they will need to revisit the sensor response time allocation. If the new sensor is one listed in Table 3.1 then the new sensor response time allocation can be made by utilizing the data available in Table 3.1. If the new sensor is not one of those listed in Table 3.1 then the utility must verify that the sensor is a candidate for response time elimination as defined in this report. Once this determination is made the utility may allocate a response time based on historical data for that transmitter type and model if sufficient historical data is available.

Entergy (Arkansas Nuclear One- Unit 2)

The procedures used by Arkansas Nuclear One Unit 2 to perform RTT on their RPS and ESFAS functions were reviewed. Prior to 1995, RTT was performed from the input of the sensor to the Trip Circuit Breakers (TCB) for the RPS or from the input of the sensor to the actuating device for the ESFAS. Testing performed in 1995 on Channel D and in 1997 on Channel A measured the response time from the input of the sensor to the output of the actuating bistable on the Bistable Control Panel (BCP) and from the output of the actuating bistable to the TCB for the RPS or from the output of the actuating bistable to the actuating device for ESFAS. The two values were added to determine the total loop response.

ANO-2 has separate procedure numbers for each of the four Channels. Channel A procedure is 2304.112, Channel B are 2304.113, Channel C is 2304.114 and Channel D is 2304.115. With the exception of the Channel being tested and the procedure change in 1995 as discussed above, the procedures are identical and determine the response times from the input of the sensor to the actuating device.

ANO-2 replaced their originally supplied transmitter with Rosemount Model 1153 or 1154 within the past 10 years with the exception of RWT level and narrow range pressurizer pressure. The RWT level transmitters were replaced in 1985 and the narrow range pressurizer pressure transmitters in 1989. A review of the historical data taken for the replacement transmitters for the RPS and ESFAS functions showed that no function has failed to meet the acceptance criteria stated in the procedures.

It is recommended that ANO-2 revise their RTT test program as follows. The current test procedures used to determine RPS and ESFAS response times will need to be revised. The procedures should be revised to delete the response time testing of the sensors and rewritten such that the response time for the remainder of the RPS and ESFAS loops, minus the sensors, is measured and recorded. An allocated response time would then be assigned to the RPS and ESFAS sensors. This allocated response time may be obtained from either the vendor-published response time data as listed in Table 3.1 or from an analysis of the historical response time data for that sensor as utilized at ANO-2. This allocated sensor response time would then be added to the measured response time for the remainder of the RPS or ESFAS protection loop and verified to meet the assumptions of the safety analysis. Once this methodology has been implemented, further response time testing of these transmitters will not be required as long as the conditions of Section 3.4 of this topical report are met.

Should ANO-2 replace any of the existing RPS or ESFAS sensors with one of different manufacture or model number than that which is currently installed, they will need to revisit the sensor response time allocation. If the new sensor is one listed in Table 3.1 then the new sensor response time allocation can be made by utilizing the data available in Table 3.1. If the new sensor is not one of those listed in Table 3.1 then the utility must verify that the sensor is a candidate for response time elimination as defined in this report. Once this determination is made the utility may allocate a response time based on historical data for that transmitter type and model if sufficient historical data is available.

3.2 PLANT HARDWARE USAGE AND DATA APPLICABILITY ASSESSMENT

As part of the study of transmitter RTT programs EPRI evaluated the most commonly used transmitters presently in service. As part of this evaluation a Failure Modes and Effects Analysis was performed on the transmitters. The results of the FMEAs showed that, with the following exceptions, no failure modes were identified that could affect transmitter response time without concurrently affecting the transmitters output. The three exceptions to this finding are:

- Loss or low sensor fill fluid due either to a manufacturing defect or slow leak from the sensor under pressurized conditions;
- Misadjustment of variable damping potentiometers; and
- Crimped capillaries from the manufacturing process, improper handling by the manufacture, or field modifications.

These three exceptions are addressed by the recommendations in Section 3.4 below. The transmitters currently being used by the CEOG utilities participating in this effort were compared to those evaluated by EPRI. With two exceptions all of the transmitter models currently used by the utilities were evaluated by EPRI.

One exception is the ITT Barton Model 763A transmitter used at Palo Verde. From ITT Barton Manual No. 83C3(A) Errata Sheet dated Nov. 1986, "... the only difference in form, fit or function between the Model 763 and 763A are as follows:

A. The soldered "thin" link wire (302 SST, 0.007" diameter, .015 gm weight) between the beam and the bourdon tube's tab has been replaced in the Model 763A by a welded "thick" link wire (17-4 PH SST, .031" diameter, .055 gm weight); and

B. The location of the insulating pads for the termination of the strain gage lead wire has been changed in the Model 763A from the beam to the clamp plate."

These changes do not effect the theory of operation of the transmitter and would not change the FMEA conclusions determined in the EPRI report performed for the Model 763. The sensing element and electronics of the Model 763A are the same as the Model 763.

The other exception is the WEED Model N-E11DM, N-E11GM and N-E13DM transmitters used at San Onofre. Discussions with WEED Instruments verified that this product line was purchased from Foxboro by WEED. The transmitters produced by WEED are identical to the Foxboro models in form, fit, function and materials used. Based on this the FMEA's performed by EPRI for the Foxboro transmitters are also applicable to their WEED counterparts. The "N" prefix associated with the WEED transmitters only indicates that the transmitter is qualified for use in nuclear applications.

Tables 3.2-1 thur 3.2-6 provides a list of the pressure or differential pressure sensors currently installed at the participating utilities and whose RTT may be eliminated as justified in this report. These sensors are generally used in the Reactor Protection System (RPS) and the Engineered Safety Features Actuation System (ESFAS).

Table 3.2-1
Palo Verde Units 1, 2 & 3 Transmitters

Function	Instrument	Make / Model
RPS Transmitter	RCS Low Flow	Barton Model 764
	Containment Pressure	Rosemount Model 1153
	SG Level	Barton Model 764
	Pressurizer Pressure – High (Units 1&3)	Rosemount Model 1154
	Pressurizer Pressure- High (Unit 2)	Barton Model 763A
	SPS – Pressurizer Over Pressure	Rosemount Model 1153
	SG Pressure (RPS & ASGT)	Barton Model 763
ESAS & AFW Transmitter	Containment Pressure – High (SIAS/CIAS/MSIS)	Rosemount Model 1153
	Containment Pressure – High-High (CSAS)	Rosemount Model 1153
	SG Level (AFAS/MSIS)	Barton Model 764
	SG Pressure (AFAS/MSIS)	Barton Model 763
	RWT Level (RAS)	Rosemount Model 1153
	Pressurizer Pressure (SIAS/CIAS)	Rosemount Model 1154

Table 3.2-2
San Onofre Units 2 & 3 Transmitters

Function	Instrument	Make / Model
PPS Transmitter	RCS Low Flow	Rosemount Model 1153
	Containment Pressure	Foxboro Model N-E11DM
	SG Level	WEED Model N-E13DM
	Pressurizer Pressure	Rosemount Model 1154, Foxboro Model N-E11GM
	RWT Level	Foxboro Model E13DM
	SG Pressure (RPS & ASGT)	WEED Model N-E11GM

Table 3.2-3
Calvert Cliffs Units 1 & 2 Transmitters

Function	Instrument	Make / Model
RPS Transmitter	RCS Low Flow	Rosemount Model 1152
	Containment Pressure	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	Pressurizer Pressure	Rosemount Model 1154
	SG Pressure (RPS & ASGT)	Rosemount Model 1154
ESAS & AFW Transmitter	Containment Pressure (ESFAS)	Rosemount Model 1153
	SG Level (AFW)	Rosemount Model 1154
	W. Pen. Rm. Letdown Isolation	Rosemount Model 1154
	SG Pressure (ESFAS, AFW)	Rosemount Model 1154
	Pressurizer Press. (ESFAS)	Rosemount Model 1154

Table 3.2-4
Waterford Unit 3 Transmitters

Function	Instrument	Make / Model
PPS Transmitter	RCS Low Flow	Barton Model 764
	Containment Pressure	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	RWT Level	Rosemount Model 1152
	Pressurizer Pressure	Rosemount Model 1154
	SG Pressure	Rosemount Model 1154

Table 3.2-5A
St. Lucie Unit 1 Transmitters

Function	Instrument	Make / Model
	Containment Pressure	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	Pressurizer Pressure	Rosemount Model 1154
	SG Pressure	Rosemount Model 1153
ESAS & AFW Transmitter	Containment Pressure (ESFAS)	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	SG Pressure	Rosemount Model 1153
	RWT Level	Rosemount Model 1153
	Pressurizer Pressure	Rosemount Model 1154

Table 3.2-5B
St. Lucie Unit 2 Transmitters

Function	Instrument	Make / Model
RPS Transmitter	RCS Low Flow	Rosemount Model 1154
	Containment Pressure	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	Pressurizer Pressure	Rosemount Model 1154
	SG Pressure	Rosemount Model 1154
ESAS & AFW Transmitter	Containment Pressure (ESFAS)	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	SG Pressure	Rosemount Model 1154
	RWT Level	Rosemount Model 1153
	Pressurizer Pressure	Rosemount Model 1154

Table 3.2-6
Arkansas Nuclear One - Unit 2 Transmitters

Function	Instrument	Make / Model
RPS Transmitter	Containment Pressure	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	Pressurizer Pressure (High)	Rosemount Model 1154
	Pressurizer Pressure (Low)	Rosemount Model 1154
	SG Pressure	Rosemount Model 1154
ESFAS Transmitter	Containment Pressure	Rosemount Model 1153
	SG Level	Rosemount Model 1154
	SG Pressure & D/P	Rosemount Model 1154
	RWT Level	Rosemount Model 1153
	Pressurizer Pressure	Rosemount Model 1154

3.3 FAILURE MODES AND EFFECTS ANALYSIS CONSIDERATIONS

The Failure Modes and Effects Analyses (FMEA) performed by EPRI and documented in NP-7243 (May 1991) and NP-7243, Rev. 1 (March 1994) form the basis for the justification of eliminating RTT surveillance requirements from CEOG plant Technical Specifications.

3.4 CONSISTENCY WITH EPRI RECOMMENDATIONS

The results of EPRI Report NP-7243, Rev 01 form the basis for justifying the elimination of response time test requirements in selected RPS and ESAS pressure and differential pressure transmitters. In this report, EPRI makes several recommendations that are applicable to this effort to eliminate sensor RTT. These recommendations provide suggested modifications to utility RTT programs if sensor RTT is to be eliminated. The CEOG agrees with these recommendations and if applicable, the utility eliminating sensor RTT should incorporate them into their revised RTT program. The recommendations to be considered are:

- Perform a hydraulic RTT prior to installation of a new transmitter/switch or following refurbishment of the transmitter/switch (e.g., sensor cell or variable damping components) to determine an initial sensor-specific response time value. The power interrupt test is an alternate method to use on force-balance transmitters; the purpose of this test is to verify sensor response time is within the limits of the allocated value for the transmitter function.
- For transmitters and switches that use capillary tubes, RTT should be performed after initial installation and after any maintenance or modification activity that could damage the capillary tubes.
- Perform periodic drift monitoring on all Rosemount pressure and differential pressure transmitters, models 1151, 1152, 1153 and 1154. Guidance on drift monitoring can be found

in EPRI NP-7121 and Rosemount Technical Bulletins. Drift monitoring intervals should be based on utility response to NRC Bulletin 90-01.

- If variable damping is used, implement a method to ensure that the potentiometer is at the required setting and cannot be inadvertently changed. This approach should eliminate the need for RTT to detect a variable damping failure mode. Otherwise, RTT each transmitter by hydraulic or electronic white noise analysis methods, at a minimum, following each transmitter calibration.

Each utility using this Topical Report as a reference to eliminate sensor RTT should address the above recommendations and if applicable to their plant, incorporate the recommended changes into their RTT program.

EPRI recommended that current RTT for pressure and differential pressure sensors could be modified to eliminate ineffective and, therefore, unproductive testing. The recommendations focus on enhancing or upgrading existing RTT and do not require modification of current RTT. The EPRI report provides a basis for eliminating all pressure and differential pressure RTT in accordance with the following:

- Hydraulic RTT should be performed before installation of new transmitters and/or switches or after refurbishment.
- Transmitters and/or switches that utilize capillary tubes should have RTT performed after initial installation and after each maintenance or modification that has the potential to damage the capillary tubes.

4.0 BENEFITS OF RTT ELIMINATION

4.1 SAFETY

A reduction in testing requirements, if done without compromising equipment reliability or functionality, provides the following improvements in plant safety:

- Reduction in challenges to the plant protection system due to improper test techniques. Testing requires placing the system to be tested in an abnormal line up. If initial test line up is performed incorrectly or if restoration from the test line up is not done properly, a plant trip signal may be generated.
- Reduction in challenges to the engineered safety features actuation system due to improper test techniques. Testing requires placing the system to be tested in an abnormal line up. If initial test line up is performed incorrectly or if restoration from the test line up is not done properly, actuation of the engineered safety features may result.
- Increased availability of plant safety equipment. Response time testing requires that safety equipment be taken off line to perform the test. A reduction in test requirements results in protection equipment remaining on-line for longer periods.

In addition to the above, elimination of certain response time test requirements will directly benefit the ALARA program. Most of the sensors that are candidates for RTT elimination are located in radiation areas. In some cases the performance of RTT also requires the technicians to

handle and dispose of radioactive fluids. The elimination of RTT requirements for these sensors will reduce worker exposure and radioactive waste.

4.2 COST

Response time testing is costly in man-hours, exposure and critical outage time. The CEOG utilities estimate that it requires approximately 30 man-hours per sensor to perform each response time test. Depending on the plant and the number of sensors tested per outage, the total time required to perform this testing can range from 400 to 1200 man-hours. Assuming $30 per man-hour, the cost of this testing on a per-outage basis can range from $12,000 to $36,000. Such costs do not include the additional savings associated with the reduction in worker exposure and radioactive waste that the elimination of this testing will generate. Based on this analysis, elimination of pressure sensor response time testing qualifies as a Cost Beneficial Licensing Action.

5.0 TECHNICAL SPECIFICATIONS

5.1 STANDARD TECHNICAL SPECIFICATIONS

Generic Letter 93-08 (Ref 6), provided NRC guidance for relocating tables of instrument response time limits for the reactor protective system and the engineered safety features actuation system instruments from the Tech Specs to the updated final safety analysis report. This guidance was implemented in NUREG-1432 (Ref 7), the Standard Technical Specifications for Combustion Engineering plants.

Section 3.3 of NUREG-1432 provides surveillance requirements for the reactor protective system and the engineered safety features actuation system. These surveillance requirements include:

Section 3.3.1, RPS Instrumentation – Operating (Digital) contains surveillance requirement 3.3.1.14 that requires the licensee to "Verify RPS RESPONSE TIME is within limits" each "[18] months on a STAGGERED TEST BASIS." Section 3.3.1.9 also provides an identical RPS surveillance requirement for plants with an Analog reactor protective system.

Section 3.3.4, ESFAS Instrumentation (Analog) provides surveillance requirement 3.3.4.5 that requires the licensee to "Verify ESF RESPONSE TIME is within limits" each "[18] months on a STAGGERED TEST BASIS." Section 3.3.5 provides a like ESFAS surveillance requirement for digital plants.

Response time acceptance criteria for surveillance tests are not defined in the Standard Technical Specifications. The surveillance requirement ensures that the channel response times are verified to be less than or equal to the maximum values assumed in the safety analysis. Suggested changes to eliminate RPS and ESFAS response time testing from the Standard Technical Specifications is shown in Appendix A.

5.2 JUSTIFICATION FOR RTT ELIMINATION

A representative evaluation concluding that the elimination of pressure and differential pressure sensor response time testing does not adversely impact plant safety is shown in Appendix B. This

evaluation will require utility review and confirmation to ensure all elements are appropriate to each utility.

6.0 CONCLUSIONS

EPRI conducted an investigation of the benefits of response time testing in response to an industry effort to improve plant availability and reduce personnel exposure. The purpose of this EPRI investigation was to determine if performing response time testing of pressure and differential pressure transmitters was necessary to justify the assumptions made in the plant safety analysis. The result of this investigation, EPRI Report NP-7243, concluded that response time testing of most pressure and differential pressure transmitters is not required to demonstrate satisfactory sensor performance. The EPRI study showed that other routine surveillance such as calibrations and drift monitoring was sufficient to demonstrate satisfactory sensor performance.

A review of more than 1400 pressure sensor response time testing data points obtained from tests performed at CEOG plants has confirmed that pressure sensors have not failed any response time tests and the testing results validate the results published by EPRI in NP-7243.

7.0 REFERENCES

1. EPRI Report No. NP-7243, "Investigation of Response Time Testing Requirements," May 1991 and Rev 01 to this report, March 1994.
2. WCAP-13787, Rev 02, "Elimination of Pressure Sensor Response Time Testing Requirements," August 1995 (Approved by the NRC in January 1996).
3. Letter, B. Boger (NRC) to R. Newton, "Review of Westinghouse Electric Corporation Topical Report WCAP-13632, Rev 02, 'Elimination of Pressure Sensor Response Time Testing Requirements,' dated August 1995 – Westinghouse Owners Group Program MUHP-3040, Revision 1," September 5, 1995.
4. B&W Owners Group Topical Report NEDO-32291, "Systems Analysis for Elimination of Selected Response Time Testing Requirements," January 1994.
5. CE NPSD-1135, Rev 01, "Review of Utility Response Time Test Results," May 1999
6. NRC Generic Letter 93-08, "Relocation of Technical Specification Tables of Instrument Response Time Limits," December 29, 1993.
7. NUREG-1432, Rev 01, "Standard Technical Specifications Combustion Engineering Plants," April 1995

Appendix A

Revisions to C-E

Standard Technical Specifications

to Remove

Pressure Sensor

Response Time Testing

REVISIONS TO TECHNICAL SPECIFICATIONS

This Appendix provides typical changes to Technical Specifications to remove the requirement to perform response time testing of RPS and ESFAS pressure and differential pressure sensors. Each plant's current Tech Specs should be compared with the sections given below to confirm whether or not a License Amendment will be required. The generic Tech Specs statements given below are based on a review of C-E Standard Tech Specs contained in NUREG-1432. Recommended Tech Spec deletions are marked with a double strike-through; text additions are marked with margin bars.

RECOMMENDED TECH SPEC DEFINITIONS

Engineered Safety Feature (ESF) Response Time

The ESF RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its ESF actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.) Times shall include diesel generator starting and sequence loading delays where applicable. ~~The response time may be measured by any sequence of sequential, overlapping, or total steps such that the entire response time is measured.~~

The response time may be verified by any sequence of sequential, overlapping, or total steps such that the entire response time is measured, or by the summation of allocated sensor response times with the results of actual measured response times for the remainder of the channel.

Reactor Protection System (RPS) Response Time

The RPS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RPS trip setpoint at the channel sensor until electrical power to the CEA drive mechanisms is interrupted. ~~The response time may be measured by any sequence of sequential, overlapping, or total steps such that the entire response time is measured.~~

The response time may be verified by any sequence of sequential, overlapping, or total steps such that the entire response time is measured, or by the summation of allocated sensor response times with the results of actual measured response times for the remainder of the channel.

RECOMMENDED TECH SPEC SURVEILLANCE REQUIREMENTS

SR 3.3.1.14 RPS Instrumentation- Operating (Digital)

Verify RPS RESPONSE TIME is within limits.

[NOTE: Neutron detectors are excluded (from RPS RESPONSE TIME testing).]

Frequency: [18] months on a STAGGERED TEST BASIS.

SR 3.3.5.4 ESFAS Instrumentation (Digital)

Verify ESF RESPONSE TIME is within limits.

Frequency: [18] months on a STAGGERED TEST BASIS.

RECOMMENDED TECH SPEC BASES

Bases for SR 3.3.1.14: RPS Instrumentation – Operating (Digital):

This SR ensures that the RPS RESPONSE TIMES are verified to be less than or equal to the maximum values assumed in the safety analysis. 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 RTCBs open. Response times are verified ~~conducted~~ on a [18]-month STAGGERED TEST BASIS. This results in the interval between successive surveillances of a given channel of n x [18] months, where n is the number of channels in the function. The Frequency of [18] months is based on operating experience, which has shown that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequent occurrences. Also, response times cannot be determined at power since equipment operation is required. ~~Testing may be performed in one measurement or in overlapping segments, with verification that all components are tested.~~

Response time may be verified by any sequence of sequential, overlapping, or total steps, including allocated sensor response time, such that the entire response time is verified. Allocations for sensor response time may be determined from records of test results, vendor test data, or vendor engineering specifications. Topical Report CE NPSD-1167 (Ref A), "Elimination of Pressure Sensor Response Time Testing Requirements," provides a basis for using allocated response times for specific pressure sensors. The allocation for sensor response times must be verified prior to placing a new component in operation and re-verified following maintenance that may adversely affect the sensor response time.

Response time testing acceptance criteria are included in Reference [B].

A Note is added to indicate that the neutron detectors are excluded from RPS RESPONSE TIME testing because they are passive devices with minimal drift and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated for by performing the daily calorimetric calibration (SR 3.3.1.4).

Bases for SR 3.3.5.4: ESFAS Instrumentation (Digital)

This Surveillance ensures that the train actuation response times are within the maximum values assumed in the safety analyses. Response time may be verified by any sequence of sequential, overlapping, or total steps, including allocated sensor response time, such that the entire response time is verified. Allocations for sensor response time may be determined from records of test results, vendor test data, or vendor engineering specifications. CE NPSD-1167 (Ref A), "Elimination of Pressure Sensor Response Time Testing Requirements," provides a basis for using allocated response times for specific pressure sensors. The allocation for sensor response times must be verified prior to placing a new component in operation and re-verified following maintenance that may adversely affect the sensor response time.

Response time testing acceptance criteria are included in Reference [B].

ESF RESPONSE TIME tests are conducted on a STAGGERED TEST BASIS of once every [18] months. The [18] month Frequency is consistent with the typical industry refueling cycle and is based upon plant operating experience, which shows that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequent occurrences.

REFERENCES

A. CE NPSD-1167, "Elimination of Pressure Sensor Response Time Testing Requirements," June 1999.

B. FSAR or other utility-controlled document concerning RPS/ESFAS Response Times.

APPENDIX B

Significant Hazards Consideration Analysis Concerning the Elimination of Pressure Sensor Response Time Testing

SIGNIFICANT HAZARDS EVALUATION

This Appendix provides a sample evaluation in accordance with 10 CFR 50.92 "Issuance of Amendment" of the impact on plant safety produced by eliminating the response time testing of pressure sensors in the reactor protection and engineered safety features actuation systems. On the basis of an evaluation, the plant licensing basis may be changed to utilize a conservative, fixed response time interval rather than perform specific response time testing for the specified pressure sensors without:

1. increasing the probability or consequences of an accident previously evaluated; or
2. creating the possibility of a new or different kind of accident from any accident previously evaluated; or
3. involving a significant reduction in a margin of safety.

As required by 10 CFR 50.92, this sample analysis is provided to demonstrate that no significant hazards are introduced by the proposed change to eliminate the requirement for response time testing of certain pressure and differential pressure sensors. The proposed change is that the total response time of certain pressure sensors will be determined based on the information provided in this Report.

BACKGROUND

In 1975, C-E Technical Specifications were revised to include response time testing (RTT) requirements; these standard Tech Specs were required for all subsequently licensed plants. The standard Tech Specs contain definitions for both reactor protection system and engineered safety features actuation system response times. Response time is defined as:

Reactor Protection System Response Time
The Reactor Protection System Response Time shall be that time interval from when the monitored parameter exceeds its trip setpoint at the channel sensor until electrical power to the CEA drive mechanism is interrupted.

Engineered Safety Feature Response Time:
The Engineered Safety Feature Response Time shall be that time interval from when the monitored parameter exceeds its ESF actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.) Times shall include diesel generator starting and sequence loading delays where applicable.

Tech Specs state that the response time may be measured by any sequence of sequential, overlapping, or total steps such that the entire response time is measured. This approach is also consistent with ISA Standard 67.06. Given this guidance and the complexity of testing an entire instrument channel from the sensor to the final device, plant surveillance procedures typically test a channel in two or more steps. One individual step in most plant test methodologies is the instrument sensor; separate procedures using specialized test equipment are typically used for testing these sensors.

Response time testing guidelines were first established in ANSI/IEEE Standard 338-1975, "Criteria for the Periodic Testing of Class IE Power and Protection Systems." Regulatory Guide 1.118, (Rev 01, Nov 1977) found that "the criteria, requirements and recommendations contained

in IEEE Std 338-1975 are considered by the NRC staff to be generally acceptable methods for the periodic testing of electric power and protection systems;" this acceptance was subject to a number of clarifying statements and supplemental information. Following Revision 2 of Reg Guide 1.118, (June 1978) the Instrument Society of America approved Standard ISA S67.06, "Response Time Testing of Nuclear Safety-Related Instrument Channels in Nuclear Power Plants" August 29, 1986. Revision 3 to RG 1.118 (April 1995) reaffirmed that IEEE Std 338-1987 provides a method acceptable to the NRC staff for periodic testing of protection systems.

This evaluation considers the safety impact of the proposed deletion of periodic response time testing measurements for certain pressure and differential pressure transmitters and substituting in its place a conservative, defined time interval. Corresponding revisions to the Standard Technical Specifications, NUREG-1432, to accommodate this change in RPS and ESFAS surveillance testing are shown in Appendix A.

EVALUATION

The primary purpose of this evaluation is to determine if the deletion of periodic response time testing could be justified for specific pressure, level, and flow functions that utilize pressure and differential pressure sensors. IEEE Standard 338-1987 defines a basis for eliminating RTT; Section 6.3.4 states:

> "Response time testing of all safety-related equipment, per se, is not required if, in lieu of response time testing, the response time of the safety system equipment is verified by functional testing, calibration check, or other tests, or both."

This Report provides the technical justification for deletion of periodic response time testing of selected pressure sensing instruments. The program described utilizes the methods contained in EPRI Report NP- 7243 Rev. 1, "Investigation of Response Time Testing Requirements," for justifying the elimination of response time testing surveillance requirements on certain pressure and differential pressure sensors. The EPRI report justifies the elimination of response time testing based on an analysis that shows that component degradation that impacts pressure sensor response time can be detected in other routine tests such as calibration tests. The EPRI report concludes that sensor RTT is redundant to other technical specification surveillance requirements such as sensor calibrations.

The basis for eliminating periodic response time testing for each sensor is discussed in this and/or the EPRI report. These reports conclude that any sensor failure that significantly degrades response time will be detectable during surveillance testing such as calibration and channel checks. Pressure sensor response time allocations may be obtained from (1) historical records based on acceptable response time tests, (2) in-place, onsite, or offsite (e.g. vendor) test measurements, or (3) vendor specifications.

ANALYSIS DETAILS

Conformance of the proposed change to the standards for a determination of an unreviewed safety question as defined in 10 CFR 50.92 is shown in the following:

1. The proposed licensing basis change does not involve a significant increase in the probability or consequences of an accident previously evaluated in the safety analysis report.

This change to the licensing basis does not result in a condition where the design, material, and construction standards that were applicable prior to the change are altered. The same RPS and ESFAS instrumentation is being used; the time response allocations/modeling assumptions in FSAR Chapter 15 analyses remain the same; only the method of verifying time response is changed. 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 licensing basis change does not create the possibility of a new or different kind of accident from any accident previously evaluated in the safety analysis report.

   This change does not alter the performance of the pressure and differential pressure sensors used in the plant protection systems. All sensors will still have their response time verified before placing the sensor in operational service and after any maintenance that could affect response time. Changing the method of periodically verifying instrument response for certain sensors (assuring equipment operability) from time response testing to calibration, use of actual data, and channel checks will not create any new accident initiators or scenarios. Periodic surveillance of these instruments will detect significant degradation in the sensor response characteristic. Implementation of the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed licensing basis change does not involve a significant reduction in margin of safety.

   The total RPS and ESFAS system response time assumed in the safety analysis is not affected by this change. The periodic system response time verification method for selected pressure and differential pressure sensors is modified to allow the use of allocated data based on actual test results or other verifiable response time data. Verification methods and calibration tests assure that any degradation sufficient to significantly affect sensor response time will be detected before the total system response time exceeds that defined in the safety analysis. Therefore, it is concluded that the proposed change does not result in a significant reduction in margin with respect to plant safety.

CONCLUSION

Based on the preceding analysis, it is concluded that elimination of periodic pressure and differential pressure sensor response time testing is acceptable and the proposed licensing basis change does not result in a finding of any significant hazards as defined in 10 CFR 50.92.

APPENDIX C

Summary of Historical Data Analysis

For SCE

The following provides a summary of the analysis performed on the historical response time data for selected sensors currently in use at SCE, and FPL. The purpose of this analysis is to determine a response time based on historical data that can be applied to the subject sensors as they are currently being used.

SCE

SCE currently has WEED/Foxboro sensors installed in the following safety functions:

- Containment Pressure
- RTW Level
- Pressurizer Pressure
- Steam Generator Pressure
- Steam Generator Level

The following is a summary of the analysis performed for each function.

Containment Pressure (Tag Numbers 2PT0351-1,2,3,4/2PT0352-1,2,3,4 & 3PT0351-1,2,3,4/3PT0352-1,2,3,4)

For the Containment Pressure function SCE utilizes a Foxboro model N-E11DM transmitter. A review of the historical data supplied by SCE for this function resulted in the following:

- Data Points – 36
- Maximum response – 423 msec.
- Minimum response – 70 msec.
- Mean value – 192.44 msec.
- Standard Deviation – 108.19 msec.

Using the above data the calculated response time (95/95) to be allocated to this sensor is 425.98 msec or rounded up to 430 msec.

Refueling Water Tank Level (Tag Numbers 2LT0305-1,2,3,4 & 3LT0305-1,2,3,4)

For the RWT function SCE utilizes a Foxboro model E113DM transmitter. A review of the historical data supplied by SCE for this function resulted in the following:

- Data Points – 20
- Maximum response – 650 msec.
- Minimum response – 115 msec.
- Mean value – 271.75 msec.
- Standard Deviation – 139.93 msec.

Using the above data the calculated response time (95/95) to be allocated to this sensor is 607.02 msec or rounded up to 610 msec.

Pressurizer Pressure and Steam Generator Pressure (Tag Numbers 2PT0101-1,2,3,4, 2PT1013-1,2,3,4, 3PT0101-1,,2,3,4 & 3PT1013-1,2,3,4)

For the Pressurizer Pressure and Steam Generator Pressure functions SCE utilizes a WEED model N-E11GM transmitter. A review of the historical data supplied by SCE for this function resulted in the following:
- Data Points – 55
- Maximum response – 170 msec.
- Minimum response – 0 msec.
- Mean value – 59.91 msec.
- Standard Deviation – 35.22 msec.

Using the above data the calculated response time (95/95) to be allocated to this sensor is 131.9 msec or rounded up to 135 msec.

Steam Generator Level (Tag Numbers 2LT1113-1,2,3,4 & 3LT1113-1,2,3,4)

For the Steam Generator Level function SCE utilizes a WEED and Foxboro model N-E13DM transmitter. A review of the historical data supplied by SCE for this function resulted in the following:
- Data Points – 38
- Maximum response – 530 msec.
- Minimum response – 130 msec.
- Mean value – 306.97 msec.
- Standard Deviation – 97.55 msec.

Using the above data the calculated response time (95/95) to be allocated to this sensor is 515.9 msec or rounded up to 520 msec.