May 21, 1998

Mr. Thomas J. Rausch, Chairman
Boiling Water Reactor Owners' Group
Commonwealth Edison Company
Nuclear Fuel Services
1400 Opus Place, 4th Floor ETWIII
Downers Grove, IL 60515

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RELATED TO THE STAFF'S REVIEW OF NEDC-32291, SUPPLEMENT 1, "SYSTEM ANALYSIS FOR ELIMINATION OF SELECTED RESPONSE TIME TESTING REQUIREMENTS" (TAC NO. MA0866)

Dear Mr. Rausch:

The staff is reviewing NEDE-32291, Supplement 1, "System Analysis for Elimination of Selected Response Time Testing Requirements," submitted by your letter dated December 12, 1887, and concludes that additional information is needed before the staff can complete its review. Enclosure 1 contains the staff's request for additional information (RAI).

You are requested to provide a response to this RAI within 30 days of the date of this letter. If you need further clarification concerning this request, please contact Paul J. Loeser at (301) 415-2825.

Sincerely,

Original Signed By:

James H. Wilson, Senior Project Manager
Generic Issues and Environmental
Projects Branch
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc w/ encl: See next page

Project No. 691

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PROJ. 691



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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Boiling Water Reactor Owners Group

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

# REQUEST FOR ADDITIONAL INFORMATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION ON TOPICAL REPORT NEDC-32291, SUPPLEMENT 1

## 1.0 GENERAL QUESTIONS AND COMMENTS

These comments apply to numerous sections within the Topical Report. The corrections should be applied to each case where the comment is appropriate.

1.1 This Topical Report covers instrumentation in loops which have a required response time of between 300 and 5000 milliseconds (ms). In general, this is a significantly faster response requirement than the items covered in the previous Topical Report, NEDC-32291. For this reason, the level of justification required, and degree of rigor required in the review of the report is correspondingly increased. In the past, an assumption that a technician will notice a response difference between one second and 5 seconds was accepted. It is doubtful that a technician would be able to notice the difference between 100 ms and 200 ms. Consequently, this topical report is based upon the concept of a "bounding response time" (BRT). According to Page 4-2, a BRT is "the maximum expected value that could result from credible 'undetected' component failure or degradation." For this concept to be valid, it must be shown that for each part failure within the designated component, failure of that part will not increase the response time beyond the BRT. In general, in Topical Report NEDC-32291, Supplement 1, this is not done. Please modify the report to include this level of detail.

1.2 The elimination of response time testing is based upon IEEE 338 Section 6.3.3 (3), which 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 equipment is verified by functional testing, calibration checks or other tests, 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 which are detectable during routine periodic tests."

In the previous topical report, the Owners Group based the detection of slow response time on technician awareness during instrument calibrations, and a delay in response time of 5 seconds. This topical report uses the BRT concept to ensure that response

ENCLOSURE

time degradation will be detected by functional test or other routine surveillance procedures. Since technician awareness can not be expected to detect an increase in response time on the order of milliseconds, please state for each component and part in the failure modes and effects analyses (FMEA) what test will show the increased response time, and how that test will show the increase if the increase is less than five seconds?

1.3 There are numerous cases where it is stated that extensive history indicates no credible potential for failure of the type being discussed. A review of past failures does not eliminate the possibility of a future different type of failure. If historical data is to be used as a justification, the amount of operating history available is critical. If, for example, a failure rate of one failure in $10^6$ hours is expected, and the operating history is $5 \times 10^5$ hours, it is only reasonable to expect that no failure may yet have occurred. In addition, reporting requirements must be discussed. If failure reporting is voluntary, and not mandatory, then the history is suspect, and can not be used as justification. In general, a lack of negative data is not the same as positive data. Merely stating that no failures of this type have been reported is inconclusive, and should not be used. Please discuss these issues and their relevance to the historical data that was used in this topical report. In addition, there are numerous comments to the effect that historical data shows no data of a certain failure mode, and therefore, it is concluded that either this failure does not occur, or that it is detected by tests other than response time testing. As above, use of historical data is difficult. Unless the historical data has a required root cause analysis showing which part of a failed component was responsible for the failure, and a failed part analysis showing why that part failed, a lack of data is not significant. If these comments are to be considered in the staff analysis, please provide more detail on the nature of the historic data, the reporting requirements, the scope of the database, e.g., nuclear only or non-nuclear, any failure analysis required, and a comparison with expected or predicted failure rates.

1.4 For each of the components listed in this Topical Report, the justification for the maximum undetected response time is not documented. For example, for Agastat relays, this is stated to be 140 ms. What is the technical basis for this number, that is, why was 140 ms. chosen, and not 130 or 150? Throughout this topical, these numbers seem arbitrarily and indefensible. The staff would expect that in each case within the FMEA, where a failure has the potential to increase response time, a sound technical justification for the amount of potential increase would be provided for that type of failure. Please provide these justifications.

1.5 The concept of "credible failure" is out of place in this report. If a failure can be postulated, it is credible. It would be possible to show that the nature of the problem is so unlikely as to need no further review, however, such a determination must be individually justified and documented. This would be based on concepts such as strength of materials or predetermined component life. An example of the first would be a mechanical part with a given strength, and a comparison of the forces on that component, with a determination that the forces, compared to strength, are so small that a break or fracture is unlikely as to be failure mechanism. An example of the second

would be a case of factory lubrication, where the vendor has determined that while the lubrication may dry out or cake, and has therefore, placed a service life on the component such that the item will be taken out of service prior to the problem manifesting itself. In this case, failure of lubrication can be stated to be a unlikely failure mechanism, as long as each licensee shows that the component will follow vendor service or shelf life recommendations, and the periodic replacement of this item is assured through some quality control process. In general, all postulated failures must be assumed to be credible, unless specific justification is shown why this is not the case. In each case were a failure was judged not to be credible, provide an evaluation of that failure showing why this failure is so unlikely so as to require no further evaluation of the results of failure.

1.6 Whenever friction is discussed, the effect of any factory lubrication, or lack thereof, should be shown. The materials that the parts are made of should be discussed, along with any anticorrosion coating or potting compound applied to the material. Since in the past response time degradation due to flowing and degrading potting compound and to out gassing and re-condensation of protective coatings have actually occurred, failures of this type should be specifically discussed.

1.7 Throughout the report, there is no reference to vendor data. Please state whether or not the manufacturer has specified a response time for the item, and if the manufacturer agrees with the concept of BRT. If no response time specification is available, to what limit does the manufacturer test prior to shipment? Has the manufacturer reviewed and approved the FMEA? If the manufacturer refused to either review the data, or disagrees with it, this should be documented and justification for the proposed assumptions provided.

1.8 The written descriptions of the components and interrelations between parts is of sufficient complexity that the staff had difficulty understanding the inner workings of these parts, and therefore, is unable to determine the adequacy of the FMEA. Please provide exploded parts drawings, cutaway drawings, or actual parts for review by the staff. These items must be in sufficient detail to allow the staff to fully understand the interrelationship of parts, and to judge the adequacy of the FMEA.

1.9 The terms "not credible" and "incredible" seem to be used interchangeably. Was this the intent, and if not, how is each term defined?

2.0 SPECIFIC COMMENTS

2.1 Figure 4-2, Page 4-5

2.1.1 The first box says to group components in sets by "similarity." "Similarity" is not sufficient. Since the evaluation is done on individual parts within the component, the parts list must be virtually identical, and where two parts vary, an individual FMEA must be done on each different part. For this reason, groupings should be based on virtually identical parts, and mere similarity is not sufficient. Please regroup these components or justify the use of the term "similar."

2.1.2 The third box lists, as the action item, "Identify credible failures that affect response time." At which point does a failure move from the "credible failure" category to an incredible failure category? What is the basis for not considering failures which the owners group has determined to be incredible?

2.1.3 The fourth box says to "Perform similarity analysis for components not directly analyzed by FMEA." There should be a comment that the analysis must show identicalness of interior parts, of an analysis of the parts for potential failures to the same degree as in the original FMEA.

2.1.4 The fifth box says to establish BRTs. The BRT must be justified with valid engineering data, and should not be a guess. In this case, unsupported engineering judgement is equivalent to an opinion, and should not be used. Any engineering judgement used must be supported, and that judgement must be documented to a degree that a qualified engineer reviewing this documentation will arrive at a similar conclusion.

3.0 AGASTAT RELAYS

3.1 Section 6.1.1

3.1.1 Section 6.1.1.2 c) refers to the qualified life. What is the qualified life of the relays, and does each licensee replace the relays at the end of that qualified life? If necessary, a statement requiring such replacement should be added to the topical report.

3..1.2 Section 6.1.1.2-c, it is stated that as a condition, "The relays are procured by the utility as nuclear safety related, or dedicated for nuclear safety related application under a utility dedication program." Please discuss how the dedication program considers response time in the dedication process. If the dedication process depends upon periodic response time testing, discuss how the dedication process will be changed, and how utilities taking advantage of this topical report will be required to demonstrate these changes.

3.2 FMEA for Agastat Type EGP

3.2.1 Item 2 - Comment states "this failure is considered unlikely due to the relatively loose fit of the contact holder in the bracket." What are the tolerances, and what is "relatively loose"? Would this not allow contamination to enter more easily, thereby causing binding?

3.2.2 Item 3 - Core/contact assembly. If it is postulated that the pivot surface becomes sticky, it must be shown that stickiness will not cause the relay to slow operation beyond 140 ms, and that if the degradation is beyond 140 ms, how that degradation will be detected. If a failure mode has been postulated, the lack of documented history showing this failure mode is insufficient to determine that this failure does not occur, or that other tests detect this failure.

3.2.3 Item 4 - Please provide a copy of the reference document, DRF A42-00126.

3.2.4 Item 5 - Core/contact assembly flat spring - It is stated that there was a documented case where degraded contacts could have been caused by a change in the flat spring contact, but that the possibility of slippage is sufficiently small to be considered not credible. How small is the possibility? Since this appears to have occurred once, why is the possibility of this occurring again considered small?

3.2.5 Item 6 - Please provide a drawing of this part to allow the staff to understand the discussion of forces acting upon the spacer/washer.

3.2.6 Item 7 - Was out gassing and redeposit of the finish considered?

3.2.7 Item 8 - What is the qualified life of the relay? Do all licensees replace the relays at the end of the qualified life? If the replacement is not done on time, what action will be triggered by the failure to replace a relay beyond its qualified life? Are these actions listed in Technical Specifications or will some other means be placed licensees referencing this topical report to ensure this action is taken?

3.2.8 Item 10 - In order for the staff to understand this comment, a copy of the schematic for the circuit is required. Please provide a schematic drawing of this circuitry.

4.0 GE HFA RELAYS

4.1 Section 6.1.2.2 of the topical states that "Even thought some performance problems have been identified in the past, all were identified by tests or actions other than response time tests." Please discuss these problems, the manner they were detected, and why similar or other problems will be recognized in the future.

4.2 Section B.3.1.2(a) What repair or maintenance is done on site?

4.3 Section B.3.1.2(b) Is this 20 ms value the manufactures response time value? If not, provide a basis for this value.

4.4 Section B.3.1.2(c) it is stated that as a condition, "The relays are procured by the utility as nuclear safety related, or dedicated for nuclear safety related application under a utility dedication program." Please discuss how the dedication program considers response time in the dedication process. If the dedication process depends upon periodic response time testing, discuss how the dedication process will be changed, and how utilities taking advantage of this topical report will be required to demonstrate that these changes have been implemented.

4.5 Section B.3.2.3 states that when a problem description stated that the loop was "marginally outside acceptance criteria" of 80 ms, that "it is reasonable to conclude that the actual times measured for the 'failed' loop were on the order of 100 ms." What is the justification for this?

This section goes on to state that a very small number of reported cases of relay failure were detected by RTT, and a relatively large number detected by other surveillance testing. Please provide values for these numbers. Is the same true when only response time failures are considered? Would the failures detected by RTT have been detected by other test methods?

4.6 Section B.3.2.4.3 states that "the worst case expected delay for the HFA Relay is a factor of 2 increase over nominal." Please justify this statement, and show why the maximum undetected response time is 40 ms.

4.7 FMEA, Table B.3-2

4.7.1 Item 2 - The comment states that action has been taken to minimize the likelihood of the glass becoming loose and dropping into the relay. What action was taken?

4.7.2 Item 3 - The comment states "Extensive history indicates no credible potential for mechanical failure molded parts." Was an analysis of the stresses on the parts performed comparing the stresses with the strength of materials?

4.7.3 Item 3 - The comment states that there is no credible potential for screws to loosen. Is some form of locking mechanism, i.e., Locktight, locking washer, etc; used in this application?

4.7.4 Item 4 - How was it determined that incorrect adjustment in contact travel will result in no more than a 50% change before contacts fail to open or close?

4.7.5 Item 5 - The comment states "There is no record of any failures caused by this condition." This comment does nothing to show why such a failure will prevent the response time from going beyond the BRT.

4.7.6 Items 6 & 10 - Please show how the functional test will show a degradation of response time of 10% more than the BRT, should the armature plate or pole piece become sticky as postulated.

4.7.7 Item 7 - What is the temperature limit for the armature return spring?

4.7.8 Items 7 & 8 - How often is the pickup voltage and armature stop bar tightness checked?

5.0 POTTER & BRUMFIELD MDR RELAYS

5.1 Section 6.1.3.1 states "The 'Potter & Brumfield MDR Relay' set includes Potter & Brumfield type MDR, 120 Vac rotary relays. Please specify which model numbers are include in this set.

5.2 Section 6.1.3.2 states the BRT is 90 ms. Please show how this value was derived.

5.3 Section 6.1.3.2(a) refers to maintenance or repair of the relays. What maintenance or repair is performed on the relays?

5.4 Section 6.1.3.2(b) refers to the qualified life of the relays. How long is the qualified life? How does each licensee referencing this topical report assure the replacement of the relays at the end of that qualified life?

5.5 Section 6.1.3.2(c) states that the relays must be manufactured after September 10, 1986, when the winding insulation was changed to epoxy. Section B.4.1.2.d) adds, as a condition to be met prior to implementing the topical: "the dedication process has confirmed that the manufacturing process used is adequate to assure full curing of the epoxy winding insulation." How will this condition be met by a referencing licensee?

5.6 Appendix D, Items 6, 7, and 8 show three examples where a Potter & Brumfield relay failed response time testing, but no other test was affected. Please discuss these failures in greater detail, and show why such a failure in the future is not a credible failure. Specifically, discuss how functional or other tests have been modified to insure this type of failure will be detected by functional or other testing.

5.7 FMEA for Potter & Brumfield MDR Relays

5.7.1 Item 2 - In the case of Agastat relays, the reasoning given for no possibility of RTT failure was that the clearance is large. In this case, the reason given is that the clearance is small. Please discuss these opposing conclusions.

5.7.2 Item 2 - The comment states that the hole is small, therefore small amounts of rust or other contaminants are unlikely to have a significant effect. It would appear that for components with tight clearance, a small amount of rust or other contaminants would have a greater effect than in instances of more clearance. Please explain how the conclusion was reached.

5.7.3 Items 1, 2, 3, and 4 - The comments state that due to metal material and low force, mechanical failure is not credible. Please discuss the type and thickness of the metal, and compare this to a value of force, i.e., 10 gauge stainless steel with required bending force of 20 ft/lb, and a force of 3 pounds and a radius of 1 foot.

5.7.4 Item 5 - This item does not discuss the change in coil size with overheating caused by short circuit. Please discuss this potential for binding or sticking.

5.7.5 Item 5 - The comment states that all cases of failure due to outgassing and redeposit of wire insulation were found by functional testing. While the staff would agree that gross failure can be detected in this manner, please discuss how a failure of 10% more than the BRT can be detected through a functional test.

5.7.6 Items 6, 9, and 12 - This questions is the same as 5.7.5, above. How will a functional test detect a failure resulting in a response time which is slightly higher value than the BRT?

5.7.7 Item 8 - The comment states that the spring weakening or breaking is not credible since the spring operates at a temperature below the annealing temperature of the steel. No mention is made of the elastic limit of the steel or fatigue stress on the spring material. Please discuss these factors.

5.7.8 Item 10 - Since a hard plastic deck ring is bolted directly to the end cap, it would appear that over tightening of the bolt would produce cracking and failure. What is the torque limit on the bolt, and how is this limit used and controlled?

6.0 TRIP UNITS

6.1 Section 6.1.4.1 and B.5.1.1 list 4 types of Trip Units for which this section applies. These are:

Any Rosemount Model 510DU Master Trip Unit or Master/Slave combination
Any Rosemount Model 710DU Master Trip Unit or Master/Slave combination
Any GE Model 184C5988Gxxx Master Trip Unit or Master/Slave combination
Any GE Model 147D8505Gxxx Analog Trip Module

The similarity Analysis in Section B.5.2.2 states that the Rosemount units are architecturally virtually identical. The GE trip units are stated to have "similar architecture." As the FMEA depends upon a detailed analysis of the parts within a component, architectural similarity, or even architectural identicalness is insufficient for a FMEA similarity analysis to be valid unless it is shown that the parts within the component are also virtually identical. Please expand the similarity analysis to emphasize the differences within the parts, and why the FMEA is valid despite these differences. Please discuss the reason why the analog trip module is called analog, and why the other units are not.

In previous submittals during the time when ATWS systems were being approved, the GE trip units were found to be acceptably diverse from Rosemount trip units based upon the plant analysis. Based upon this similarity analysis, does the BWROG plan to revisit the generic ATWS design, or will it be the responsibility of each licensee to show that similar GE and Rosemount units are not used in instances where diversity is required?

6.2 Please expand the trip unit model number identification to show exactly which Rosemount or GE units are the subject of this request. In those cases where a series of units is requested, i.e., xxxx, please describe what options or features are described by the unspecified designators.

6.3 The GE units are shown as having similar architecture to the Rosemount units. Did Rosemount design or build the GE units, or is this similarity coincidental?

6.4 In Section B.5.1.2, please justify the 24 ms BRT. Is this value valid for both a master unit and a master/slave combination?

6.5 In Section B.5.1.2, it was stated that these units have had performance problems in the past. Please discuss the problems, and how other tests were able to identify the problems.

6.6 In Section B.5.2.2, it is stated that a change in capacitor values by a factor of 2 is unlikely. Was the possibility of capacitors shorting or opening considered, and if so, what is the effect on response time?

6.7 Since the detailed analysis is of circuitry, please provide schematic drawings of the various circuits discussed. In the case of review by similarity, please provide schematic drawings of both sets of circuitry, that were reviewed and that were determined to be similar enough to need no review.

6.8 Of the seven circuits contained in the reviewed unit, only three were reviewed. It was stated that only those three are involved in the trip function. The other four were not included in the FMEA. Please discuss the interface between these other four with the three reviewed, and why that interface can in no instance cause a change in response time of the unit.

6.9 Trip Unit FMEA, Table B5-2

Please discuss each component in the circuitry, and show that any failure of that component can not cause the response time to exceed the BRT of 24 ms.

7.0 GE CR120A RELAYS

7.1 Section 6.1.5.1 states that this review is applicable for any GE Type CR120A , 120 Vac or 115 Vac, 60 Hz coil. How many different models of this type relay exist, and what are the differences between them?

7.2 Please justify the 80 ms BRT.

7.3 Sections 6.1.5.2(a) and B.6.1.2(a) state that the relays must be confirmed to open in 20 ms prior to installation of after any maintenance to repair of the relays. What maintance or repair is performed on the relays?

7.4 Sections 6.1.5.2(b) and B.6.1.2(b) require, in part, that "Vendor maintenance, application and replacement recommendations have been followed." What are these recommendations, and how will the licensees wishing to take advantage of the topical report demonstrate that the recommendations have been followed?

7.5 Section B.6.1.2 states that "performance problems with the CR120A relays have been identified in the past, all were identified by tests or actions other than response time tests." Section B.6.2.3 again mentions the problems, but does not discuss what they were, or how they were discovered. What were these problems, and how were they identified?

7.6 In Section B.6.2, only one model of relay was identified; therefore, it is difficult to know which other models are similar to the GE CR120A04022AA. As in Item 7.1 above, please identify each model which is considered similar to the GE CR120A04022AA.

7.7 FMEA on GE CR120A04022AA.

7.7.1 Item 3 refers to "loose tolerances of the design." What are the tolerances, and how is a "loose tolerance" distinguished from poor design?

7.7.2 The Item 3 comment states that there is no history of failures that result in outgassing resulting in deposits of glue-like substances. What materials within the relay have been tested to determine that outgassing is not possible? What would the results be if such outgassing did occur?

7.7.3 Several items in this FMEA discuss low forces. In each case, please state what the value of the force is, and the mass these forces act upon.

8.0 RPS SCRAM CONTACTORS

8.1 Section 6.1.6 is not clear in what is requested, and which components are the subject of the request. It appears that the BWROG is attempting to exempt a system, which may be comprised of various components. The note in Section 6.1.6.1 seems to state that the Potter & Brumfield MDR relays, a part of this system, still need to be tested for response time because the required response time is less than the BRT mentioned in Section 6.1.3. Please verify this interpretation.

8.2 The other components in the system seem to be GE CR105, GE CR205, or GE CR305 Magnetic Contactors. It appears that these Magnetic Contactors are the subject of this request, and it is these components which the BWROG wishes to have exempted from RTT. Please confirm that the components for which relief of RTT is requested are these contactors.

8.3 Section 6.1.6.2 appears to state that the BRT will be either 65 ms or 45 ms, depending on how the rest of the system is tested. Since in the other portions of this topical report, the BRT is based upon a FMEA and the physical constraints of the component and parts within the component, it is difficult for the staff to understand why this series of components is being treated differently. Please expand the discussion of this concept in sufficient detail to clarify and justify the reason for this change.

8.4 Please describe in detail what testing would continue to be performed, and which components would be exempted if this portion of the topical report were to be approved.

8.5 Section B.7 does not have a similarity analysis or a FMEA included. It is, therefore, unclear which components have been analyzed, which other components are considered similar to the one analyzed, or what analysis has been done. Please perform a FMEA on the desired components, and document the results.

9.0 SECTION 6.3, DEFENSE IN DEPTH

The argument that a 5-second response would not result in a significant degradation in safety, while a part of the original submittal, was not a significant consideration in the approval of the submittal. In addition, there is a significant difference between adding 5 seconds to a response time requirement of 20 seconds, and adding 5 seconds to a requirement of 200 ms. If the BWROG wishes to go forth with this argument, a worst case analysis, with corresponding changes to the plant specific accident analysis will be required. Does the BWROG wish to make this a required part of each plant specific RTT TS amendment referencing this topical report? In addition, any plant specific TS amendment would have to take into consideration any other component in the trip system for which the 5 second delay may have already been assumed, and add all the postulated delays to determine the worst case delay. Please confirm that this will be the case for future RTT elimination for individual components.

10.0 APPENDIX E - REVISIONS TO IMPROVED STANDARD TECHNICAL SPECIFICATIONS

The Topical Report does not change the basic requirement stated in IEEE 338 that response time testing shall be required to verify that the response times are within the limits given in the Safety Analysis Report including Technical Specifications. The revisions to the TS as shown in this appendix seem to eliminate references to response time testing. While some response time testing requirement may have been shown to be fulfilled through other means, the requirements are still present, and as such, must be reflected in the TS. In addition, the relaxations in RTT are only valid if certain instruments, specifically reviewed, are used by licensees. This appendix should be revised to retain the requirements for RTT, and specifically list those portions of the trip system whose components do not require testing. In addition, there must be some manner to alert licensee personnel that if a current model of instrument is replaced at some future time with a model or manufacturer of instrument which has not been specifically exempted, response time testing must be resumed. Please rewrite this appendix to maintain RTT requirements and specifically list those component items and trip systems containing those items which may be exempted from RTT.