**From:** "MILLAR, DANA" <DMILLAR@entergy.com>
**To:** "'twa@nrc.gov'" <twa@nrc.gov>
**Date:** 12/17/02 3:48PM
**Subject:** ANO-2 EDG AOT Extension RAI

Tom,

Attached is a draft copy of the request for additional information for the ANO-2 EDG AOT Extension. We will talk from this document tomorrow during the conference call.

We will initiate the call however if you need to call us below are the number at which we can be reached just prior to the conference call.

Dana Millar

2CAN1202XX

December 20, 2002

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

SUBJECT: { AUTOTEXTLIST * MERGEFORMAT }
{ AUTOTEXTLIST * MERGEFORMAT }
Supplement to Amendment Request
Extension of Emergency Diesel Generator Allowable Outage Time

REFERENCES:
1. Letter Submitted to the NRC September 19, 2002 from Arkansas Nuclear One, Unit 2, License Amendment Request Extension of Emergency Diesel Generator Allowable Outage Time (2CAN090202)

Dear Sir or Madam:

By letter (reference 1), Entergy Operations, Inc. (Entergy) proposed a change to the { AUTOTEXTLIST \s "Normal" * MERGEFORMAT } Technical Specifications (TSs) to extend the emergency diesel generator allowable outage time.

On October 22, 2002, Entergy and members of your staff held a call to discuss questions related to the probabilistic safety assessment performed in support of the proposed amendment. As a result of the call, five questions were determined to need formal response. Entergy's response is contained in Attachment 1.

There are no technical changes proposed. The original no significant hazards considerations included in reference 1 is not affected by any information contained in the supplemental letter. There are no new commitments contained in this letter.

If you have any questions or require additional information, please contact { AUTOTEXTLIST * MERGEFORMAT }.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 20, 2002.

Sincerely,

Sherrie R. Cotton,
Director, Nuclear Safety and Assurance

SRC/dm

Attachments:
1. Response to Request for Additional Information

{ AUTOTEXTLIST \s"normal" * MERGEFORMAT }

**Attachment 1**

**To**

**2CAN1202XX**

**Response to Request for Additional Information**

**RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ANO-2 EDG AOT EXTENSION REQUEST SUBMITTAL**

**QUESTION 1:**

The risk metric values (Annual Average ΔCDF, ICCDP, Annual Average ΔLERF, and ICLERP) provided in Table 1 of the ANO-2 EDG AOT extension request submittal (reference 1) assume Preventative Maintenance (PM) on the EDGs. Provide values for these risk metrics assuming Corrective Maintenance (CM) on the EDGs and describe how the PM and CM results differ.

**RESPONSE:**

Table A, below, provides Corrective Maintenance (CM) values for the following risk metrics: annual average change in core damage frequency (CDF), incremental conditional core damage probability (ICCDP), annual average change in large early release frequency (LERF), and incremental conditional large early release probability (ICLERP). The ICCDP and ICLERP values in this table correspond to a 14 day allowable outage time (AOT) for CM purposes on the most risk significant emergency diesel generator (EDG) and the annual average ΔCDF and ΔLERF values correspond to a 14 day AOT for CM purposes on both EDGs once per cycle. The CM values are higher than the Preventative Maintenance (PM) values reported in Table 1 of reference 1. The CM values assume elevated common cause failure (CCF) probabilities associated with the operable EDG and the Alternate AC Diesel Generator (AACDG) and assume that test and maintenance may be in progress in the switchyard, on the startup transformers, or on equipment that affects the operable EDG or AACDG during the EDG CM window. Whereas, for the PM case, it was assumed that CCF of the operable EDG and the AACDG was determined to be absent and it was assumed that no test and maintenance was in progress in the switchyard, on the startup transformers, or on equipment that affects the operable EDG or AACDG during the EDG PM window.

The CM metrics were not used in the ANO-2 EDG AOT extension request; only the PM metrics apply to this request. This is consistent with Technical Specifications paragraph 3.8.1.1 Action b.2, with the verbiage in the associated Technical Specifications Bases, and with the List of Regulatory Commitments (Attachment 4 to reference 1).

Table A. Risk Metrics Associated with 14 day Corrective Maintenance EDG AOT

| Risk Metric | Significance Criterion | Internal Events Results [Note 1] | External Events Results [Note 2] |
|---|---|---|---|
| Annual Average ΔCDF | < 1.0E-06/rx-yr | 4.8E-07/rx-yr [Note 3] | 4.0E-07/rx-yr [Note 4] |
| ICCDP | < 5.0E-07 | 3.6E-07 [Note 3] | 3.0E-07 [Note 4] |
| Annual Average ΔLERF | < 1.0E-07/rx-yr | 6.4E-08/rx-yr [Note 4] | 3.4E-08/rx-yr [Note 4] |
| ICLERP | < 5.0E-08 | 4.8E-08 [Note 4] | 2.6E-08 [Note 4] |

Notes:
1 includes modeled "internal events" risk contributors, excludes ATWS and ISLOCA
2 includes "external events" risk contributors and ATWS and ISLOCA
3 based on quantitative assessment using ANO-2 PSA model
4 based on qualitative assessment using insights from the ANO-2 Individual Plant Examination (IPE) and ANO-2 IPE for External Events (IPEEE)

**QUESTION 2:**

Provide the nominal internal events and external events ANO-2 CDF and LERF values.

**RESPONSE:**

Table B, below, provides the nominal internal events and external events ANO-2 CDF and LERF values.

Table B

| Risk Metric | Internal Events (excludes ATWS, ISLOCA) | External Events (includes ATWS, ISLOCA) |
|---|---|---|
| Nominal CDF (with nominal test and maintenance (T&M)) | 8.3E-6/rx-yr [Note 1] | 5.1E-6/rx-yr [Note 2] |
| Nominal LERF (with nominal T&M) | 9.0E-7/rx-yr [Note 2] | 4.2E-7/rx-yr [Note 2] |

Notes: 1 based on quantitative assessment of the ANO-2 PSA model
2 based on qualitative assessment using insights from ANO-2 IPE and IPEEE

**QUESTION 3:**

Describe the general methodology used to treat common cause failures (CCFs) in the ANO-2 PSA model.

**RESPONSE:**

A majority of the CCF event multiplier factors were quantified using the "alpha factor" method described in NUREG/CR-5485 (reference 2) with alpha CCF values from NUREG/CR-5497 (reference 3) and NUREG/CR-6268 (reference 4). The CCFWIN software and database was used where readily applicable alpha factors were not available from the references 2 or 3. When the CCFWIN results were significantly inconsistent with the reported values for similar equipment in references 2 or 3, the latter (INEEL Report NUREG/CR-5497) was used. When there was a doubt as to the validity of the result obtained from the CCFWIN database (e.g., due to data not having been collected for a component) then either screening values or results reported for similar equipment in the other industry studies or from the previous version of the ANO-2 PSA were used.

**QUESTION 4:**

Describe the treatment of Station Blackout (SBO) induced Reactor Coolant Pump (RCP) seal failure in the ANO-2 PSA model.

**RESPONSE:**

The treatment of SBO induced RCP seal failure in the ANO-2 PSA model is based on methodology described in CE NPSD-755, Rev. 01 (reference 6). This is consistent with the ANO-2 Byron-Jackson (BJ) N-9000 RCP seal design. An updated version of this methodology is documented in CE NPSD-1199 (reference 7). The latter report incorporated Staff comments on the former and is currently undergoing Staff review.

The CE RCP seal failure model was developed as an alternative to the "Rhodes" RCP seal failure model. The Rhodes model, developed and applied to Westinghouse RCP seals (reference 8), does not apply to CE RCP seals due to differences between the Westinghouse and CE RCP seal design, construction, and materials.

Although the ANO-2 PSA model employs the reference 6 RCP seal failure model, the RCP failure probability assumed in the ANO-2 model is conservative with respect to that of the updated model. Thus, the current model conservatively bounds the risk associated with SBO induced RCP seal failure.

**QUESTION 5:**

Summarize the significant Facts & Observations (F&Os) identified during the ANO-2 PSA Peer Review process and describe their effect on the risk results provided in the ANO-2 EDG AOT extension submittal.

**RESPONSE:**

A Combustion Engineering Owners Group (CEOG) PSA Peer Review was conducted on the ANO-2 PSA during the week of February 11, 2002. At this time, an interim version of the ANO-2 PSA peer review report has been issued; the final report is expected to be issued early in 2003.

The review followed a process adapted by the CEOG from the industry peer review process described in NED 00-02 (reference 5). This review was conducted under CEOG sponsorship. A review team consisted of seven highly experienced PSA practitioners who were independent of the ANO-2 PSA model development.

The general scope of the PSA Peer Review included a review of major technical elements of the at-power PSA. The peer review provided an assessment of the technical adequacy of each of the major technical elements and identified specific strengths and weaknesses associated with each. The major product of the review process is the specific strengths and weaknesses documented in the Facts and Observation (F&O) sheets associated with the review of each technical element and the recommendations for improvements.

There were six F&Os on the ANO-2 PSA model that were graded with an "A" Level of Significance, i.e., "extremely important and necessary to address to assure the technical adequacy of the PSA or the quality of the PSA or the quality of the PSA update process." The "A" level F&Os are summarized below. Their impact on the conclusions of the ANO-2 EDG AOT extension risk analysis is also presented below. The overall conclusion of these assessments is that the incorporation of all of these issues into the model, as appropriate, has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal. Thus, the expected risk increase associated with the EDG AOT extension are within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

**F&O AS-01:**

The initiating event %T7 (Total Loss of Service Water Flow Initiating Event) appears with basic event STM2-2P4BM (2P-4B IN TEST & MAINTENANCE) in the top cutsets. Although, during normal operation, the standby service water (SW) pump is available for recovery from the %T7 initiator, there is an increased likelihood that the standby pump will fail due to same common cause event that resulted in the initiator. Thus, the model does not appear to account for the expected dependency between the loss of SW initiator and the availability of the standby SW pump to recovery from this initiator.

**F&O AS-01 Impact Assessment:**

The subject F&O does not affect the EDG AOT Extension risk impact, since cutsets involving a CCF of all three SW pumps cannot also involve an EDG maintenance event (since the EDGs require SW for cooling). A sensitivity analysis confirmed this expectation. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension remain within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

**F&O AS-02:**

Many initiating events were assumed to challenge the primary safety relief valves (SRVs); however, very few of these initiators are realistically expected to challenge the SRVs.

**F&O AS-02 Impact Assessment:**

The subject modeling leads to conservatively high CDF estimates and subsequently leads to a conservatively high estimate of the impact of the EDG AOT risk. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension remain within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

**F&O AS-03:**

The family of cutsets involving %T14 (LOSS OF AC BUS 2B5 <IE>)* DBT2DSCD11*PRY201002T* PRY201052T do not account for the potential of multiple operator actions and thus their contribution to the overall risk appears to be very conservative.

**F&O AS-03 Impact Assessment:**

The subject family of cutsets leads to conservatively high CDF estimates and subsequently leads to a conservatively high estimate of the risk impact of the EDG AOT extension. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension are within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

**F&O SY-02:**

This F&O was comprised of four issues:

1. a CCF event affecting all three EFW/AFW pumps (i.e., the TD EFW pump 2P-7A, the MD EFW pump 2P-7B, and the MD AFW pump 2P-75) was not included in the ANO-2 PSA model

2. a CCF event between the AC-powered and DC-powered EFW injection valves was not included in the ANO-2 PSA model

3. a CCF event between the AC and DC MOVs associated with the ECCS Vent Valve and LTOP valves was not included in the ANO-2 PSA model

4. CCF events HCC2SUCKVCCF (CCF HPSI Suction Flow Path Check Valves (2 of 2) Fail to Open) and HCC2HRWTCV (CCF HPSI RWT Suction Flow Path Check Valves (2 of 2) Fail To Open) appear to have been erroneously assumed to be interchangeable.

**F&O SY-02 Impact Assessment:**

1. A CCF of the motor-driven (MD) emergency feedwater (EFW) pump and the MD auxiliary feedwater (AFW) pump was included in the ANO-2 PSA model used for the risk assessment of EDG AOT extension: events QCC2EFMDPS (CCF To Start Of Motor Driven Pumps 2P75 and 2P7B) and QCC2EFMDPR (CCF To Run Of Motor Driven Pumps 2P75 and 2P7B). However, no CCF event affecting all three EFW/AFW pumps was included in the model on the basis that the pump drivers were expected to dominate the failure probability of the pumps; thus, the CCF associated with the MD pumps was not applied to the turbine-driven (TD) EFW pump. A sensitivity analysis was performed to assess the effect of adding a CCF event affecting all three EFW/AFW pumps. This CCF event was added to the model; the probability of this CCF event was based on alpha values presented in Tables 9-1 and 9-4 of NUREG/CR-5497. This analysis revealed that the risk impact of the EDG AOT extension remained acceptable, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension

remain within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

2. A CCF event associated with the DC powered EFW injection valves and another CCF event associated with the AC powered EFW injection valves were included in the ANO-2 PSA model used for the risk assessment of EDG AOT extension: events QCC2CCF1DC (Common Cause Failure Module Of EFW DC Injection Valves) and QCC2CCF1AC (Common Cause Failure Of EFW AC Injection Valves). However, no CCF event affecting both the AC and DC valves was included in the model on the basis that motors on the AC and DC valves differed and that some of the valve bodies differed (namely, MD EFW discharge valves differ from the others). The only shared dependency between all of the valves is the valve operators and this element has not historically been a relatively large contributor to the failure of these valves at ANO-2. A specific sensitivity analysis of this issue was not performed, but the effect of adding this issue to the model is expected to be bounded by the results of the sensitivity analysis of adding a CCF event affecting all three EFW/AFW pumps. Thus, incorporation of the subject F&O issue into the model is not expected to impact the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension remain within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

3. A CCF of the LTOP valves RCC2473141 (Failure Of LTOP Valves 2CV4731-2 and 2CV4741-1 To Open) was included in the ANO-2 PSA model used for the risk assessment of EDG AOT extension. However, a CCF affecting both the DC powered ECCS vent valves and the AC powered LTOP valves was not included in the model on the basis of differences in the valve motors. A sensitivity analysis was performed to assess the effect of adding a CCF event affecting both the LTOP and ECCS vent valves. This CCF event was added to the model; the probability of this CCF event was based on the alpha values presented in Table 37-1of NUREG/CR-5497. This analysis revealed that the risk impact of the EDG AOT extension remained acceptable, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension remain within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

4. CCF events HCC2SUCKVCCF (CCF HPSI Suction Flow Path Check Valves (2 of 2) Fail To Open) and HCC2HRWTCV (CCF HPSI RWT Suction Flow Path Check Valves (2 of 2) Fail To Open) were not used interchangeably. Consistent with its description, HCC2HRWTCV was used to account for CCF associated with RWT suction flowpath check valves. There are no equivalent check valves on the Containment Sump suction flowpath and, thus, HCC2SUCKVCCF was not needed and, as appropriate, was not used in the model.

**F&O SY-09:**

The ANO-2 station batteries are assumed capable of providing DC power for up to 8 hours following the loss of all battery charging. However, operator action is required in order to assure battery availability for this long a period and the PSA model does not account for operator failure to shed DC loads during accidents involving the loss of all charging to a station battery.

**F&O SY-09 Impact Assessment:**

A sensitivity analysis was performed to assess the effect of operator action to shed DC loads. Based on discussions with electrical design engineering, both station batteries (2D-11 and 2D-12) were assumed to completely discharge in 2.5 hours given no charging and no load reduction. Assessing the impact of a shorter battery discharge time (i.e., 2.5 hours rather than 8 hours with successful operator action to load shed batteries) involved accounting for changes in the probabilities of (1) Loss of Off Site Power (LOSP) recovery factors and (2) operator actions whose available time are dependent on the time to battery discharge. In addition, based on engineering judgment, a probability of 0.1 was assumed for operator failure to shed DC loads. Combining these effects revealed that the risk impact of the EDG AOT extension remained acceptable, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT extension are within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

**F&O QU-01:**

Recovery action YHF2CSSUMP (Failure to Recover Sump Suction Valves 2CV-5649-1 and 2CV-5650-2) is applied to cutsets which involve common cause failure of the outside containment sump valves. The application of this recovery to these cutsets has several problems:

1. The event only assumes the need to manually open the affected valves. The problem with this assumption is that when the RWT goes closed on RAS and the sump valves are not open, the actual action needs to place the HPSI pump in pull to lock, place the CS pump in pull to lock, open the sump valves manually, restart the HPSI pump, and then to restart the CS pump. This detail could not be found in the procedures.

2. The recovery action does not account for unrecoverable mechanical faults that prevent the valves from being opened manually.

3. Based on the action taking 45 minutes, the original HRA analysis assigned a value of .14. The expert panel revised this valve to .055 based on the operator not having to dress out and expected the action to only take 20 minutes. No discussion to failure of the operator to recognize the need to open the valve or a formal timeline performed to justify the shorter time.

Because of these issues, the .055 is probably overly optimistic.

**F&O QU-01 Impact Assessment:**

A sensitivity analysis was performed on the internal events CDF portion of the ANO-2 EDG AOT Extension risk analysis to assess the effect of taking no credit for operator action YHF2CSSUMP. This analysis revealed that the risk impact of the EDG AOT extension remained acceptable, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr. Thus, incorporation of the subject F&O into the model has no impact on the conclusions of the ANO-2 EDG AOT Extension submittal: the expected risk increase associated with the EDG AOT

extension remain within the Regulatory Guide 1.174 and 1.177 guidelines, i.e., ICCDP < 5E-7 and Annual Average ΔCDF < 1E-6/rx-yr.

**REFERENCES:**

1. Letter from Craig Anderson (Entergy) to USNRC, "Extension of Emergency Diesel Generator Allowable Outage Time", 2CAN090202, September 19, 2002
2. USNRC, Guidelines on Modeling Common-Cause Failures in Probabilistic Risk Assessment, NUREG/CR-5485, USNRC, Washington, DC, November 1998.
3. USNRC, Common-Cause Failure Parameter Estimations, NUREG/CR-5497, USNRC, Washington, DC, October 1998.
4. USNRC, Common-Cause Failure Database and Analysis System, NUREG/CR-6268, USNRC, Washington, DC, June 1998.
5. NEI 00-02, "Probabilistic Risk Assessment (PRA) Peer Review Process Guidance", Nuclear Energy Institute, March, 2000.
6. CE NPSD-755, Rev. 01, Reactor Coolant Pump Seal Failure Probability Given a Loss of Seal Injection, C-E Owners Group, May 1998.
7. CE NPSD-1199, Model to Failure of RCP Seals Given Loss of Seal Cooling, July 2000.
8. BNL Technical Report W6211-08/99, Guidance Document for Modeling of RCP Seal Failures, Martinez-Guridi, G. et. al., August 1999.

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**Subject:** ANO-2 EDG AOT Extension RAI
**Creation Date:** 12/17/02 3:48PM
**From:** "MILLAR, DANA" <DMILLAR@entergy.com>

**Created By:** DMILLAR@entergy.com

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