

February 24, 2004

Mr. Jeff Forbes, Vice President  
Entergy Operations, Inc.  
Arkansas Nuclear One  
1448 SR 333  
Russellville, Arkansas 72802

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING SEVERE  
ACCIDENT MITIGATION ALTERNATIVES FOR ANO-2

Dear Mr. Forbes:

The staff has reviewed Entergy's analysis of severe accident mitigation alternatives (SAMAs) submitted in support of its application for license renewal for ANO-2, and has identified areas where additional information is needed to complete its review. Enclosed is the staff's request for additional information.

As discussed with your staff, we request that you provide your responses to these RAIs within 60 days of the date of this letter. If you have any questions, please contact me at (301) 415-1120.

Sincerely,

**/RA/**

Thomas J. Kenyon, Sr. Environmental Project Manager  
License Renewal and Environmental Impacts Branch  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

Docket No.: 50-368

Enclosure: As stated

cc w/encl: See next page

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DATE	2/19/04	2/24/04	2/24/04	2/24/04

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**Request for Additional Information Regarding the Analysis of Severe Accident Mitigation Alternatives (SAMAs) for Arkansas Nuclear One, Unit 2**

1. The SAMA analysis is based on the most recent version of the ANO-2 Probabilistic Safety Assessment (PSA) for internal events, i.e., Revision 3p2, which is a modification to the IPE submittal transmitted to the NRC in March 1994. Please provide the following information regarding this PSA model:
  - a. A description of the internal and external peer reviews of the level 1 and 2 portions of the PSA that have been performed since the IPE.
  - b. A description of the overall findings of the owner's group peer review (by element), and discussion of any findings/observations (e.g., A and B Facts and Observations) that could potentially affect the SAMA identification and evaluation process, and how Entergy has addressed these findings for this application (including, for example, sensitivity studies of the impacts of alternative assumptions).
  - c. A breakdown of the internal events core damage frequency (CDF) by major contributors, initiators or accident classes, such as loss of offsite power (LOOP), station blackout (SBO), transients, anticipated transient without scram (ATWS), loss-of-coolant accident (LOCA), interfacing systems LOCA (ISLOCA), steam generator tube rupture (SGTR), internal floods, etc. According to ER Table 4-4, the staff has calculated the following:

Transients	3.90E-6
Small Break LOCA	1.52E-6
ISLOCA	3.27E-7
Vessel Rupture	2.70E-7
Medium Break LOCA	1.66E-7
Large Break LOCA	2.25E-7
SGTR	1.03E-7
Total CDF	6.51E-6

The total CDF calculated by the staff does not equate to the CDF of 7.17E-06/year calculated and used by Entergy in the SAMA analysis. It appears that ATWS and internal flooding are not included in the CDF results displayed in Environmental Report (ER) Table 4-4. This might explain the difference in CDF values given by Entergy and calculated by the staff. Please update/revise the numbers as appropriate, and explain any differences. If ATWS and internal floods are not included, provide justification for their exclusion.

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- d. The approximate CDF and large early release frequency (LERF) for each revision to the PSA model, and a description of the major reasons for the changes from the prior version, i.e., a brief statement about major hardware and/or modeling changes that resulted in the new CDF.
  - e. The changes in the level 2 methodology since the IPE submittal, including major modeling assumptions, containment event tree (CET) structure, and binning of end states.
  - f. A description of the mapping of Level 1 results into the various containment end states/release categories. If this remains unchanged since the IPE, please indicate so.
  - g. Table E.1-2 lists the release category frequencies and fission product release fractions used in the level 3 analysis. These appear to be unchanged since the IPE submittal. If this is the case, explain why the current CDF was not used in the SAMA analysis. If not, please provide the updated values used in the level 3 analysis.
  - h. A breakdown of the population dose (person-rem per year within 50 miles) by containment release mode, such as steam generator tube rupture (SGTR), ISLOCA, early containment failure, late containment failure, and no containment failure.
2. Discuss the RCP seal LOCA model utilized in the ANO-2 PSA and why it is judged to provide an appropriate representation of RCP seal LOCA events. Also, indicate the current percent contribution to the CDF for RCP seal LOCA.
  3. Based on the accident sequence descriptions provided in the ER, it does not appear that thermally-induced SGTR is included in the level 1 PSA model. Discuss the impact including thermally-induced SGTR events on the SAMA analysis.
  4. Relative to the MACCS2 input and results, please provide the following:
    - a. A brief discussion on how the releases were modeled, e.g., at ground level with a thermal content the same as ambient, and
    - b. Clarification of whether the replacement power costs were scaled relative to the 910 MWe reference plant since ANO-2 is rated at 1023 MWe.
  5. According to the ER, Entergy evaluated 192 SAMA candidates and eliminated 99 SAMAs during the initial screening. In this regard, please provide the following:
    - a. A description of how the dominant risk contributors at ANO-2, including dominant sequences and equipment failures and operator actions identified through importance analyses (e.g., Fussell-Vesely, Risk Reduction Worth, etc.) were used to identify potential plant-specific SAMAs.

- b. The percentage of the total CDF represented by the top 100 cut sets that were evaluated.
  - c. A listing of equipment failures and human actions that have greatest potential for reducing risk at ANO-2 based on importance analysis and cut set screening.
  - d. For each dominant contributor identified in the current PSA, a cross-reference to the SAMA(s) evaluated in the ER that address that contributor. If a SAMA was not evaluated for a dominant risk contributor, justify why SAMAs to further reduce these contributors would not be cost beneficial.
  - e. A list of the 99 SAMAs that were screened out in the initial screening and the basis for excluding each of these SAMAs.
  - f. The status of each of the SAMA candidates obtained from the IPEEE (SAMAs IPEEE-01 through IPEEE-11), and
  - g. By letter dated October 5, 1995, Entergy indicated that SAMA FW-17 was implemented in 1993. In addition, the staff understood that SAMA CB-23 was implemented. However, these enhancements are evaluated in the SAMA analysis and found to not be cost beneficial. Confirm whether these enhancements were actually implemented.
6. The SAMA analysis did not include an assessment of SAMAs for external events. The ANO-2 IPE for External Events (IPEEE) SER reports that the CDF due to internal fire initiated events is about  $3.8 \times 10^{-5}$  per reactor year which is substantially greater than the internal events CDF on which the SAMA evaluation is based. The risk analyses at other commercial nuclear power plants also indicate that external events could be large contributors to CDF and the overall risk to the public. In this regard, the following additional information is requested:
- a. NUREG-1742 ("Perspectives Gained From the IPEEE Program," Final Report, 4/02), lists the significant fire area CDFs for ANO-2 (page 3-8 of Volume 2). While these fire-related CDF estimates may be conservative, they are still large relative to the ANO-2 internal events CDF. For each fire area, please explain what measures were taken to further reduce risk, and explain why these CDFs can not be further reduced in a cost effective manner.
  - b. NUREG-1742 lists seismic outliers and improvements for ANO-2 (page 2-25 of Volume 2). Indicate whether the "Plant improvements" that address the outliers have been implemented for all outliers. If not, please explain why within the context of this SAMA study.
7. Entergy has opted to double the estimated benefits (for internal events) to accommodate any contributions for external events. This is acceptable when sound reasons exist to support such a numerical adjustment. However, based on the information in the ER and in the ANO-2 IPEEE report, the fire CDF is approximately a factor five greater than the internal events CDF, which suggests that the estimated

benefit for the SAMAs should be increased by at least a factor of six to account for external events (in contrast to the factor of two used in the SAMA analysis). In order to determine if external events have been satisfactorily accounted for, please provide the following information:

- a. The current CDF for fire-initiated events, and justification that doubling the estimated benefits for internal events will bound the risk from fire events.
  - b. An assessment of the impact on the initial and the final screenings if the internal events risk reduction estimates are increased by a factor that would bound the risk from fire and seismic events, and
  - c. Justification for why the following SAMAs would not be cost beneficial when the risk reduction associated with external events is reflected in the baseline estimates, given that the implementation costs are within a factor of 3 of the estimated benefits: AC/DC-16, AT-02, CB-10, CB-26, CC-07, CW-06, CW-21, CW-23, CW-27, EV-02, FW-13, FW-17, HV-03, HV-05, and OT-06.
8. The SAMA analysis did not include an assessment of the impact of PSA uncertainties. On that basis, please provide the following information to address these concerns:
- a. An estimate of the uncertainties associated with the calculated core damage frequency (e.g., the mean and median internal events CDF estimates and the 5<sup>th</sup> and 95<sup>th</sup> percentile values of the uncertainty distribution), and
  - b. An assessment of the impact on the final screening if risk reduction estimates are increased to account for uncertainties in the risk assessment. Please consider the uncertainties due to both the averted cost-risk and the cost of implementation to determine changes in the net value for these SAMAs.
9. Based on a review of Table E.2-1 of the ER, cost estimates for implementation are provided only when a previous cost estimate was available, or when the candidate SAMA involves a modification to a procedure. For the remaining SAMAs, only a generic statement is provided that the cost of implementing the SAMA is judged to exceed the attainable benefit. Please provide justification, supported by a more detailed analysis or cost estimate, for eliminating the following SAMA candidates, particularly when the risk reduction associated with external events is reflected in the baseline estimates: CB-03, CB-14, CC-01, CC-20, CW-01, CW-09, CW-13, CW-24, CW-26, EV-31, and FW-01.

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