

May 18, 2001

The Honorable Richard A. Meserve  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Dear Chairman Meserve:

SUBJECT: REPORT ON THE SAFETY ASPECTS OF THE LICENSE  
RENEWAL APPLICATION FOR ARKANSAS NUCLEAR ONE,  
UNIT 1

During the 482<sup>nd</sup> meeting of the Advisory Committee on Reactor Safeguards, May 10-11, 2001, we completed our review of Entergy Operations, Inc., application for license renewal of Arkansas Nuclear One, Unit 1 (ANO-1), and the related final Safety Evaluation Report (SER). Our review included two meetings with the staff and the applicant. We had the benefit of the documents referenced.

#### Conclusions and Recommendations

1. Entergy has properly identified the structures, systems, and components (SSCs) that are subject to aging management review consistent with the requirements of 10 CFR Part 54.
2. Aging mechanisms associated with passive, long-lived SSCs have been appropriately identified.
3. The programs instituted to manage aging-related degradation of the identified SSCs are appropriate and provide reasonable assurance that ANO-1 can be operated in accordance with its current licensing basis for the extended license term without undue risk to the health and safety of the public. The programs do not explicitly address the potential for circumferential cracking in control rod drive mechanism (CRDM) nozzle penetrations, such as has been observed at the Oconee Nuclear Plant, Unit 3. We expect that this current problem will be resolved and that the resolution will be incorporated into the current licensing basis and carried over into the license renewal period.

4. The staff has performed a comprehensive and thorough review of Entergy's application, and the open items identified in the January 2001 draft SER have been satisfactorily resolved .
5. The staff should determine whether modification of the current guidance in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," is required to reflect the lessons learned from the ANO-1 application regarding aging management of small-bore piping and medium-voltage buried cable.

### Background and Discussion

This report fulfills the requirement of 10 CFR 54.25 that the ACRS review and report on license renewal applications. Entergy requested renewal of the operating license for ANO-1 for a period of 20 years beyond the current license term, which expires on May 20, 2014. The final SER documents the results of the staff's review of information submitted by Entergy, including those commitments that were necessary to resolve open items identified by the staff in its January 2001 draft SER. The staff's review included verification of the completeness of the SSCs identified in the application, the validation of the integrated plant assessment process, the identification of the possible aging mechanisms associated with each passive long-lived component, and the adequacy of the aging management programs.

Our Subcommittee on Plant License Renewal met with the applicant and the staff on February 22, 2001, to review the SER with open items. The Subcommittee did not identify any issues to be addressed other than the six open items identified by the staff. This remarkably small number of open items is due, in large part, to the fact that the applicant implemented relevant lessons learned from the previous license renewal applications. In addition, the applicant structured the application using the standard application format and the guidance in Nuclear Energy Institute (NEI) Report 95-10, which facilitated the review. Because of the small number of open items and the scrutability of the application, we decided that there was no necessity to provide an interim report and have reviewed the SER on an accelerated basis.

The process implemented by the applicant to identify SSCs within the scope of the License Renewal Rule is effective. Reactor coolant system (RCS) components were identified using the generic Babcock & Wilcox Owners Group (BWOG) topical reports that address aging of RCS piping, pressurizer, reactor vessel, and reactor vessel internals. These topical reports, which have been approved by the staff, are applicable to ANO-1 and were used to support the license renewal application for Oconee. All other components in scope were determined on a plant-specific basis. At ANO-1, the safety-related SSCs included in the quality assurance program ("Q" list), as required by 10 CFR Part 50, Appendix B, are

those that meet the definition of “safety related” in 10 CFR 54.4(a)(1). Furthermore, the majority of SSCs whose failure could prevent satisfactory accomplishment of any of the safety-related functions in 10 CFR 54.4(a)(1) are also classified as safety-related and included in the ANO-1 “Q” list. Therefore, the applicant was able to use the “Q” list to identify the bulk of the ANO-1 SSCs within the scope of the License Renewal Rule. This process has also resulted in the conservative inclusion of some SSCs that do not meet the criteria of 10 CFR 54.4(a)(2). We concur with the staff that the applicant has properly identified SSCs requiring an aging management review.

The applicant conducted a comprehensive aging management review of SSCs in scope. Aging effects of RCS components were identified using the aforementioned BWOOG topical reports. Aging effects of all other SSCs were identified based on component material, operating environment, and operating stresses using plant-specific and industry-wide operating experience. Appendix B of the application describes the 22 existing or modified programs and the seven new programs implemented to manage aging during the period of extended operation.

ANO-1 has proposed a significantly smaller number of one-time inspections than did previous applicants. This is due, in part, to the fact that existing or modified ANO-1 programs manage aging effects that previous applicants do not manage during their current license terms. Consequently, previous applicants had to implement a larger number of one-time inspections to support license renewal. For example, aging of small-bore piping is managed at ANO-1 by a plant-specific risk-informed inspection program, and therefore, does not require a one-time inspection. We agree with the staff that the applicant has properly identified possible aging mechanisms associated with passive, long-lived SSCs and that the programs instituted to manage aging degradation of the identified SSCs are appropriate.

The ANO-1 application identifies cracking at welded joints of the CRDM pressure boundary as an aging effect to be managed. Appendix B of the application describes the aging management program instituted to deal with this aging degradation mechanism; i.e., “CRDM nozzle and other vessel closure penetration inspection program.” This program identifies primary water stress corrosion cracking of Alloy-600 nozzles with partial penetration welds as the aging effect of concern and ties programmatic elements, such as the frequency of inspections, to the results of plant-specific and sister plant inspection findings. The initiatives included in this program are adequate to deal with this identified aging effect during the remaining portion of the current license term and during the period of extended operation. However, it is likely that the recent observations of stress corrosion cracking at the outer surface of CRDM nozzle penetrations may require some revisions to the program. We have noted previously that aging management

programs may have to be revised if it is found that new modes of degradation are occurring.

The ANO-1 application includes time limited aging analyses (TLAA) to evaluate the impact of neutron embrittlement on reactor vessel integrity. These analyses determine reactor vessel resistance to failure during pressurized thermal shock (PTS) events and the maintenance of acceptable Charpy upper-shelf energy levels. The TLAA used the methodology described in topical report BAW-2251A, "Demonstration of the Management of Aging Effects for the Reactor Vessel." This topical report was reviewed and approved by the staff and reviewed by the ACRS. Based on the composition of the limiting welds, Entergy projected that the ANO-1 reactor vessel will not reach the PTS and Charpy upper-shelf energy screening limits until well after 60 years of operation. The ANO-1 reactor vessel integrity program will be utilized to ensure that the time-dependent parameters used in the TLAA evaluations are tracked so that the TLAA remain valid during the license renewal period.

Entergy committed to implementing a plant-specific program to manage the effects of fatigue. Using the correlations published in NUREG/CR-5704, Entergy has found that the surge line, the high pressure injection/makeup nozzles, and safe ends may reach the limits of acceptable fatigue during the period of extended operation. To address this condition, Entergy has proposed a program that will include one or more of the following options: refinement of the fatigue analyses, repair, replacement, or management of fatigue effects using a program that will be reviewed and approved by the staff. We concur with the staff that Entergy's proposed program is an acceptable plant-specific approach for resolving the concerns of Generic Safety Issue-190, "Fatigue Evaluation of Metal Components for 60 Year Plant Life."

ANO-1 region 1 spent fuel storage racks currently use Boraflex as a neutron absorber. Aging of Boraflex was identified in the application as a time limited aging analysis. During the staff's review of the ANO-1 application, Entergy informed the staff that Boraflex had been found to degrade more rapidly than previously expected, and was not expected to last through the current 40-year licensing term. Therefore, a corrective action plan for the remainder of the 60-year operating term would be identified and committed to before the end of 2002. In Open Item 4.7.2-1 associated with Boraflex degradation, the staff requested that Entergy continue to recognize aging of Boraflex as a time limited aging analysis and provide details on the required monitoring program. Entergy has now provided the requested programmatic details. We concur with the staff that either the implementation of a permanent solution during the current licensing period or the Boraflex monitoring program provided by Entergy and described in the SER provides acceptable management of Boraflex degradation during the period of extended operation.

The staff has performed a comprehensive and thorough review of Entergy's application. The applicant and the staff have identified possible aging mechanisms associated with passive long-lived components. Adequate programs have been established to manage the effects of aging so that ANO-1 can be operated safely in accordance with its current licensing basis for the extended license term.

The review of the ANO-1 application has provided significant new information on small-bore piping and medium-voltage buried cable aging degradation and related management programs. As described above, ANO-1 has implemented a small-bore piping inspection program because it has identified small-bore piping in safety-significant locations that is susceptible to aging degradation. The staff should determine whether current guidance in the GALL report needs to be modified to reflect this experience. Also, ANO-1 has implemented a medium-voltage buried cable aging management program that includes the options of cable testing or periodic replacement of buried cables. ANO-1 has included the replacement option because it has found that in a number of instances testing was not effective in identifying cable degradation. The staff needs to evaluate the adequacy of testing of buried cables and provide appropriate guidance in the next update of the GALL report.

Dr. William J. Shack did not participate in the Committee's deliberations on aging-induced degradation.

Sincerely,

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George E. Apostolakis  
Chairman

References:

1. U.S. Nuclear Regulatory Commission, "Safety Evaluation Report Related to the License Renewal of Arkansas Nuclear One, Unit 1," dated April 2001.
2. Letter dated January 31, 2000, from C. R. Hutchinson to the U.S. Nuclear Regulatory Commission, Subject: Arkansas Nuclear One, Unit 1, License Renewal Application.
3. Letter dated March 14, 2001, from J. D. Vandergrift to the U.S. Nuclear Regulatory Commission, Subject: Arkansas Nuclear One, Unit 1, License Renewal Safety Evaluation Report Open Item Responses.

4. Babcock and Wilcox Owners Group Generic License Renewal Program Topical Report, BAW-2251A, "Demonstration of the Management of Aging Effects for the Reactor Vessel," dated June 1996.
5. U. S. Nuclear Regulatory Commission, NUREG/CR-5704, "Effects of LWR Coolant Environment on Fatigue Design Curves of Austenitic Steels," dated April 1999.
6. U. S. Nuclear Regulatory Commission, Generic Safety Issue - 190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life."