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

August 9, 2011

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT NO. 2 - CORRECTION TO SAFETY EVALUATION FOR AMENDMENT NO. 293 RELATED TO USE OF ALTERNATE SOURCE TERM (TAC NO. ME3678)

Dear Sir or Madam:

By letter dated April 26, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML110980197), the Nuclear Regulatory Commission (NRC) issued Amendment No. 293 to Renewed Facility Operating License No. NPF-6 for Arkansas Nuclear One, Unit No. 2 (ANO-2). The amendment consisted of changes to the Technical Specifications (TSs) in response to Entergy Operations, Inc.'s (Entergy's, the licensee's) application dated March 31, 2010, as supplemented by letters dated June 23, June 24, August 9, and September 16, 2010 (ADAMS Accession Nos. ML102000199, ML101750247, ML102250417, and ML102590567, respectively).

The amendment modified the requirements of the TS definitions, requirements, and terminology related to the use of an Alternate Source Term (AST) associated with accident offsite and control room dose consequences. In addition, implementation of the AST supports adoption of the control room envelope habitability controls in accordance with NRC-approved Technical Specification Task Force (TSTF)-448, Revision 3, "Control Room Habitability."

By electronic mail dated May 2, 2011 (ADAMS Accession No. ML111510824), Entergy notified the NRC staff of certain discrepancies in the Safety Evaluation (SE) enclosed with the NRC letter dated April 26, 2011. The NRC staff has reviewed this information, corrected the SE, and provided revised SE pages 5, 24, 25, and 27 in the enclosure to this letter, with revision bars indicating the areas of change. The specific corrections made are described below:

Correction to SE Section 3.1, page 5, lines 5 and 6

Current TS SR 4.4.8.1 in SE Section 3.1, page 5, lines 5 and 6, states:

> 4.4.8.1 Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity ≤ 3200 μCi/gm once every 7 days.*

Current TS SR 4.4.8.1 in SE Section 3.1, page 5, lines 5 and 6, is revised to state:

> 4.4.8.1 Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity ≤ **1200** μCi/gm once every 7 days.*

Correction to SE Section 3.3.6.2.1.2, pages 24 and 25

Current SE Section 3.3.6.2.1.2, pages 24 and 25, states:

3.3.6.2.1.2 ESF Recirculation Leakage

For ANO-2, it was assumed that leakage of coolant from ESF systems is possible upon initiation of those systems. The ANO-2 TSs do not provide a specific limitation on the total amount of operational leakage that is allowed from ESF systems. However, as a current design basis, the licensee assumed, consistent with the analyses discussed in Section 0 of this evaluation, that the total leakage from ECCS is equal to 2,060 cc/hr, assuming two containment spray and three high pressure safety injection (HPSI) pumps in operation. In accordance with the guidance of RG 1.183, the licensee assumed twice this amount (4,120 cc/hr) in analyzing the dose consequence from the ESF leakage pathway.

The licensee's DBA analysis assumed leakage to start at 1,560 seconds, which the licensee determined to be the time that the recirculation phase begins, and is consistent with AST activity release assumptions. The leakage was assumed to continue for the duration of the accident. The licensee conservatively took no credit for holdup or filtration of this leakage by assuming that the leaked activity is immediately available for release to the atmosphere.

The licensee assumed that, with the exception of iodine, all radioactive material in the recirculating coolant is retained in the liquid phase, and also in accordance with RG 1.183, the chemical form of the released iodine activity is assumed to be 97.00 percent elemental and 3.00 percent organic. The licensee determined the maximum ANO-2 sump temperature to be greater than 212 °F, and therefore, assuming constant enthalpy, applied the equation shown in RG 1.183, Appendix A, Section 5.4 to calculate the flashing fraction of leaked coolant. The licensee determined this value to be 2.29 percent; however, in accordance with RG 1.183 guidance, a conservative flashing fraction of 10 percent is used in the licensee's analysis.

The licensee's treatment of ESF leakage is consistent with its current design basis and the applicable regulatory guidance, and the NRC staff concludes it to be acceptable.

Revised SE Section 3.3.6.2.1.2, page 24 will state:

3.3.6.2.1.2 **NOT USED**.

The SE Section 3.3.6.2.1.2 has been deleted in its entirety. In order to keep the flow of the pages the same as the original SE, the entire space under the paragraph is left as a blank.

<u>Correction to SE Section 3.3.7, last paragraph, lines 2 and 5</u>

Current SE Section 3.3.7, last paragraph, states:

> The total bounding unfiltered inleakage into the ANO-2 control room assumed by the licensee was 82 cfm. This value was also assumed for the accident duration. In a letter dated August 28, 2003 (ADAMS Accession No. ML032450205), in response to NRC Generic Letter 2003-01, "Control Room Habitability," the licensee indicated to the NRC staff that the maximum measured unfiltered inleakage into the ANO-2 control room was 61 cfm. Therefore, the modeled unfiltered inleakage value is conservative and provides margin for future measurements of control room inleakage.

Revised SE Section 3.3.7, last paragraph, corrects the line 2 value of "82" cfm to "250" cfm and the line 5 value of "61" cfm to "30" cfm. Accordingly, revised SE Section 3.3.7, last paragraph will state:

> The total bounding unfiltered inleakage into the ANO-2 control room assumed by the licensee was **250** cfm. This value was also assumed for the accident duration. In a letter dated August 28, 2003 (ADAMS Accession No. ML032450205), in response to NRC Generic Letter 2003-01, "Control Room Habitability," the licensee indicated to the NRC staff that the maximum measured unfiltered inleakage into the ANO-2 control room was **30** cfm. Therefore, the modeled unfiltered inleakage value is conservative and provides margin for future measurements of control room inleakage.

These were administrative errors on the part of NRC staff. The corrections to the SE dated April 26, 2011, do not change the NRC staff's conclusions regarding Amendment No. 293 for ANO-2. We regret any inconvenience caused by this error.

If you have any questions regarding this matter, please contact me at (301) 415-1480.

Sincerely,

N. Kaly Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
Revised SE pages 5, 24, 25, and 27

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ENCLOSURE

REVISED SAFETY EVALUATION PAGES 5, 24, 25, AND 27

ARKANSAS NUCLEAR ONE, UNIT NO. 2

AMENDMENT NO. 293 RELATED TO USE OF ALTERNATE SOURCE TERM

DOCKET NO. 50-368

effective dose conversion factors for air submersion listed in Table III.1 of EPA Federal Guidance Report No. 12, 1993, "External Exposure to Radionuclides in Air, Water, and Soil."

Current TS 3.4.8, "Reactor Coolant System – Specific Activity," SR 4.4.8.1 states:

4.4.8.1 Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity $\leq$ 1200 µCi/gm once every 7 days.*

Revised SR 4.4.8.1 would state:

4.4.8.1 Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity $\leq$ 3100 µCi/gm once every 7 days.*

Current TS 6.5.12, "Control Room Envelope Habitability Program," states that:

A Control Room Envelope (CRE) Habitability Program shall be established and implemented to ensure that CRE habitability is maintained such that, with an OPERABLE Control Room Emergency Ventilation System (CREVS), CRE occupants can control the reactor safely under normal conditions and maintain it in a safe condition following a radiological event, hazardous chemical release, or a smoke challenge. The program shall ensure that adequate radiation protection is provided to permit access and occupancy of the CRE under design basis accident (DBA) conditions without personnel receiving radiation exposures in excess of 5 rem whole body or its equivalent to any part of the body for the duration of the accident. The program shall include the following elements:

a.-f. [no change]

Revised TS 6.5.12 would state:

A Control Room Envelope (CRE) Habitability Program shall be established and implemented to ensure that CRE habitability is maintained such that, with an OPERABLE Control Room Emergency Ventilation System (CREVS), CRE occupants can control the reactor safely under normal conditions and maintain it in a safe condition following a radiological event, hazardous chemical release, or a smoke challenge. The program shall ensure that adequate radiation protection is provided to permit access and occupancy of the CRE under design basis accident (DBA) conditions without personnel receiving radiation exposures in excess of 5 rem Total Effective Dose Equivalent (TEDE) for the duration of the accident. The program shall include the following elements:

a.-f. [no change]

from the damaged fuel in the primary coolant, which is then made available for release to the secondary side through primary-to-secondary leakage. Through analysis, the first CREA case, the containment leakage release, was determined to be bounding. This is consistent with Appendix H of RG 1.183.

3.3.6.2.1 Containment Release Case

3.3.6.2.1.1 Containment Leakage

For the containment leakage release, the ejected control rod would effectively cause the equivalent of a small break LOCA by breaching the RPV. The licensee assumed that the activity leaks from the containment atmosphere to the environment at the design basis containment leak rate for the first 24 hours of the accident. The current ANO-2 design basis containment leak rate, L_a, is equal to 0.1 percent per day, at containment peak pressure, as expressed in ANO-2 FSAR Table 15.1.13-1. The licensee then assumed that, based on the containment pressure decreasing over time, the leak rate is reduced to 50 percent of the TS value (0.05 percent per day) at 24 hours and for the duration of the accident. This is consistent with the guidance of RG 1.183. Though the licensee did not credit removal of activity by containment sprays, it still separated the containment volume into two individually well-mixed compartments, one "sprayed" and one "unsprayed." In the licensee's model, mixing between the two volumes is accomplished by the containment fan coolers that provide 11,880 cfm of mixing flow between the sprayed and unsprayed regions of the ANO-2 containment. The guidance of RG 1.183 allows for an assumption of a mixing rate equal to two turnovers of the unsprayed volume per hour, due to natural convection. Because the volume of the ANO-2 unsprayed region determined by the licensee is 392,000 ft^3, the natural convection mixing rate could potentially have been calculated to be approximately 13,000 cfm, which is considerably more than the mixing rate assumed by the licensee. The licensee's model for achieving a well-mixed containment atmosphere is conservative and consistent with the appropriate regulatory guidance and is, therefore, acceptable to the NRC staff.

The licensee took credit for sedimentation of aerosols. Conservatively, the licensee takes no credit for the removal of released activity by the containment sprays or the internal containment recirculation HEPA filters. These assumptions are consistent with the appropriate regulatory guidance and are, therefore, acceptable to the NRC staff.

3.3.6.2.1.2 NOT USED.

3.3.6.2.1.3 Shine Contribution

For shine dose resulting from an activity cloud internal to the ANO-2 containment, the licensee stated that the contribution to the total CREA dose for this case would be negligible. This assumption was based upon the internal containment cloud shine dose calculated for the LOCA and a comparison between the LOCA and CREA source terms. The licensee stated, and the NRC staff agrees, that the activity released into the containment following a CREA is far less than that released to the containment during a LOCA. This is because the CREA assumes only 14 percent fuel damage and 0 percent fuel melt, while the LOCA assumes 100 percent fuel melt. All transport characteristics between the two events would be identical. Therefore, based on the above discussion, the NRC staff concludes that the shine contribution due to the CREA is bounded by that due to the LOCA. Therefore, it is acceptable for this DBA analysis to not include a dose contribution from internal containment cloud shine.

For the calculation of external cloud shine dose to the control room, the licensee applied the source term that was calculated using the model of accident releases into containment and out to the environment. As modeled by the licensee in its submitted CREA design analysis, airborne activity that leaks from containment results in a radioactive plume external to the ANO-2 control room. During the postulated accident, this cloud will in turn result in additional dose to the control room operator inside the control room due to shine. The licensee calculated the dose contribution from this external plume by using the simulations that were used to calculate the control room doses due to airborne activity transport with slight modifications. The licensee created new DCF input files to apply to these existing models. The new DCF input files set inhalation DCFs to zero, and adjusted the external exposure DCFs by multiplying them by a calculated attenuation factor associated with the concrete of the ANO-2 control room wall. This method will result in the RADTRAD code to output dose calculations resulting from direct activity shine only; the ingestion and inhalation component of the dose has been ignored. Also, it is mathematically appropriate and analytically acceptable to apply the control room wall attenuation factor directly to the DCF. Based on the above, the NRC staff concludes that the computer code. The staff's calculation confirmed the licensee's dose results. The major parameters and assumptions used by the licensee and found acceptable to the staff are presented in Table 3.2.6 in this SE. The results of the licensee's design basis radiological consequence calculation are provided in Table 3.2 in this SE. The staff concludes that the EAB, LPZ, and control room doses estimated by the licensee for the CREA meet the applicable accident dose criteria and are, therefore, acceptable.

3.3.7 Control Room Habitability and Modeling

The current ANO-2 non-LOCA DBA analyses, as shown in FSAR Chapter 15, do not calculate control room dose; therefore, the control room dose model provided in the revised DBA accident analyses that support this AST-based LAR, represents a change in the ANO-2 licensing basis.

For its revised analyses, the licensee credits post-accident control room isolation with filtered recirculation and pressurization only after the emergency operation mode is initialized. The control room ventilation system is designed and modeled as providing 35,200 cfm of unfiltered makeup air in normal operation mode and 333 cfm of filtered makeup air in emergency operation mode. As stated by the licensee, this emergency operation mode filtration system provides 99 percent filtration of aerosol, elemental, and organic forms of iodine. In addition to makeup air flow, the ANO-2 design basis credits 1,667 cfm of filtered recirculation flow, again, only after the emergency operation mode is initialized. The filtration associated with the recirculation system is 99 percent removal of aerosol activity and 95 percent for elemental and organic forms of iodine. For its analyses, the licensee assumed that recirculation flow is initiated immediately upon isolation of the normal control room intake, which was assumed to occur at 10 seconds following the initiation of the accident. Also, upon isolation of the normal control room intake, the licensee took credit for the filters associated with the control room emergency operation mode for the duration of the DBA.

The total bounding unfiltered inleakage into the ANO-2 control room assumed by the licensee was 250 cfm. This value was also assumed for the accident duration. In a letter dated August 28, 2003 (ADAMS Accession No. ML032450205), in response to NRC Generic Letter 2003-01, "Control Room Habitability," the licensee indicated to the NRC staff that the maximum measured unfiltered inleakage into the ANO-2 control room was 30 cfm. Therefore, the modeled unfiltered inleakage value is conservative and provides margin for future measurements of control room inleakage.

3.3.8 Summary

As described above, the NRC staff reviewed the assumptions, inputs, and methods used by the licensee to assess the radiological consequences of the postulated DBA analyses with the proposed TS changes. The staff concludes that the licensee used analysis methods and assumptions consistent with the conservative regulatory requirements and guidance identified in Section 2.0. The staff compared the doses estimated by the licensee to the applicable criteria identified in Section 2.0. The staff also concludes, with reasonable assurance, that the licensee's estimates of the EAB, LPZ, and control room doses will comply with these criteria. The staff further concludes with reasonable assurance that ANO-2, as modified by this approved license amendment, will continue to provide sufficient safety margins, with adequate defense-in-depth, to address unanticipated events and to compensate for uncertainties in

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Sincerely,
/RA/
N. Kaly Kalyanam, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
Revised SE pages 5, 24, 25, and 27

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