

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

December 24, 2013

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

#### SUBJECT: ARKANSAS NUCLEAR ONE, UNITS 1 AND 2 – SAFETY EVALUATION RELATED TO REVISED DOSE CONSEQUENCES BASED ON ALTERNATE SOURCE TERM (TAC NOS. MF0524 AND MF0525)

Dear Sir or Madam:

By letter dated January 8, 2013, Entergy Operations, Inc. (the licensee), submitted for U.S. Nuclear Regulatory Commission (NRC) review and approval of the revised loss-of-coolant accident (LOCA) dose calculated for the ANO-1 control room for Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2). The revised LOCA doses are due to reanalyses to rectify a program error identified in the RADionuclide Transport and Removal and Dose Estimation (RADTRAD) code.

The NRC staff has reviewed the radiological impact of the proposed change to ANO-1 and ANO-2 and concludes that the proposed changes are acceptable with regard to the radiological consequences of postulated design-basis accidents.

A copy of our related Safety Evaluation is enclosed. If you have any questions, please contact me at 301-415-1480 or via e-mail at <u>kaly.kalyanam@nrc.gov</u>.

Sincerely,

aly W

N. Kaly Kalyanam, Project Manager Plant Licensing IV-2 and Decommissioning Transition Branch Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation

Docket Nos. 50-313 and 50-368

Enclosure: Safety Evaluation

cc w/encl: Distribution via Listserv



# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# RELATED TO REVISED DOSE CONSEQUENCES

# BASED ON ALTERNATE SOURCE TERM

## ENTERGY OPERATIONS, INC.

## ARKANSAS NUCLEAR ONE, UNIT NOS. 1 AND 2

## DOCKET NOS. 50-313 AND 50-368

#### 1.0 INTRODUCTION

By letter dated January 8, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13009A288), Entergy Operations, Inc. (the licensee), submitted revised dose consequences based on alternate source term (AST) for Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2). The licensee requested to revise the calculated loss-of-coolant accident (LOCA) doses in order to rectify a program error identified in the RADTRAD code.

## 2.0 REGULATORY EVALUATION

The NRC staff has established the requirements and methodologies for evaluating the radiological consequences of the postulated design-basis accidents (DBAs) using the dose criteria specified in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.67, "Accident source term," and the guidance described in Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors." The requirements of 10 CFR 50.67 state that the applicable dose acceptance criteria are 5 roentgen equivalent man (rem) Total Effective Dose Equivalent (TEDE) in the control room (CR), 25 rem TEDE at the exclusion area boundary (EAB), and 25 rem TEDE at the outer boundary of the low population zone (LPZ). RG 1.183 provides guidance to licensees on acceptable application of AST submittals, including acceptable radiological analysis assumptions for use in conjunction with the accepted AST. The NRC staff also considered relevant information in the ANO-1 and ANO-2 Final Safety Analysis Report (FSAR), Technical Specifications (TSs), and applicable previous licensing actions.

The NRC approved the AST methodology for ANO-1 via Amendment No. 238 dated October 21, 2009 (ADAMS Accession No. ML092740035), and for ANO-2 via Amendment No. 293 dated April 26, 2011 (ADAMS Accession No. ML110980197). The ANO-1 and ANO-2 dose consequence analyses were performed by the licensee using the Simplified Model for <u>Rad</u>ionuclide <u>Transport and Removal and Dose Estimation (RADTRAD)</u>, Version 3.0.3, computer code. As described in NUREG/CR-6604, "RADTRAD: A Simplified Model for

Enclosure

Radionuclide Transport and Removal and Dose Estimation," April 1998, the NRC sponsored the development of the RADTRAD computer code. The code estimates transport and removal of radionuclides and radiological consequence doses at selected receptors.

#### 3.0 TECHNICAL EVALUATION

In its letter dated January 8, 2013, the licensee stated that the vendor for the RADTRAD computer code notified the RADTRAD Users Group in December 2011 of an implementation error within its RADTRAD code, Version 3.0.3. Specifically, a program error was found to occur when the following combinations are chosen: (1) a timed release, (2) more than one compartment receives a portion of the released radionuclides, and (3) radionuclide decay. This combination was not correctly implemented in the code because the initial fuel inventory is decayed each time an additional source compartment is entered. The error notice advises users to rerun any problematic cases in multiple runs (i.e., one run for each source term compartment), and then sum the dose results to obtain the correct answer). However, no actual change to the RADTRAD code itself, or its embedded methodology, has occurred.

The licensee reviewed the ANO-1 and ANO-2 AST analyses and found that the error notice applies to the LOCA analysis for both units. In those analyses, the release into the containment is divided into two "compartments," representing the sprayed and unsprayed regions within the structure. Therefore, the licensee recalculated the LOCA analyses for both ANO units providing separate containment leakage dose contributions from its sprayed and unsprayed regions. Those dose results were added to the doses associated with Emergency Safeguards Features system leakage, and for the CR, containment, and cloud shine doses, to determine the total calculated doses associated with the accident. All other portions of the analyses have not changed. The licensee compared the current dose consequences results to the revised results and determined that the ANO-1 CR dose had increased by more than 10 percent. Therefore, NRC review and approval was required prior to implementing the new analysis.

The NRC staff reviewed the methods, parameters, and assumptions that the licensee used in its LOCA radiological dose consequence analyses for ANO-1 and ANO-2 and concludes that they are consistent with the conservative guidance provided in RG 1.183. The NRC staff used the RADTRAD computer code to perform an independent confirmatory dose evaluation to ensure an understanding of the licensee's methods. The NRC staff concludes that summing the results of multiple runs, as described above, is an acceptable approach for correcting the RADTRAD error because it will account for all the nuclides available for release. The ANO-1 and ANO-2 revised LOCA dose results are shown below Table 1. The NRC staff evaluated the radiological consequences at the EAB and LPZ and in the CR are within the dose criteria specified in 10 CFR 50.67. Therefore, this change is acceptable with respect to the radiological consequences of DBAs.

1

# Table 1 Calculated Radiological Consequences TEDE (rem) for LOCA

Unit	EAB	LPZ	CR
ANO-1	11.091	2.738	3.896
ANO-2	9.452	0.709	2.094
Dose Criteria <sup>(1)</sup>	25	25	5

<sup>(1)</sup> From 10 CFR 50.67

#### 4.0 <u>CONCLUSION</u>

As described above, the NRC staff reviewed the justification and assumptions used by the licensee to assess the radiological impacts of the proposed change described in Section 3.0 and concludes that the licensee used methods consistent with regulatory requirements and guidance identified in Section 2.0 above. The staff concludes, with reasonable assurance, that the licensee's estimates of the EAB, LPZ, and CR doses will continue to comply with the 10 CFR 50.67 criteria.

Principal Contributor: Dylanne Duvigneaud

Date: December 24, 2013

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

#### SUBJECT: ARKANSAS NUCLEAR ONE, UNITS 1 AND 2 – SAFETY EVALUATION RELATED TO REVISED DOSE CONSEQUENCES BASED ON ALTERNATE SOURCE TERM (TAC NOS. MF0524 AND MF0525)

Dear Sir or Madam:

By letter dated January 8, 2013, Entergy Operations, Inc. (the licensee), submitted for U.S. Nuclear Regulatory Commission (NRC) review and approval of the revised loss-of-coolant accident (LOCA) dose calculated for the ANO-1 control room for Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2). The revised LOCA doses are due to reanalyses to rectify a program error identified in the RADionuclide Transport and Removal and Dose Estimation (RADTRAD) code.

The NRC staff has reviewed the radiological impact of the proposed change to ANO-1 and ANO-2 and concludes that the proposed changes are acceptable with regard to the radiological consequences of postulated design-basis accidents.

A copy of our related Safety Evaluation is enclosed. If you have any questions, please contact me at 301-415-1480 or via e-mail at <u>kaly.kalyanam@nrc.gov</u>.

Sincerely,

/**ra**/

N. Kaly Kalyanam, Project Manager Plant Licensing IV-2 and Decommissioning Transition Branch Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation

Docket Nos. 50-313 and 50-368

Enclosure: Safety Evaluation

cc w/encl: Distribution via Listserv

DISTRIBUTION: PUBLIC LPL4-2 Reading RidsAcrsAcnw\_MailCTR Resource RidsNrrDorlDpr Resource RidsNrrDorlLpl4-2 Resource

RidsNrrDraAadb Resource RidsNrrLAJBurkhardt Resource RidsNrrPMANO Resource RidsRgn4MailCenter Resource DDuvigneaud, NRR/DRA/AADB

\*See SE dated 11/xx/13

#### ADAMS Accession No. ML13326A502

OFFICE	NRR/DORL/LPL4-2/PM	NRR/DORL/LPL4-2/LA	NRR/DRA/AADB/BC(A)	NRR/DORL/LPL4-2/BC	NRR/DORL/LPL4-2/PM
NAME	NKalyanam	JBurkhardt	JDozier*	DBroaddus	NKalyanam
DATE	12/4/13	12/3/13	11/19/13	12/22/13	12/24/13

OFFICIAL RECORD COPY