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AEP-NRC-2016-23
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Docket Nos. 50-315
50-316

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Donald C. Cook Nuclear Plant Unit 1 and Unit 2
Response to Sixth Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term

References:

1. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to U. S. Nuclear Regulatory Commission (NRC), "Donald C. Cook Nuclear Plant, Units 1 and 2, License Amendment Request to Adopt TSTF-490, Revision 0, 'Deletion of E Bar Definition and Revision to Reactor Coolant System Specific Activity Technical Specification' and Implement Full-Scope Alternative Source Term," dated November 14, 2014, Agencywide Documents Access and Management System (ADAMS) Accession No. ML14324A209.

2. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2, Supplemental Information for the License Amendment Request to Adopt TSTF-490, Revision 0, 'Deletion of E Bar Definition and Revision to Reactor Coolant System Specific Activity Technical Specification' and Implement Full-Scope Alternative Source Term," dated February 12, 2015, ADAMS Accession No. ML15050A247.

3. E-mail capture from A. W. Dietrich, NRC, to H. L. Kish, I&M, "D.C. Cook Units 1 and 2 – SRXB RAI Concerning LAR to Adopt TSTF-490 and Implement Full Scope AST (MF5184 MF5185)," dated February 11, 2016, ADAMS Accession No. ML16043A484.

4. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2 - Response (Part 1) to Fourth Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term," dated November 16, 2015, ADAMS Accession No. ML15323A434.

5. Letter from NRC to J. P. Gebbie, I&M, "Donald C. Cook Nuclear Plant, Units 1 and 2 - Regulatory Audit Report Regarding License Amendment Request to Adopt Technical Specifications Task Force-490, Rev. 0, and Implement Alternative Source Term (CAC Nos. MF5184 AND MF5185)," dated January 20, 2016, ADAMS Accession No. ML 16007A180.

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6. Letter from Q. S. Lies, I&M, to NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2, Response to Fifth Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term," dated February 19, 2016, ADAMS Accession No. ML16069A151.

This letter provides Indiana Michigan Power Company's (I&M), licensee for Donald C. Cook Nuclear Plant (CNP) Units 1 and 2, response to the sixth Request for Additional Information (RAI) by the U. S. Nuclear Regulatory Commission (NRC) regarding a license amendment request (LAR) to adopt Technical Specification Task Force (TSTF)-490 and implement alternative source term (AST).

By Reference 1, as supplemented by Reference 2, I&M submitted a request to amend the Technical Specifications to CNP Units 1 and 2 Renewed Facility Operating Licenses DPR-58 and DPR-74. I&M proposes to adopt TSTF-490, Revision 0, and implement full scope AST radiological analysis methodology. By Reference 3, the NRC transmitted an RAI from the Reactor Systems Branch regarding the LAR submitted by I&M in Reference 1.

Enclosure 1 to this letter provides an affirmation statement. Enclosure 2 to this letter provides I&M's response to the RAI contained in Reference 3.

In addition to the response for the RAI contained in Reference 3, this letter also contains information related to three additional items regarding the LAR submitted by I&M in Reference 1. These are items that were requested previously by NRC staff but the response was delayed because of meteorological data input errors discovered during preparation of a response to requested information (Reference 6).

In Reference 4, I&M's response to RAI-ARCB-5 indicated that RADTRAD files were also affected by the meteorological data input errors referenced above and stated the intent to provide updated files after the meteorological data input had been corrected. The updated RADTRAD files are provided on a compact disc (CD) with Enclosure 3 to this letter, which completes the response to the information requested by Reference 4.

By Reference 5, the NRC conveyed the results of an on-site document audit and identified supplemental information to be provided by I&M in support of the technical review. As a result of the errors in the application of meteorological data, some of the reference documents requested by Reference 4 required revision. Those errors have been corrected and the revised documents that were requested by Reference 5 are provided on a CD with Enclosure 4 to this letter.

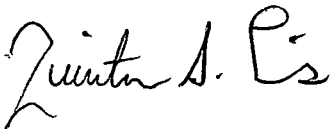
The errors in the application of meteorological data also affected the information provided in Enclosure 9 of Reference 1, Red Wolf Associates (RWA), "D. C. Cook AST Radiological Analyses Technical Report," (RWA-1313-015). Enclosure 5 to this letter provides an updated RWA technical report, on a CD, that has been revised to reflect the error corrections and replaces Enclosure 9 of Reference 1 in its entirety. The revised RWA technical report reflects modified atmospheric dispersion factors as previously outlined in Enclosure 2 to Reference 6. The revised RWA technical report also reflects changes made regarding the modeling of steam generator (SG) flashing fractions and post-trip SG tube uncovery utilized in various dose consequence accident scenarios.

Discussion of the revised SG flashing fractions and tube uncovery is provided in Enclosure 2 to this letter. Where changes were made to the revised RWA technical report, revision bars are provided in the margin of the document.

Copies of this letter are being transmitted to the Michigan Public Service Commission and Michigan Department of Environmental Quality, in accordance with the requirements of 10 CFR 50.91.

There are no new regulatory commitments made in this letter. Should you have any questions, please contact Mr. Michael K. Scarpello, Regulatory Affairs Manager, at (269) 466-2649.

Sincerely,



Q. Shane Lies
Site Vice President

TLC/mll

Enclosures:

1. Affirmation
2. Response to Sixth Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term
3. Updated RADTRAD files (Provided on compact disc enclosed with this letter)
4. Documents Requested by NRC On-site Document Audit - Vendor Calculations from Red Wolf Associates (RWA) (Provided on compact disc enclosed with this letter)
5. Red Wolf Associates (RWA) Technical Report RWA-1313-015, Rev. 1, "D. C. Cook AST Radiological Analyses Technical Report" (Provided on compact disc enclosed with this letter)

c: R. J. Ancona, MPSC
A. W. Dietrich, NRC, Washington, D.C.
MDEQ – RMD/RPS
NRC Resident Inspector
C. D. Pederson, NRC, Region III
A. J. Williamson, AEP Ft. Wayne, w/o enclosures

**Enclosure 1 to AEP-NRC-2016-23**

AFFIRMATION

I, Q. Shane Lies, being duly sworn, state that I am the Site Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this request with the U. S. Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

Indiana Michigan Power Company

Q. Shane Lies
Site Vice President

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 16 DAY OF May, 2016

Notary Public

My Commission Expires 04-04-2018

DANIELLE BURGOYNE
Notary Public, State of Michigan
County of Berrien
My Commission Expires 04-04-2018
Acting in the County of Berrien

**Enclosure 2 to AEP-NRC-2016-23**

**Response to Sixth Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term**

By letter dated November 14, 2014 (Reference 1), as supplemented by letter dated February 12, 2015 (Reference 2), Indiana Michigan Power Company (I&M), the licensee for the Donald C. Cook Nuclear Plant (CNP), Units 1 and 2, submitted a license amendment request. The proposed amendment consists of adoption of Technical Specifications Task Force-490, Revision 0, and implementation of a full scope alternative source term (AST) radiological analysis methodology.

The U. S. Nuclear Regulatory Commission (NRC) staff in the Reactor Systems Branch (SRXB) of the Office of Nuclear Reactor Regulation is currently reviewing the submittal, as supplemented, and has determined that additional information is needed in order to complete the review (Reference 3). The text of the request for additional information (RAI) and I&M's response are provided below.

**RAI-SRXB-2**

*As presented in Section 15.0.1 of NUREG-0800, Standard Review Plan (SRP), Title 10 of the Code of Federal Regulations (10 CFR), Section 50.67, "Accident source term," allows a holder of an operating license issued prior to January 10, 1997, and holders of renewed licenses under 10 CFR Part 54 whose initial operating license was issued prior to January 10, 1997, to voluntarily revise the accident source term used in design basis radiological consequence analyses. Paragraph 10 CFR 50.67(b) requires that applications under this section contain an evaluation of the consequences of applicable Design-Basis Accidents (DBAs) previously analyzed in the plant's Final Safety Analysis Report (FSAR). Potential changes in consequences could be due to the impact of the characteristics of the Alternative Source Term (AST) itself or from the proposed plant modifications. Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," provides guidance to licensees on performing evaluations and analyses in support of the implementation of an AST.*

*As discussed in Chapter 15 of the SRP, in order to establish a licensing basis, licensees must analyze transients and accidents in accordance with the requirements of 10 CFR 50.34, 10 CFR 50.46, and where applicable, NUREG-0737, "Clarification of Three Mile Island Action Plan Requirements." These accidents and transients are described in the SRP. Specifically, Section 15.0.2 of the SRP describes the U.S. Nuclear Regulatory Commission (NRC) staff's review process and acceptance criteria for analytical models and computer codes used by licensees to analyze accident and transient behavior. The purpose of the NRC staff review for this SRP section is to verify that the evaluation model is adequate to simulate the accident under consideration. Section 50.34 of 10 CFR specifies the transient and accident events that must be considered in the safety analyses.*

*Guidance to the industry for the analysis of transient behavior is set forth in RG 1.203, "Transient and Accident Analysis Methods" and, in particular, licensees must include a complete assessment of all code models against applicable experimental data and/or exact*

*solutions, in order to demonstrate that the code is adequate for analyzing the chosen scenario.*

*RG 1.183 provides guidance to licensees of operating power reactors on acceptable applications of alternative source terms; the scope, nature, and documentation of associated analyses and evaluations; consideration of impacts on analyzed risk; and content of submittals. Appendices A, B, E, F, G, and H of RG 1.183 provide guidance for evaluating the radiological consequences of pressurized water reactor accidents of concern for AST. As specifically cited by RG 1.183, Section 15.0.1 of the SRP applies for the assessment of the AST. This SRP section provides, in part, guidance to the NRC staff for the review of the models, assumptions, and parameter inputs used by the licensee for the calculation of the AST radiological consequences.*

*The NRC staff performed an audit at the offices of Indiana Michigan Power Company (the licensee) during the week of September 21, 2015, as documented in an audit report dated January 20, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16007A180). During the audit, the NRC staff reviewed the supporting documentation and calculation files for the AST license amendment request (LAR) for Donald C. Cook Nuclear Plant (CNP). The staff was unable to determine that the computer code which forms the basis for several of the AST inputs from the CNP operator training simulator meets the NRC regulatory requirements for computer codes used by licensees to analyze accident and transient behavior. Therefore, the use of the operator training simulator is inconsistent with Section 15.0.2 of the SRP. Based on its audit review, the staff requests the following additional information.*

- *Provide revised analyses supporting the AST that are based on an NRC-approved computer code for transient behavior, or based on calculations from a previously NRC-approved license amendment for the same AST transient behavior, and resubmit the affected AST analyses. The licensee must demonstrate that all of the thermal-hydraulic parameter values for a particular AST-related transient (e.g., steam generator tube rupture, main steam line break, etc.) were provided by the same NRC-approved computer code or from the same calculations that supported a prior NRC-approved license amendment for the installed steam generators. Analysis with an NRC-approved computer code for transient behavior should satisfy previously described 10 CFR Part 50 regulations and SRP Chapter 15 guidance when applicable.*

**I&M Response to RAI-SRXB-2:**

As noted in RAI-SRXB-2, several input parameters are based on CNP operator training simulator data. These parameters, listed in the input and assumptions tables provided in Reference 4, include:

- duration of intact steam generator (SG) tube uncovery following a reactor trip (utilized in the steam generator tube rupture (SGTR), main steam line break (MSLB), locked rotor accident (LRA), and control rod ejection (CRE) dose consequence analyses),
- SG tube break flow flashing fraction (utilized in the SGTR analysis), and
- SG tube leakage flashing fraction (utilized in the SGTR, MSLB, LRA, and CRE dose consequence analyses),

The staff was unable to determine that the computer code for the CNP training simulator, which forms the basis for the inputs, meets the NRC regulatory requirements for computer codes used by licensees to analyze accident and transient behavior. Therefore, an alternate basis has been utilized for the parameters that were previously based on CNP training simulator data.

*Duration of Intact SG Tube Uncovery Following Reactor Trip*

Following a reactor trip, the water level in the intact SG secondary drops below the top of the tubes due to redistribution of fluid until the level is recovered by auxiliary feed water. For the purposes of dose consequence analyses, primary-to-secondary leakage is assumed to be released to the environment with no partitioning in the steam generators during periods of tube uncovery. The CNP training simulator transient information was originally used to derive a tube uncovery time of 40 minutes as shown in the tables provided in Reference 4.

An alternate approach has been used to determine an appropriate duration of SG tube uncovery following a reactor trip. Actual CNP post-trip SG level data was retrieved from the Plant Process Computer (PPC), which showed that the previously utilized value of 40 minutes remains an acceptable assumption for the duration of SG tube uncovery following a reactor trip. Therefore, a tube uncovery time of 40 minutes is utilized in the SGTR, MSLB, LRA, and CRE dose consequence analyses.

*SG Tube Break Flow and SG Tube Leakage Flashing Fractions*

The behavior of iodine and particulates in the SG is modeled using the guidance provided in Section 5.5 and 5.6 of Appendix E to Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," July 2000. Section 5.5.1 of Appendix E to RG 1.183 states:

*A portion of the primary-to-secondary leakage will flash to vapor, based on the thermodynamic conditions in the reactor and secondary coolant.*

- *During periods of steam generator dryout, all of the primary-to-secondary leakage is assumed to flash to vapor and be released to the environment with no mitigation.*
- *With regard to the unaffected generators used for plant cooldown, the primary-to-secondary leakage can be assumed to mix with the secondary water without flashing during periods of total tube submergence.*

In addition, Section 5.6 of the Appendix E to RG 1.183 adds:

> *Operating experience and analyses have shown that for some steam generator designs, tube uncovery may occur for a short period following any reactor trip…The potential impact of tube uncovery on the transport model parameters (e.g., flash fraction, scrubbing credit) needs to be considered. The impact of emergency operating procedure restoration strategies on steam generator water levels should be evaluated.*

As discussed above, the intact SG water levels are assumed to temporarily drop below the top of the tubes following a reactor trip, with tube bundle recovery occurring at approximately 40 minutes. During the time of tube uncovery, a portion of the primary-to-secondary leakage will flash to vapor and be released directly to the environment without mitigation.

**Calculation of Time-Dependent SG Flashing Fractions**

The time-dependent SG flashing fractions used in the dose consequence analyses outlined in Reference 1 were based on plant training simulator transient information. An alternate approach has been used to determine the flashing fractions and the dose consequence analyses have been re-performed. A Unit 2 SGTR calculation, including operator actions, was previously performed using the Westinghouse thermal hydraulic code LOFTTR2 in support of the license amendment request approved by the NRC in Amendment Nos. 256 and 239 (Reference 5). Using information from this calculation, new flashing fractions were derived for use in the dose consequence analyses. A similar calculation was performed for Unit 1, but the Unit 2 values are bounding in comparison.

The fraction of the broken tube flow which flashes to vapor in the ruptured steam generator for the SGTR dose consequence analysis is derived from the integrated break flow and the integrated flashed break flow from the Unit 2 SGTR LOFTTR2 analysis. The figures provided in this calculation present the total break flow and the flashed break flow as a function of time. This allows the break flow flashing fraction to be determined for any incremental period during the event to be calculated using a simple ratio:

$$Flashing\ Fraction = \frac{Flashed\ Flow\ (lbm)}{Break\ Flow\ (lbm)}$$

As an example, the integrated break flow at 100 seconds from this calculation is provided as 8200 pounds-mass (lbm). Similarly, the integrated flashed break flow from the same calculation is provided as 1500 lbm. Therefore, the average pre-trip flashing fraction is calculated as:

$$Flashing\ Fraction_{0-100\ sec} = \frac{1500 - 0\ lbm}{8200 - 0\ lbm} = 0.183$$

This method is applied to selected time intervals until flashing stops due to reactor coolant system (RCS) cooldown. The resulting integrated flows and flashing fractions are shown in Table 1.

**Table 1: Integrated Break Flow and Flashed Break Flow**

| Interval Start Time ($t_1$) (sec) | Interval End Time ($t_2$) (sec) | Integrated Break Flow at $t=t_2$ (lbm) | Integrated Flashed Break Flow at $t=t_2$ (lbm) | Flashing Fraction |
|---|---|---|---|---|
| 0.0 | 100.0 | 8200 | 1500 | 0.183 |
| 100.0 | 500.0 | 34000 | 3500 | 0.078 |
| 500.0 | 1000.0 | 65000 | 5200 | 0.055 |
| 1000.0 | 1500.0 | 96000 | 6850 | 0.053 |
| 1500.0 | 1890.0 | 120000 | 7617 | 0.032 |

The flashing fraction value at the 1500 second interval start time in Table 1 was conservatively adjusted in Table 2 to maintain the pre-cooldown value until the break flow is isolated at 30 minutes. This adjustment removes any relationship between the flashing fractions and the timing of the start of the cooldown. Additionally, all the values in Table 2 are rounded up to provide additional conservatism, resulting in a flashed flow mass that is approximately 30 percent greater than that determined by the mass release assessments performed in support of the submittal approved by Reference 5. Since the flashing fractions are primarily determined by the thermodynamic conditions in the reactor hot leg, and since the intact and ruptured SG pressures are comparable prior to the RCS cooldown, these flashing fractions can be applied to both the ruptured SG (SGTR dose consequence analysis) and to the intact SGs (SGTR, MSLB, LRA, and CRE dose consequence analyses).

**Table 2: Final Flashing Fractions**

| Event Time (sec) | Time After Rx Trip (sec) | Analysis Flashing Fraction |
|---|---|---|
| 0.0 | Pre-Trip | 0.19 |
| 100.0 | 0.0 | 0.08 |
| 500.0 | 400.0 | 0.06 |
| 1000.0 | 900.0 | 0.055 |
| 1500.0 | 1400.0 | 0.055 |
| 1800.0 | 1700.0 | 0.04 |

The SGTR, MSLB, LRA, and CRE dose consequence analyses have been re-analyzed using the flashing fractions presented in Table 2 for the applicable time periods. The input and assumptions tables provided in the revised technical report (Enclosure 5 to this letter) outline how the flashing fractions are applied in each analysis. Additionally, the results of the re-analyzed dose consequence events can also be found in Table 3.9-1 of the revised technical report.

**REFERENCES**

1. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to U. S. Nuclear Regulatory Commission (NRC), "Donald C. Cook Nuclear Plant, Units 1 and 2, License Amendment Request to Adopt TSTF-490, Revision 0, 'Deletion of E Bar Definition and Revision to Reactor Coolant System Specific Activity Technical Specification' and Implement Full-Scope Alternative Source Term," dated November 14, 2014, Agencywide Documents Access and Management System (ADAMS) Accession No. ML14324A209

2. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2, Supplemental Information for the License Amendment Request to Adopt TSTF-490, Revision 0, 'Deletion of E Bar Definition and Revision to Reactor Coolant System Specific Activity Technical Specification' and Implement Full-Scope Alternative Source Term," dated February 12, 2015, ADAMS Accession No. ML15050A247

3. E-mail capture from A. W. Dietrich, NRC, to H. L. Kish, I&M, "D.C. Cook Units 1 and 2 – SRXB RAI Concerning LAR to Adopt TSTF-490 and Implement Full Scope AST (MF5184 MF5185)," dated February 11, 2016, ADAMS Accession No. ML16043A484

4. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2, Response to Second Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term," dated August 24, 2015, ADAMS Accession No. ML15238A726

5. Letter from NRC to R. P. Powers, I&M, "Donald C. Cook Nuclear Plant, Units 1 and 2 - Issuance of Amendments (TAC Nos. MB0739 AND MB0740)," dated October 24, 2001, ADAMS Accession No. ML 012690136

**Enclosure 3 to AEP-NRC-2016-23**

**Updated RADTRAD files**
(Provided on compact disc enclosed with this letter)

As discussed on page 1 of Enclosure 2 to this letter, Indiana Michigan Power Company (I&M), the licensee for the Donald C. Cook Nuclear Plant, Units 1 and 2, submitted a license amendment request (LAR) to the U.S. Nuclear Regulatory Commission (NRC). During review of the LAR, NRC staff determined that additional information was needed in order to complete the review. On November 16, 2015, I&M responded to the request for additional information (RAI) (Reference 1). In that response, I&M stated that the information requested by RAI-ARCB-5 was affected by recently discovered meteorological data input errors and would be provided at a later date. This enclosure provides a response to RAI-ARCB-5. The RAI is restated below followed by the response.

**RAI-ARCB-5**

a) *Provide the RADTRAD input files, in electronic format, for each of the AST DBAs described in the LAR.*

**I&M Response to RAI-ARCB-5:**

As noted in the initial response to RAI-ARCB-5 (Reference 1), the RADTRAD input files were affected by meteorological data input errors. These files were also affected by updates to thermal hydraulic parameters (steam generator (SG) flashing fractions and tube uncovery). The RADTRAD input files have been revised to reflect the corrected meteorological data input and updated thermal hydraulic parameters, and are being provided electronically via a compact disc, as listed below in Tables 1 – 8.

| Table 1: Loss of Coolant Accident (LOCA) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RADTRAD Nuclear Inventory File, Reactor Coolant System (RCS) | Cook_RCS.nif |
| RADTRAD Nuclear Inventory File (Core) | Cook_Core.nif |
| LOCA Purge Release Fraction Timing File | LOCA_Purge_R2.rft |
| LOCA Purge RADTRAD 3.10 Input File | LOCA_Purge_R2.psf |
| LOCA Containment Release Fraction Timing File | LOCA_Contain_R2.rft |
| LOCA Containment RADTRAD 3.10 Input | LOCA_Contain_R2.psf |
| LOCA Engineered Safety Feature (ESF) Leakage Release Fraction Timing File | LOCA_ESF_R2.rft |
| LOCA ESF Leakage RADTRAD 3.10 Input | LOCA_ESF_R2.psf |
| LOCA Refueling Water Storage Tank (RWST) Leakage RADTRAD 3.10 Input | LOCA_RWST_R2.psf |

| Table 2: Fuel Handling Accident (FHA) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| Fuel Handling Source Term Nuclear Inventory File | Cook_FHA.nif |
| FHA Release Fraction Timing File | Cook_FHA_R1.rft |
| FHA Containment Release RADTRAD 3.10 Input File | FHA_Contain_R1.psf |
| FHA Auxiliary Building Release RADTRAD 3.10 Input File | FHA_Aux_Bldg_R1.psf |

| Table 3: Main Steam Line Break (MSLB) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RADTRAD Nuclear Inventory File (RCS) | Cook_RCS.nif |
| Iodine Spike Source Term Nuclear Inventory File | MSLB_I_Spike.nif |
| Noble Gas Release Fraction Timing File | MSLB_NG_R1.rft |
| Noble Gas Release Fraction Timing File | MSLB_Pre_I_R1.rft |
| Noble Gas Release Fraction Timing File | MSLB_Spike_I_R1.rft |
| Non-Noble Gas Release Fraction Timing File | MSLB_Spike_RCS_R1.rft |
| Initial SG Iodine Release Fraction Timing File | MSLB_SG_I_R1.rft |
| Noble Gas Release RADTRAD 3.10 Input File | MSLB_NG_R1.psf |
| Pre-Accident Spike RADTRAD 3.10 Input File | MSLB_Pre_I_R1.psf |
| Concurrent-Accident Spike (Iodine) RADTRAD 3.10 Input File | MSLB_Spike_I_R1.psf |
| Concurrent-Accident Spike (RCS) RADTRAD 3.10 Input File | MSLB_Spike_RCS_R1.psf |
| Initial SG Iodine Release RADTRAD 3.10 Input File | MSLB_SG_I_R1.psf |

| Table 4: Steam Generator Tube Rupture (SGTR) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RADTRAD Nuclear Inventory File (RCS) | Cook_RCS.nif |
| Iodine Spike Source Term Nuclear Inventory File | SGTR_I_Spike.nif |
| Noble Gas Release Fraction Timing File | SGTR_NG_R1.rft |
| Noble Gas Release Fraction Timing File | SGTR_Pre_I_R1.rft |
| Noble Gas Release Fraction Timing File | SGTR_Spike_I_R1.rft |
| Non-Noble Gas Release Fraction Timing File | SGTR_Spike_RCS_R1.rft |
| Initial SG Iodine Release Fraction Timing File | SGTR_SG_I_R1.rft |
| Noble Gas Release RADTRAD 3.10 Input File | SGTR_NG_R1.psf |
| Pre-Accident Spike RADTRAD 3.10 Input File | SGTR_Pre_I_R1.psf |
| Concurrent-Accident Spike (Iodine) RADTRAD 3.10 Input File | SGTR_Spike_I_R1.psf |
| Concurrent-Accident Spike (RCS) RADTRAD 3.10 Input File | SGTR_Spike_RCS_R1.psf |
| Initial SG Iodine Release RADTRAD 3.10 Input File | SGTR_SG_I_R1.psf |

| Table 5: Locked Rotor Accident (LRA) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RADTRAD Nuclear Inventory File (RCS) | Cook_RCS.nif |
| Non-LOCA Source Term Nuclear Inventory File | Cook_Non_LOCA.nif |
| Noble Gas Release Fraction Timing File | Rotor_NG_R1.rft |
| Noble Gas Release RADTRAD 3.10 Input File | Rotor_NG_R1.psf |
| Non-Noble Gas Iodine Release Fraction Timing File | Rotor_Non_NG_I_R1.rft |
| Non-Noble Gas Iodine Release RADTRAD 3.10 Input File | Rotor_Non_NG_I_R1.psf |
| Non-Noble Gas Alkali Metal Release Fraction Timing File | Rotor_Non_NG_Alkali_R1.rft |
| Non-Noble Gas Alkali Metal Release RADTRAD 3.10 Input File | Rotor_Non_NG_Alkali_R1.psf |
| Initial SG Iodine Release Fraction Timing File | Rotor_SG_I_R1.rft |
| Initial SG Iodine Release RADTRAD 3.10 Input File | Rotor_SG_I_R1.psf |

| Table 6: Control Rod Ejection (CRE) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RADTRAD Nuclear Inventory File (RCS) | Cook_RCS.nif |
| RADTRAD Nuclear Inventory File (Core) | Cook_Core.nif |
| Sec. Release - Noble Gas Cladding Failure - Release Fraction Timing File | CRE_NG_Clad_R1.rft |
| Sec. Release - Noble Gas Fuel Melt - Release Fraction Timing File | CRE_NG_Melt_R1.rft |
| Sec. Release - Noble Gas Cladding Failure RADTRAD 3.10 Input File | CRE_NG_Clad_R1.psf |
| Sec. Release - Noble Gas Fuel Melt RADTRAD 3.10 Input File | CRE_NG_Melt_R1.psf |
| Sec. Release - Non-Noble Gas - Cladding Failure - Iodine - Release Fraction Timing File | CRE_Non_Clad_I_R1.rft |
| Sec. Release - Non-Noble Gas - Cladding Failure - Alkali - Release Fraction Timing File | CRE_Non_Clad_Alkali_R1.rft |
| Sec. Release - Non-Noble Gas - Fuel Melt - Release Fraction Timing File | CRE_Non_Melt_R1.rft |
| Sec. Release - Non-Noble Gas - Cladding Failure - Iodine - RADTRAD 3.10 Input File | CRE_Non_Clad_I_R1.psf |
| Sec. Release - Non-Noble Gas - Cladding Failure - Alkali - RADTRAD 3.10 Input File | CRE_Non_Clad_Alkali_R1.psf |
| Sec. Release - Non-Noble Gas Fuel Melt RADTRAD 3.10 Input File | CRE_Non_Melt_R1.psf |
| Containment Release - Cladding Failure - Release Fraction Timing File | CRE_Contain_Clad_R1.rft |
| Containment Release - Fuel Melt - Release Fraction Timing File | CRE_Contain_Melt_R1.rft |
| Containment Release - Cladding Failure - RADTRAD 3.10 Input File | CRE_Contain_Clad_R1.psf |
| Containment Release – Fuel Melt - RADTRAD 3.10 Input File | CRE_Contain_Melt_R1.psf |
| Initial SG Iodine Release Fraction Timing File | CRE_SG_I_R1.rft |
| Initial SG Iodine Release RADTRAD 3.10 Input File | CRE_SG_I_R1.psf |

| Table 7: Waste Gas Decay Tank (WGDT) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RCS Source Term Nuclear Inventory File | Cook_WGDT.nif |
| WGDT Failure Fraction Timing File | Cook_WGDT_R1.rft |
| WGDT Failure RADTRAD 3.10 Input File | Cook_WGDT_R1.psf |

| Table 8: Volume Control Tank (VCT) Input Files | |
|---|---|
| **Description** | **File Name** |
| RADTRAD Dose Conversion Factor File | RWA-1205-004.inp |
| RCS Source Term Nuclear Inventory File | Cook_VCT.nif |
| VCT Failure Fraction Timing File | Cook_VCT_R1.rft |
| VCT Failure RADTRAD 3.10 Input File | Cook_VCT_R1.psf |

**References**

1. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook Nuclear Plant Unit 1 and Unit 2 - Response (Part 1) to Fourth Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term," dated November 16, 2015, ADAMS Accession No. ML15323A434

**Enclosure 4 to AEP-NRC-2016-23**

**Documents Requested by NRC On-site Document Audit -**
**Vendor Calculations from Red Wolf Associates**
(Provided on compact disc enclosed with this letter)

As discussed in Enclosure 2 to this letter, Indiana Michigan Power Company (I&M), the licensee for the Donald C. Cook Nuclear Plant, Units 1 and 2, submitted a license amendment request (LAR) to the U.S. Nuclear Regulatory Commission (NRC) (References 1 and 2). The proposed amendment requests adoption of Technical Specifications Task Force-490, Revision 0, and implementation of alternative source term (AST) methodology for accident analysis.

The NRC staff in the Reactor Systems Branch (SRXB) reviewed the amendment request and determined that additional information was needed in order to complete the review. By Reference 3, the NRC transmitted a request for additional information (RAI) regarding the LAR submitted by I&M in Reference 1. In that RAI, the NRC requested I&M to provide source documents that would validate the input parameter values applied in each accident analysis. By Reference 4, I&M provided a response to the RAI, which contained updated source document information for the revised accident analyses input parameters listed in the tables in Enclosure 12 of Reference 1.

In Reference 4, I&M stated that source documents for all input parameters that were not currently available on the docket would be made available during an on-site audit of documents. An on-site audit of documents was conducted by the NRC during the period of September 21, 2015, through September 24, 2015. In Reference 5, the NRC provided results of the audit report and identified additional documents that were needed to complete their review but were not readily available to I&M at the time of the audit.

The request to review additional documents included both proprietary and non-proprietary documents. However, prior to providing the non-proprietary documents to the NRC, errors were discovered in the application of meteorological data that affected those reference documents. The errors have been corrected and the reference documents have been revised. The following non-proprietary documents requested by the NRC are listed below and provided electronically on a compact disc with this enclosure:

- RWA-1313-001, Rev. 1, Cook Nuclear Plant AST Radiological Analysis Input Parameter Development - prepared for I&M by Red Wolf Associates (RWA)

- RWA-1313-010, Rev. 1, Cook Nuclear Plant Main Steam Line Break AST Radiological Analysis - prepared for I&M by RWA

- RWA-1313-011, Rev. 1, Cook Nuclear Plant Steam Generator Tube Rupture AST Radiological Analysis - prepared for I&M by RWA

The following documents, some of which are proprietary, were requested by the NRC and have been uploaded to a read-only electronic reading room (ERR):

- CN-CRA-99-047, Rev. 0, D. C. Cook Units 1 & 2 Steam Releases for Radiological Dose Calculation - Westinghouse Electric Company, LLC (WEC) Proprietary Calculation
- CN-CRA-99-055, Rev. 1, Donald C. Cook Steam Generator Tube Rupture T&H Analysis for NUREG-1465 Dose Project – Revised - WEC Proprietary Calculation
- AEP-13-63, American Electric Power, Donald C. Cook Units 1 And 2, Ultimate Heat Sink Program - WEC Proprietary Analysis
- (Design Information Transmittal) DIT-B-03594-00, -01, and -02 Miscellaneous Input for Dose Reanalysis Effort (Contract # 01559762) – Engineering document prepared by I&M staff

The ERR is administered by Curtiss-Wright and access has been provided to the NRC for these documents.

**References**

1. Letter from J. P. Gebbie, Indiana Michigan Power Company (I&M), to U. S. Nuclear Regulatory Commission (NRC), "Donald C. Cook Nuclear Plant Units 1 and 2, License Amendment Request to Adopt TSTF-490, Revision 0, 'Deletion of E Bar Definition and Revision to Reactor Coolant System Specific Activity Technical Specification' and Implement Full-Scope Alternative Source Term," dated November 14, 2014, Agencywide Documents Access and Management System (ADAMS) Accession No. ML14324A209

2. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook, Unit 1 and Unit 2 - Supplemental Information for the License Amendment Request to Adopt TSTF-490, Rev 0, 'Deletion of E Bar Definition and Revision to Reactor Coolant System Specific Activity Technical Specification' and Implement Full-Scope Alternative Source Term," dated February 12, 2015, ADAMS Accession No. ML15050A247

3. E-mail capture from A. W. Dietrich, NRC, to T. L. Curtiss, I&M, "D.C. Cook Units 1 and 2 – SRXB RAI Concerning LAR to Adopt TSTF-490 and Implement Full-Scope AST (TAC NOS. MF5184 AND MF5185)," dated July 14, 2015, ADAMS Accession No. ML15195A698

4. Letter from J. P. Gebbie, I&M, to NRC, "Donald C. Cook, Unit 1 and Unit 2 - Response to Second Request for Additional Information Regarding the License Amendment Request to Adopt TSTF-490 and Implement Alternative Source Term," dated August 24, 2015, ADAMS Accession No. ML15238A726

5. Letter from NRC to J. P. Gebbie, I&M, "Donald C. Cook Nuclear Plant, Units 1 and 2 - Regulatory Audit Report Regarding License Amendment Request to Adopt Technical Specifications Task Force-490, Rev. 0, and Implement Alternative Source Term (CAC Nos. MF5184 AND MF5185)," dated January 20, 2016, ADAMS Accession No. ML 16007A180

**Enclosure 5 to AEP-NRC-2016-23**

**Red Wolf Associates (RWA) Technical Report**

**RWA-1313-015, Rev. 1, "D. C. Cook AST Radiological Analyses Technical Report"**

(Provided on compact disc enclosed with this letter)

**Enclosure 4 to AEP-NRC-2016-23**

**Documents Requested by NRC On-site Document Audit -**
**Vendor Calculations from Red Wolf Associates**
(Provided on compact disc enclosed with this letter)

As discussed in Enclosure 2 to this letter, Indiana Michigan Power Company (I&M), the licensee for the Donald C. Cook Nuclear Plant, Units 1 and 2, submitted a license amendment request (LAR) to the U.S. Nuclear Regulatory Commission (NRC) (References 1 and 2). The proposed amendment requests adoption of Technical Specifications Task Force-490, Revision 0, and implementation of alternative source term (AST) methodology for accident analysis.

The NRC staff in the Reactor Systems Branch (SRXB) reviewed the amendment request and determined that additional information was needed in order to complete the review. By Reference 3, the NRC transmitted a request for additional information (RAI) regarding the LAR submitted by I&M in Reference 1. In that RAI, the NRC requested I&M to provide source documents that would validate the input parameter values applied in each accident analysis. By Reference 4, I&M provided a response to the RAI, which contained updated source document information for the revised accident analyses input parameters listed in the tables in Enclosure 12 of Reference 1.

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