



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

April 21, 2016

Mr. Joseph W. Shea
Vice President, Nuclear Licensing
Tennessee Valley Authority
1101 Market Street, LP 3R-C
Chattanooga, TN 37402-2801

**SUBJECT: BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3 – REGULATORY
AUDIT PLAN FOR MAY 3 - 5, 2016, AUDIT AT EXCEL FACILITY IN ROCKVILLE,
MARYLAND, IN SUPPORT OF EXTENDED POWER UPRATE LICENSE
AMENDMENT REQUEST (CAC NOS. MF6741, MF6742, AND MF6743)**

Dear Mr. Shea:

By letter dated September 21, 2015, as supplemented by letters dated November 13, December 15, and December 18, 2015, Tennessee Valley Authority submitted a license amendment request (LAR) for the Browns Ferry Nuclear Plant, Units 1, 2, and 3. The proposed amendment would increase the authorized maximum steady-state reactor core power level for each unit from 3,458 megawatt thermal (MWt) to 3,952 MWt. This LAR represents an increase of approximately 20 percent above the original licensed thermal power level of 3,293 MWt, and an increase of approximately 14.3 percent above the current licensed thermal power level of 3,458 MWt.

In addition, by letter dated February 18, 2016, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI). The licensee, by letter dated March 28, 2016, responded to the RAI.

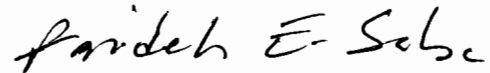
To support its safety evaluations, the NRC staff will conduct an audit at the EXCEL Services Corporation facility in Rockville, Maryland, from May 3 – 5, 2016. The audit plan to support the review of the extended power uprate (EPU) LAR regarding containment accident pressure is enclosed.

J. Shea

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If you have any questions, please contact me at (301) 415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

A handwritten signature in black ink, reading "Farideh E. Saba". The signature is written in a cursive style with a large, stylized 'F' and 'S'.

Farideh E. Saba, Senior Project Manager
Plant Licensing II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260, and 50-296

Enclosure:
Audit Plan for EPU LAR

cc w/encl: Distribution via Listserv

REGULATORY AUDIT PLAN FOR MAY 3 - 5, 2016, AUDIT
AT EXCEL FACILITY IN ROCKVILLE, MARYLAND, TO SUPPORT REVIEW OF
EXTENDED POWER UPRATE LICENSE AMENDMENT REQUEST
TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3
DOCKET NOS. 50-259, 50-260, AND 50-296

Purpose

In the proposed extended power uprate (EPU) application (References 1 and 2) for Browns Ferry Nuclear Plants (BFN) Units 1, 2, and 3, Tennessee Valley Authority (TVA or the licensee) did not credit containment accident pressure (CAP) in the determination of net positive suction head (NPSH) for the residual heat removal (RHR) and core spray pumps during a design basis loss-of-coolant accident (LOCA), abnormal events, and safe-shutdown of the non-accident unit. The purpose of this audit is to review the key items that form the basis for not crediting CAP in the NPSH analyses.

Audit Background

The U.S. Nuclear Regulatory Commission (NRC) staff is currently engaged in a review of a license amendment request (LAR) for the BFN, Units 1, 2, and 3. By letter dated September 21, 2015 (References 1 and 2), as supplemented by letters dated November 13, December 15, and December 18, 2015 (References 3, 4, and 5, respectively), the licensee submitted an LAR for the BFN, Units 1, 2, and 3. The proposed amendment would increase the authorized maximum steady-state reactor core power level for each unit from 3,458 megawatt thermal (MWt) to 3,952 MWt. This LAR represents an increase of approximately 20 percent above the original licensed thermal power level of 3,293 MWt, and an increase of approximately 14.3 percent above the current licensed thermal power (CLTP) level of 3,458 MWt.

The NRC staff has determined that a regulatory audit of the BFN LAR should be conducted in accordance with the Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, "Regulatory Audits," for the NRC staff to gain a better understanding of the licensee's calculations and other aspects of the LAR regarding CAP.

Enclosure

Containment Accident Pressure Background

National Fire Protection Association (NFPA) 805 Fire Event Safe Shutdown NPSH Analysis at the CLTP.

The use of CAP in the NPSH analysis for the RHR system pumps during a postulated NFPA 805 Fire event safe shutdown at the CLTP was proposed to be eliminated by the licensee in References 6 and 7, and was approved by the NRC staff in safety evaluation (Reference 8) with a license condition [emphasis added]. Elimination of CAP implies that the NPSH analysis for the event results in a positive NPSH margin without crediting the developed containment pressure higher than that present before the event. The NPSH margin (difference between NPSH available (NPSHa) and NPSH required) is a measure of the pump ability to avoid excessive cavitation so that it can perform its safety function(s).

The method used for eliminating CAP credit in the NFPA 805 Fire NPSH analysis at CLTP was to increase the NPSHa by lowering the vapor pressure at the pump inlet, which was accomplished by lowering the suppression pool temperature response. The lowering of the suppression pool temperature response was done by improving the thermal performance, that is, the K-factor of the RHR heat exchanger (HX). The licensee developed a new acceptance criterion for the design value of the RHR HX K-factor from its current value of 223 BTU/sec-°F to 265 BTU/sec-°F using the projected heat transfer at its most limiting conditions. The basis for the revised acceptance criterion was the as-found performance testing of BFN Unit 3, RHR system HX 3C in year 2012 after 4 years from the previous cleaning required by BFN response to Generic Letter (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment." The measured fouling resistance (FR) in this test was 0.000674 hour - square foot -degrees Fahrenheit / British thermal unit (hr-ft²-°F/BTU). At the LOCA state point operation of the RHR HX, without crediting CAP, with a K-factor of 265 BTU/sec-°F, the licensee calculated the required design FR to be 0.001517 hr-ft²-°F/BTU or less, which bounds the measured FR 0.000674 hr-ft²-°F/BTU. At the NFPA 805 Fire event state point at CLTP, with a design FR resistance of 0.001517 hr-ft²-°F/BTU, the K-factor would be 284.5 BTU/sec-°F and, therefore, the heat transfer performance would be better. For the purpose of comparison, the licensee provided an estimated value of K-factor to be 372 BTU/sec-°F for a clean RHR HX, which is, zero fouling and no tubes plugged at the limiting NFPA 805 Fire analysis state point conditions.

The license condition imposed in Reference 30, Item 49 of Table S-3 of NRC safety evaluation (Reference 8) is as follows:

Revise the program that monitors BFN Residual Heat Removal (RHR) heat exchanger performance for consistency with the assumptions of the NFPA 805 Net Positive Suction Head (NPSH) analysis. The monitoring program shall include verification that the tested worst fouling resistance, with measurement uncertainty added, of all BFN Units 1, 2, and 3 RHR heat exchangers is less than the design value of 0.001517 hr-ft²-°F/BTU and the worst tube plugging is less than 4.57 percent.

Extended Power Uprate Design Basis LOCA and Abnormal Events NPSH Analysis

In the proposed EPU application (References 1 and 2), the licensee has similarly not credited CAP in the NFPA 805 Fire safe shutdown NPSH analysis as well as for the design basis LOCA, station blackout, stuck-open relief valve, anticipated transient without scram, and loss of shutdown cooling events, and safe shutdown of the non-accident unit NPSH analyses. The basis for not crediting CAP and having a positive NPSH margin is the tested value of the RHR HX FR. The licensee has proposed revision of the design FR resistance from 0.001517 hr-ft²-°F/BTU to 0.001521 hr-ft²-°F/BTU.

Regulatory Audit Basis

The basis of this audit is TVA's LAR and NUREG-0800, "Standard Review Plan for the Review of Nuclear Power Plants: Section 6.2.2, "Containment Heat Removal Systems."

This audit will provide information necessary for the evaluation of the CAP associated with the proposed EPU LAR to the NRC staff from the Reactor Systems Branch (staff previously in Containment and Ventilation Branch (SCVB)), Division of Safety Systems, NRR.

Regulatory Audit Scope

The scope of this regulatory audit will include supporting documents including calculations associated with the CAP.

Information Necessary for the Regulatory Audit

The NRC staff requests the licensee to present the following items regarding the staff's requests for additional information (RAIs) during the audit:

1. Proposed revision of the license condition for the NFPA 805 Fire event NPSH analysis at CLTP for EPU and justification.
2. Proposed revision to the GL 89-13 response for EPU regarding the RHR HX and justification.
3. RHR HX test setup for fouled and clean RHR HX performance monitoring test – information requested in SCVB-RAI 1.¹
4. Data acquisition method for the RHR HX performance monitoring test – information requested in SCVB-RAI 1 and the TVA response.²
5. Data reduction method for the RHR HX performance monitoring test – information requested in SCVB-RAI 1.
6. Description of PROTO-HX code, including how the RHR HX FR is calculated.

¹ This RAI was transmitted to TVA by letter dated February 18, 2016 (Reference 9).

² TVA responded to SCVB-RAI 1 by letter dated March 28, 2016 (Reference 10).

7. PROTO-HX methodology for calculating the RHR HX UA [overall heat transfer coefficient times the heat transfer area] and U [overall heat transfer coefficient] without knowing the number of plugged tubes in case the HX is not inspected in the as-found condition.
8. Uncertainty analysis and its conservativeness and how it is performed – information requested in SCVB-RAI 1.
9. As-found test results for FR and uncertainty for all BFN RHR HX tested.
10. As-found inspection results for all BFN HX, including number of fully and partially blocked tubes, and definition of a partially blocked tube.
11. Discussion regarding the upcoming supplement scheduled to be submitted the end of May 2016; proposed changes, and the necessity for the changes.

In addition, the licensee is requested to have the draft responses available on site for the audit team for draft RAI associated with CAP that were transmitted to TVA by e-mails on March 24 and 25, 2016. The draft responses could be provided electronically or by paper copies. If provided electronically, the licensee is requested to have at least two computers available for the audit team, with a printer attached.

Additional information needs identified during the audit will be communicated to the designated point of contact.

The NRC staff also requests the licensee to make personnel who are familiar with the LAR (including site staff and contractors, if appropriate) accessible upon request (either in person or by phone). The personnel should be able to respond to NRC staff questions.

Team Assignments / Resource Estimates

Audit Team	Assigned Auditor
Audit Team Lead	Farideh Saba (NRC)
Technical Reviewer	Ahsan Sallman (NRC)
Technical Reviewer	Yuri Orechwa (NRC)

Logistics

The audit will be conducted with the licensee at the EXCEL Services Corporation facility in Rockville, Maryland, from May 3 to 5, 2016. Entrance and exit briefings will be held at the beginning and end of this audit. The licensee is requested to provide a conference room for the use by the audit team.

The audit will start at 9:00 a.m. on Tuesday, May 3, 2016, and conclude on Thursday, May 5, 2016. Our tentative schedule for the audit is as follows:

May 3, 2016

9:00 a.m.	Check-in at EXCEL Office – meet licensee contact(s), setup for entrance meeting.
9:30 a.m.	Entrance Meeting - introductions, audit activities, goals, and logistics.
10:00 a.m.	NRC Team Breakout/Discussion with the licensee.
12:00 p.m.	Lunch.
1:00 p.m.	NRC Team Breakout/Discussion with the licensee.
4:00 p.m.	Audit Team Caucus.
4:30 p.m.	NRC/Licensee Interim Meeting.
5:00 p.m.	Audit Team Daily Closeout.

May 4, 2016

9:00 a.m.	NRC Team Breakout/ Discussion with the licensee.
12:00 p.m.	Lunch.
1:00 p.m.	NRC Team Breakout/Discussion with the licensee.
3:30 p.m.	Audit Team Caucus.
4:00 p.m.	NRC/Licensee Interim Meeting.
5:00 p.m.	Audit Team Daily Closeout.

May 5, 2016

9:00 a.m.	NRC Team Breakout/Discussion with the licensee.
12:00 p.m.	Lunch.
1:00 p.m.	NRC Team Breakout/Discussion with the licensee.
3:30 p.m.	Audit Team Caucus.
4:00 p.m.	NRC/Licensee Interim/Exit Meeting.
5:00 p.m.	NRC/Licensee Audit Closeout.

Deliverables

At the conclusion of the audit, the NRC staff will conduct an exit briefing and will provide a summary of audit results in each subject area defined in the audit scope. An audit report/summary will be issued to the licensee within approximately 90 days from the end of the audit. Additionally, the results of the audit will be utilized to focus the scope of any requests for additional information issued in the course of this review.

References

- 1 Letter from TVA to NRC dated September 21, 2015, "Proposed Technical Specifications Change TS-505 – Request for License Amendments – Extended Power Uprate" (Agencywide Documents Access and Management System (ADAMS) Accession Number ML15282A152).
- 2 Attachment 6 to Reference 1, "NEDC-33860P, Safety Analysis Report for Browns Ferry Nuclear Plant Units 1, 2, and 3 Extended Power Uprate (proprietary)" (ADAMS Accession Number ML15282A264), (Non-Proprietary ADAMS Accession Number ML15282A181).
- 3 Letter from TVA to NRC dated November 13, 2015, "Proposed Technical Specifications Change TS-505 - Request for License Amendments - Extended Power Uprate - Supplemental Information" (ADAMS Accession Number ML15317A361).
- 4 Letter from TVA to NRC dated December 15, 2015, "Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU) - Supplement 2, MICROBURN-B2 Information" (ADAMS Accession Number ML15351A113).
- 5 Letter from TVA to NRC dated December 18, 2015, "Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU) - Supplement 3, Interconnection System Impact Study Information" (ADAMS Accession Number ML15355A413).
- 6 Letter from TVA to NRC dated March 27, 2013, "License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition) (Technical Specification Change TS-480)" (ADAMS Accession No. ML13092A393).
- 7 Attachment X to TVA, Browns Ferry Nuclear Plant Units 1, 2 and 3, Transition Report dated March 2013, "Transition to 10 CFR 50.48(c) - NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition" (ADAMS Accession No. ML13092A392).
- 8 Letter from NRC to TVA dated October 28, 2015, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Issuance of Amendments Regarding Transition to a Risk-Informed, Performance-Based Fire Protection Program in Accordance with 10 CFR 50.48(c)" (ADAMS Accession No. ML15212A796).
- 9 Letter from NRC to TVA, dated February 18, 2016, "Request for Additional Information Related to License Amendment Request Regarding Extended Power Uprate" (ADAMS Accession No. ML16041A307).
- 10 Letter from TVA to NRC dated March 28, 2016, "Proposed Technical Specifications (TS) Change TS-505 - Request for License Amendments - Extended Power Uprate (EPU) - Supplement 8, "Response to Request for Additional Information" (ADAMS Accession No. ML16089A054).

J. Shea

- 2 -

If you have any questions, please contact me at (301) 415-1447 or Farideh.Saba@nrc.gov.

Sincerely,

/RA/

Farideh E. Saba, Senior Project Manager
Plant Licensing II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-259, 50-260, and 50-296

Enclosure:
Audit Plan for EPU LAR

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***by memorandum**

OFFICE	NRR/DORL/LPLIV-1/PM	NRR/DORL/LPLII-2/PM	NRR/DORL/LPLII-2/LA
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OFFICE	NRR/DSS/SRXB/BC(A)	NRR/DORL/LPLII-2/BC	NRR/DORL/LPLII-2/PM
NAME	EOesterle	BBeasley	FSaba
DATE	4/21/2016	4/21/2016	4/21/2016

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