ENT000088
Submitted: March 28, 2012

April 15, 2005

Mr. Joseph E. Venable
Vice President Operations
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 - ISSUANCE OF AMENDMENT RE: EXTENDED POWER UPRATE (TAC NO. MC1355)

Dear Mr. Venable:

The Commission has issued the enclosed Amendment No. 199 to Facility Operating License No. NPF-38 for the Waterford Steam Electric Station, Unit 3 (Waterford 3). This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated November 13, 2003, as supplemented by letters dated January 29, March 4, April 15, May 7, May 12, May 13, May 21, May 26, July 14, July 15, July 28, August 10, August 19, August 25, September 1, September 14, October 8 (2 letters), October 13, October 18, October 19, October 21, October 29 (2 letters), November 4, November 8, November 16, and November 19, 2004, and January 5, January 14, February 5, February 16, and March 17, 2005. Entergy Operations, Inc., (Entergy) requested changes to the Facility Operating License and TSs for Waterford 3.

The amendment increases the maximum steady-state reactor core power level from 3441 megawatts thermal (MWt) to 3716 MWt, which is an increase of approximately 8 percent. The increase is considered an extended power uprate (EPU).

By supplemental letter dated July 15, 2004, Entergy decided to implement an Alternative Source Term (AST), as permitted by 10 CFR 50.67, “Accident source term,” for calculating accident offsite doses and doses to control room personnel. This request has been reviewed by the U.S. Nuclear Regulatory Commission staff and the amendment was issued on March 29, 2005.

The staff is not providing a technical evaluation of Entergy’s dose analyses using the original licensing source term in the attached safety evaluation (SE) (Section 2.9) for the EPU, and has referred to the SE for the AST license amendment. The staff's finding of acceptability for the proposed increase in power uprate is based on the AST application meeting the requirements of 10 CFR 50.67 and General Design Criterion 19, and the staff's approval of the request for a full-scope implementation of an AST for Waterford 3 via letter dated March 29, 2005.

In the supplemental letter dated February 5, 2005, Entergy has a commitment as follows:

> Prior to exceeding 3441 MWt, Entergy will submit, for NRC review and approval, a description of how Entergy accounts for instrument uncertainty for each Technical Specification parameter impacted by the Waterford 3 Extended Power Uprate.

This commitment is included in the amendment as a license condition, as discussed during a telephone call with you on April 14, 2005. You will need to submit a separate license amendment request pursuant to 10 CFR 50.90 and then receive NRC approval of that request, via a separate license amendment, to complete this license condition.

We want to provide some observations on the overall conduct of this review that resulted in the unusually large expenditure of staff resources and the extended schedule. The completeness and thoroughness of the engineering work and project planning supporting your application appear to have evolved during the NRC's review rather than having been developed up front. There were many problems, changes, and errors that arose during the course of the review, some identified by the staff and others by Entergy, that could and should have been anticipated and addressed before you submitted the amendment application. Similarly, we believe you could have taken fuller advantage of your Arkansas Nuclear One, Unit 2, EPU experience. We are conducting a lessons-learned evaluation to assess our review experience with the new EPU review standard and to determine whether we could have detected these issues in your application during our acceptance review. We hope that you too will critically review your performance for any useful lessons learned.

A copy of our related SE is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA by T. Alexion for/

N. Kalyanam, Project Manager, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosures: 1. Amendment No. 199 to NPF-38
2. Safety Evaluation

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EEIB/B**	SPLB/A	SPLB/B	SPSB/C	SRXB/B	IROB/B	IEPB/A	SPSB/BC*
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2-28-05	2-24-05	3-3-05	2-23, 23, 24-05	2-25-05	3-14-05	2-24-05	10-7-04

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 199 TO

FACILITY OPERATING LICENSE NO. NPF-38

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

1.0 INTRODUCTION

1.1 Application

By application dated November 13, 2003, (Reference 1), as supplemented by letters dated January 29 (Reference 2), March 4 (Reference 3), April 15 (Reference 4), May 7 (Reference 5), May 12 (Reference 6), May 13 (Reference 7), May 21 (Reference 8), May 26 (Reference 9), July 14 (Reference 10), July 15 (Reference 11), July 28 (Reference 12), August 10 (Reference 13), August 19 (Reference 14), August 25 (Reference 15), September 1 (Reference 16), September 14 (Reference 17), October 8 (Reference 18 and Reference 19), October 13 (Reference 20), October 18 (Reference 21), October 19 (Reference 22), October 21 (Reference 23), October 29 (Reference 24 and Reference 25), November 4 (Reference 26), November 8 (Reference 27), November 16 (Reference 28), and November 19, 2004 (Reference 29), and January 5 (Reference 30), January 14 (Reference 70), February 5 (Reference 71), February 16 (Reference 72), and March 17, 2005 (Reference 75), Entergy Operations, Inc., (Entergy, the licensee) requested changes to the Facility Operating License and Technical Specifications (TSs) for the Waterford Steam Electric Station, Unit 3 (Waterford 3).

The proposed changes would increase the maximum steady-state reactor core power level from 3441 megawatts thermal (MWt) to 3716 MWt, which is an increase of approximately 8 percent. The proposed increase in power level is considered an extended power uprate (EPU).

1.2 Background

The Waterford 3 site is located in southeastern Louisiana on the west bank of the Mississippi River near the town of Taft in Saint Charles Parish. The nearest population center is Kenner, 13 miles east of the site. New Orleans is approximately 25 miles east-southeast of the site.

Technical Evaluation

The licensee stated that Waterford 3 Service Level 1 coatings in containment were selected and tested to meet design basis accident (DBA) and normal operating conditions. These coatings meet the requirements of American National Standards Institute (ANSI) Standards N5.12, "Protective Coatings (Paints) for the Nuclear Industry," dated June 20, 1974, and N101.2, "Protective Coatings (Paints) for Light Water Nuclear Reactor Containment Facilities," dated May 30, 1972. The quality assurance during manufacturing, transportation, and storage is in compliance with ANSI Standard N101.4, "Quality Assurance for Protective Coating Applied to Nuclear Facilities," dated November 1972, in conjunction with the general quality assurance requirements of ANSI Standard N45.2, "Quality Assurance Program Requirements for Nuclear Power Plants." The licensee stated that the procurement, application, and maintenance of Service Level 1 protective coatings used inside the containment are consistent with the licensing basis and regulatory requirements. The requirements of 10 CFR Part 50, Appendix B, are implemented through specification and procedures that delineate appropriate technical and quality requirements for the Service Level 1 coatings program, including ongoing maintenance activities. The protective coatings are discussed in UFSAR Section 6.1.2.

The EPU conditions that can affect the qualification of the coatings are changes in pressure, temperature, radiation, and chemistry. The licensee concluded that changes in pressure, temperature, radiation, and chemistry for DBA and normal conditions due to the EPU are bounded by current DBA and normal conditions for these parameters. Consequently, the protective coatings remain qualified for EPU conditions.

On the basis of the NRC staff review, the NRC staff concludes that the protective coating systems are acceptable under the EPU conditions because the current DBA and normal conditions bound the EPU conditions for the pressure, temperature, radiation, and chemistry parameters.

Summary

The NRC staff has reviewed the licensee's evaluation of the effects of the proposed EPU on protective coating systems and concludes that the licensee has appropriately addressed the impact of changes in conditions following a DBLOCA and their effects on the protective coatings. The NRC staff further concludes that the licensee has demonstrated that the protective coatings will continue to be acceptable following implementation of the proposed EPU and will continue to meet the requirements of Appendix B to 10 CFR Part 50. Therefore, the NRC staff finds the proposed EPU acceptable with respect to protective coating systems.

2.1.8 Flow-Accelerated Corrosion

Regulatory Evaluation

Flow-accelerated corrosion (FAC) is a corrosion mechanism occurring in carbon steel components exposed to flowing single- or two-phase water. Components made from stainless steel are not affected by FAC, and FAC is significantly reduced in components containing small amounts of chromium or molybdenum. The rates of material loss due to FAC depend on velocity of flow, fluid temperature, steam quality, oxygen content, and pH. During plant operation, control of these parameters is limited and the optimum conditions for minimizing FAC effects, in most cases, cannot be achieved. Loss of material by FAC will, therefore, occur. The NRC staff has reviewed the effects of the proposed EPU on FAC and the adequacy of the licensee's FAC program to predict the rate of loss so that repair or replacement of damaged components could be made before they reach critical thickness. The licensee's FAC program is based on NUREG-1344, GL 89-08, and the guidelines in EPRI Report NSAC-202L-Revision 2 (Reference 39). It consists of predicting loss of material using the CHECWORKS computer code, and visual inspection and volumetric examination of the affected components. The NRC's acceptance criteria are based on the structural evaluation of the minimum acceptable wall thickness for the components undergoing degradation by FAC.

Technical Evaluation

The licensee used EPRI's CHECWORKS code to estimate the effects of EPU on components that are susceptible to FAC. The licensee used changes to the plant operating parameters (e.g., increased flow rates, changes in steam quality, temperatures, and pressures) to determine the effects of the EPU conditions on FAC wear rates. The licensee updated the current CHECWORKS model with the EPU conditions for all modeled systems that are susceptible to FAC. The updated model also incorporates all inspection data for calibration of predicted wear rates. This study compared the current predicted wear rates and the post-EPU predicted wear rates of all modeled systems in the FAC program. The systems analyzed are FW, blowdown, HDRs, extraction steam, miscellaneous drains, and condensate drains. The results showed that the FAC wear rates after the EPU will increase by a low to moderate amount.

The licensee stated that during each outage inspections are performed to identify piping in need of replacement. The pipes are repaired to preclude falling below minimum wall thickness. The increase in the FAC wear rate after EPU and consequent reduction in pipe wall thickness will be monitored via the FAC inspection program. The licensee stated that the piping will be replaced if the measured wall thickness at the current RFO and/or the projected wall thickness at the next RFO falls below the ASME Code-allowable wall thickness.

In Question 1 of its Request for Additional Information (RAI) dated January 28, 2004 (ML040330260), the NRC staff asked the licensee to provide a list of the components most susceptible to FAC, including initial wall thickness (nominal), current wall thickness, and the predicted wall thickness. By Reference 3, the licensee provided data of the wear rate on sample piping obtained in the pre- and post-EPU conditions. The data indicate the initial and current wall thickness of the (sample) piping that shows high wear rate and also contain predicted wall thickness of the piping in the current operating conditions and post-uprated conditions.

In Question 2, the NRC staff asked the licensee to provide examples of the piping components for which wall thinning is predicted by CHECWORKS based on the current operating conditions and confirmed measured NDE. The comparison of predicted wall thickness versus measured wall thickness would show the effectiveness of CHECWORKS in prediction. By Reference 3, the licensee submitted a comparison of predicted wall thickness vs. measured wall thickness of sample piping. The data show that the wall thickness prediction by CHECWORKS is conservative. Therefore, the NRC staff finds that the CHECWORKS prediction at Waterford 3 has been demonstrated to be adequate.

In Question 3, the NRC staff asked the licensee to discuss the inspection technique and inspection scope (e.g., how many piping systems are inspected) in the FAC program and specific subsection in the ASME Code by which the minimum wall thickness is calculated.

By Reference 3, the licensee responded that it uses ultrasonic testing as the primary inspection technique for FAC. The following systems are monitored in the FAC program: FW, blowdown, FW HDRs, extraction steam, main steam drain headers, condensate, steam bypass, cross-under pipe, and main steam. The licensee stated that its FAC inspection program is consistent with the recommendations in Reference 39.

The licensee stated further that for wall thinning in piping due to FAC that occurs in a localized region, the decision to replace the piping is based on comparing measured or projected wall thickness at the localized region with the allowable localized wall thickness. The allowable localized wall thickness is the minimum thickness, based on the geometry of the thinned location, calculated by ASME Code proximity criteria equations with allowables for Class 1 piping in ASME subarticle NB-3200. The acceptance criteria in Reference 39 are also based on the ASME Code Class 1 design rules that dictate screening criteria for identifying wall thinning.

The NRC staff's Question 4 asked the licensee to discuss the limit on the percentage of wall thickness below which the pipe is replaced, and discuss whether the pipe replacement due to FAC is consistent with ASME Code, Section XI, Case N597-1, which is referenced in RG 1.147, Revision 13, June 2003; and Reference 39.

By Reference 3, the licensee responded that its piping replacement criteria meet the EPRI Guideline Document (NP-5911SP), which recommends that piping be replaced when measured or projected wall thickness falls below 20 percent of nominal wall thickness. The piping is replaced or repaired when (1) the projected wall thickness is below 30 percent of nominal wall thickness for ASME Class 1 and 2 Piping, (2) the projected wall thickness is below 20 percent of nominal wall thickness for ASME Class 3 piping, and (3) the projected wall thickness is the lesser of 0.3 x nominal and 0.5 x minimum thickness for Class 3 low energy and B31.1 piping.

The licensee stated that the existing piping replacement criteria are consistent with the guidelines in Reference 39, and/or NRC guidance. ASME Section XI, Code Case N597-1, provides the requirements for analytical evaluation of pipe wall thinning. This Code case is supplemented by the provisions in Reference 39, for developing the inspection requirements, the method of predicting the rate of wall thickness loss, and the value of predicted remaining wall thickness. Piping components affected by FAC to which Code Case N597-1 is applied must be repaired or replaced in accordance with the construction Code of record and owner’s requirements, or a later NRC-approved edition of Section III of the ASME Code prior to the value of projected wall thickness reaching the allowable minimum wall thickness. The licensee stated that the inspection requirements, the method of predicting the rate of wall thickness loss, and the value of predicted remaining wall thickness meet the guidance in Reference 39.

The licensee compares the measured/projected wall thickness as obtained during the outage to the acceptable minimum wall thickness as discussed above. If the projected wall thickness is below the acceptable minimum wall thickness, the licensee performs a detailed engineering evaluation following a methodology for evaluating localized thinning in piping for ASME Section III, ANSI B31.7, and ANSI B31.1 carbon steel piping.

As discussed with members of the NRC staff on September 2, 2004, the licensee stated in Reference 17 that the heat balance used to assess the impact of EPU on FAC has been revised to incorporate precision pressure measurements for the throttle steam pressure and reheater heating steam pressures. Also, to better bound expected operating conditions, the heat balance has been run at a circulating water temperature of 42 °F, in addition to the circulating water temperature of 92 °F used previously. Running with a low circulating water temperature maximizes extraction steam flow in the low point FW heaters and therefore maximizes flow in the associated HDR lines. As a result, minor impacts may be seen on components enclosed inside the condenser. Therefore, Entergy will update the FAC program with the revised heat balance and reassess the EPU impact on FAC prior to EPU implementation.

By Reference 17, Entergy submitted a commitment (See Section 4.0 of this SE, Commitment 50), which reads: "Entergy will update the FAC program with the revised heat balance and reassess the EPU impact on FAC prior to EPU implementation..." The NRC staff finds the commitment acceptable.

The NRC staff finds that the FAC program is acceptable under the EPU because the program is consistent with the guidance in Reference 39, was demonstrated to be conservative in its application, and the program (i.e., the prediction method) has been adjusted to account for the EPU conditions.

<u>Summary</u>

The NRC staff has reviewed the licensee's evaluation of the effect of the proposed EPU on the FAC analysis for the plant and concludes that the licensee has adequately addressed changes in the plant operating conditions on the FAC analysis. The NRC staff further concludes that the licensee has demonstrated that the updated analyses will predict the loss of material by FAC and will ensure timely repair or replacement of degraded components following implementation of the proposed EPU. Therefore, the NRC staff finds the proposed EPU acceptable with respect to FAC.

2.1.9 Steam Generator Tube Inservice Inspection

<u>Regulatory Evaluation</u>

SG tubes constitute a large part of the RCPB. SG tube inservice inspection (ISI) provides a means for assessing the structural and leaktight integrity of the SG tubes through periodic inspection and testing of critical areas and features of the tubes. The NRC staff's review in this area covered the effects of changes in differential pressure, temperature, and flow rates resulting from the proposed EPU on plugging limits, potential degradation mechanisms (e.g., flow-induced vibration (FIV)), plant-specific alternate repair criteria, and redefined inspection boundaries. The NRC's acceptance criteria for SG tube ISI are based on 10 CFR 50.55a requirements for periodic inspection and testing of the RCPB. Specific review criteria are contained in SRP Section 5.4.2.2 and other guidance provided in Matrix 1 of Reference 31. Additional review guidance is contained in Technical Specification (TS) 3/4.4.4, STEAM GENERATORS, for SG surveillance requirements; RG 1.121 for SG tube plugging limits; GL 95-03; BL 88-02 for degradation mechanisms, structural and leakage performance criteria in