Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-3093
Tel 504-739-6685
jjarrel@entergy.com

John P. Jarrell III
Manager, Regulatory Assurance
Waterford 3

W3F1-2018-0037

June 27, 2018

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: Closure of Commitment Associated with Control Element Assembly Drop Time License Amendment
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

References:

1. W3F1-2015-0040, License Amendment Request to Revise Control Element Assembly Drop Times, July 2, 2015 [ADAMS Accession Number ML15197A106].

2. NRC License Amendment 246, Control Element Assembly Drop Times, November 13, 2015 [ADAMS Accession Number ML15289A143].

3. U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Final Safety Evaluation for Topical Report WCAP-17642-P/NP, Revision 1, "Westinghouse Performance Analysis and Design Model (PAD5)" Westinghouse Electric Company Project 700, September 28, 2017 [ADAMS Accession Number ML17257A338].

4. NRC Letter, "Verification Letter of the Approval Version of Westinghouse Electric Company Topical Report WCAP-17642-P/NP, Revision 1, "Westinghouse Performance Analysis and Design Model (PAD5)," (TAC No. MF3096), January 8, 2018 [ADAMS Accession Number ML17338A453].

5. PROPRIETARY – Westinghouse Letter CWTR3-18-14 to Entergy Operations, Inc., "Transmittal of Thermal Conductivity Degradation Justification Applicable to Waterford-3," March 23, 2018.

Dear Sir or Madam:

This letter serves as notification by Entergy Operations, Inc. (Entergy) of completion of Commitment 4 associated with License Amendment 246 (Control Element Assembly Drop Times).

Commitment 4 states the following:

> The radial power fall-off curve limits shall be verified each cycle as part of the Westinghouse reload analysis methodology until a new licensing basis long term fuel methodology is approved for Waterford 3. Upon NRC approval of a new long term fuel evaluation model and associated methods that explicitly account for thermal conductivity degradation (TCD) that is applicable to Waterford Unit 3 design, Entergy will, within 6 months:
>
> a) Demonstrate that Waterford Unit 3 safety analysis remain conservatively bounded in licensing basis analyses when compared to the NRC-approved new long term fuel evaluation model that is applicable to Waterford Unit 3 design, and/or
>
> b) Provide a schedule for reanalysis using the NRC-approved new long term fuel evaluation model that is applicable to Waterford 3 design for any affected licensing basis analyses.

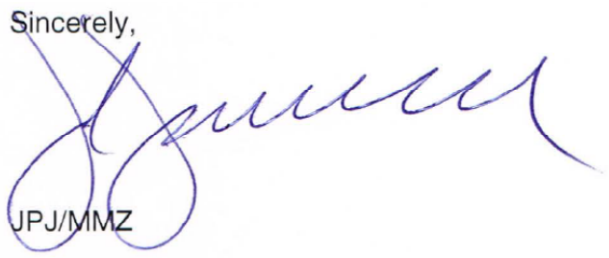
Entergy has satisfied this regulatory commitment by completion of part a) and has determined that part b) is not needed, as the existing safety analysis remains bounded and therefore no licensing basis analyses are affected. Additional information related to this commitment closure is provided in the Enclosure.

Closure of this commitment has been validated by Entergy's standard commitment closure verification process.

This letter contains no new commitments.

If you have any questions or require additional information, please contact the Regulatory Assurance Manager, John P. Jarrell, at (504) 739-6685.

Sincerely,



JPJ/MMZ

Enclosure: Waterford Steam Electric Station, Unit 3 Closure of Control Element Assembly Drop Time License Amendment Commitment 4 (with attachment)

cc: Mr. Kriss Kennedy, Regional Administrator
U.S. NRC, Region IV
RidsRgn4MailCenter@nrc.gov

U.S. NRC Project Manager for Waterford 3
April.Pulvirenti@nrc.gov

U.S. NRC Senior Resident Inspector for Waterford 3
Frances.Ramirez@nrc.gov
Chris.Speer@nrc.gov

Enclosure to

W3F1-2018-0037

Waterford Steam Electric Station, Unit 3
Closure of Control Element Assembly Drop Time
License Amendment Commitment 4

(2 pages)

Waterford Steam Electric Station, Unit 3
Closure of Control Element Assembly Drop Time
License Amendment Commitment 4

On July 2, 2015, Entergy submitted a License Amendment Request (Reference 1) to revise the control element assembly drop times associated with Technical Specification 3.1.3.4 for Waterford Steam Electric Station, Unit 3 (Waterford 3). License Amendment 246 was issued on November 13, 2015. As documented in the safety evaluation (Reference 2), Commitment 4 states the following:

> Commitment: The radial power fall-off curve limits shall be verified each cycle as part of the Westinghouse reload analysis methodology until a new licensing basis long term fuel methodology is approved for Waterford 3. Upon NRC approval of a new long term fuel evaluation model and associated methods that explicitly account for thermal conductivity degradation (TCD) that is applicable to Waterford Unit 3 design, Entergy will, within 6 months:
>
> a) Demonstrate that Waterford Unit 3 safety analysis remain conservatively bounded in licensing basis analyses when compared to the NRC-approved new long term fuel evaluation model that is applicable to Waterford Unit 3 design, and/or
>
> b) Provide a schedule for reanalysis using the NRC-approved new long term fuel evaluation model that is applicable to Waterford 3 design for any affected licensing basis analyses.

Entergy has satisfied this regulatory commitment by completion of part a) and has determined that part b) is not needed, as the existing safety analysis remains bounded and therefore no licensing basis analyses are affected.

Westinghouse topical report WCAP-17642-P/NP, Revision 1, “Westinghouse Performance Analysis and Design Model (PAD5),” describes the fuel performance evaluation methodology and the PAD5 computer code which is the principal design tool for evaluating fuel rod performance and meets the review guidance criteria per Sections 4.2 and 15.02 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition” (SRP). NRC Letter, “Verification Letter of the Approval Version of Westinghouse Electric Company Topical Report WCAP-17642-P/NP, Revision 1, “Westinghouse Performance Analysis and Design Model (PAD5),” dated January 8, 2018 (Reference 4), provided NRC approval of the PAD5 computer code as a long term fuel evaluation model and associated methods. The Final Safety Evaluation for Topical Report WCAP-17642-P/NP, “Westinghouse Performance Analysis and Design Model (PAD5),” (Reference 3) identifies that this model and associated method accounts for TCD that is applicable to Combustion Engineering Pressurized Water Reactors, and therefore, to Waterford 3.

Per item a) of the above commitment, Westinghouse has performed an analysis which justifies the TCD allowance used in Waterford 3 (Reference 5). This analysis uses PAD5 to document a code-to-code benchmark to validate that the thermal effects of TCD are sufficiently accounted for in the analyses. The Attachment to this Enclosure contains the summary and conclusions for the TCD allowance justification.

Enclosure Attachment to

W3F1-2018-0037

Westinghouse Electric Company Document CE-18-110, Rev. 0, Attachment 2, "Summary and Conclusions for Thermal Conductivity Degradation Allowance Justification (Non-Proprietary)"

(6 pages)

CE-18-110, Rev. 0, Attachment 2

Summary and Conclusions for Thermal Conductivity Degradation Allowance Justification (Non-Proprietary)

The PAD5 benchmark study is performed as a code-to-code comparison, which shows temperature, RIP and gap conductance differences between the PAD5 and FATES3B code when applied to Waterford-3. The PAD5 code has considered a wide array of thermal data from the Halden reactor, including data at a wide range of powers and burnups. The benchmark study indicates the differences in the thermal model behavior between the two codes including any models that contribute to fuel temperature predictions. The differences in fuel temperatures and rod internal pressures were reviewed with respect to how they are used in the Waterford-3 safety analyses.

A review of the fuel performance design criteria listed in Reference 3 was performed based on the benchmark study. Table A provides a summary of the evaluations for each criterion. The design criteria that were reviewed include Rod Internal Pressure (RIP) – no clad liftoff, Departure from Nucleate Boiling (DNB) propagation, clad stress, clad strain, clad oxidation and hydriding, fuel melt, clad fretting, clad fatigue, clad flattening, and rod axial growth.

The review of the fuel performance criteria has shown that all fuel performance limits will be met considering the effects of TCD.

The maximum Large Break Loss of Coolant Accident (LBLOCA) Peak Cladding Temperature (PCT) results are dependent on multiple factors including fuel average temperature, fuel pin pressure and gap conductance. These factors, and others, exert competing influences on the cladding swell and eventual rupture, which block flow channels and thus influence the calculation of PCT due to flow starvation downstream of the flow blockage. Later in life higher fuel average temperatures and RIP results in increased PCT. However, early in life the low RIP delays rupture and results in increased PCT. The limiting PCT result comes from fuel pellets not coated with ZrB_2 and is shown in Figure A. Two different cases are shown because the original FATES3B based STRIKIN-II LBLOCA analysis had two different cases that reported limiting results relative to the 10 CFR 50.46 Appendix K criteria. The cases refer to the break sizes used in the original LBLOCA analysis. In this case, the limiting PCT results are at a burnup 32,000 MWD/MTU. After this point the power decreases to 95% of its full power level and PCT results are no longer limiting.

Incorporating PAD5 predictions from the code-to-code comparison into the LBLOCA analysis results in PCTs less than those reported as part of the Analysis of Record (AOR). Therefore, results of the LBLOCA analyses are conservative with respect to the PAD5 benchmark study.

With the exception of rod ejection the Non-LOCA safety analyses are performed with the CENTS and HERMITE codes. These codes use generic gap conductances to calculate fuel average temperatures used in Doppler feedback analyses. TCD always causes increases in the steady state fuel temperatures, which decreases the Doppler feedback. Events that have an initial rise in power bias temperatures to make the feedback as least negative as possible. The use of more realistic, but conservative, gap conductances in combination with the incorporation of TCD is bounded by the current generic gap conductances. Thus, there is no impact on the Non-LOCA events analyzed with the CENTS and HERMITE codes.

Control rod ejection is analyzed by increasing the deposited energy in the rod to the melt limit. The energy is transformed into an allowable ejected rod worth that is confirmed by Core Design as part of the reload. As shown in Figure B, the fuel melt limit is increased in PAD5. Increasing the melt limit supports increases in the allowable ejected rod worths providing an overall benefit compared to FATES3B based analyses.

The results of the Non-LOCA analyses are unchanged with respect to the PAD5 benchmark study.

Therefore, this comparison demonstrates that in all cases the limiting results and conclusions remain unchanged. The TCD allowance included in the Control Rod Drop Time LAR is confirmed to be acceptable based on the PAD5 benchmark study.

Table A: Summary of Fuel Performance Design Criteria

Criterion	Evaluation
RIP - No Clad Liftoff	Bounded
Clad Strain	Limit remains met
Clad Fatigue	Limit remains met
Fuel Melt	Bounded
DNB Propagation	Bounded
Clad Stress	Bounded
Oxidation/Hydriding	Not Impacted
Clad Fretting	Not Impacted
Clad Flattening	Not Impacted
Rod Axial Growth	Not Impacted

Figure A: PCT Comparison Between PAD5 Based Inputs and FATES3B Based Inputs

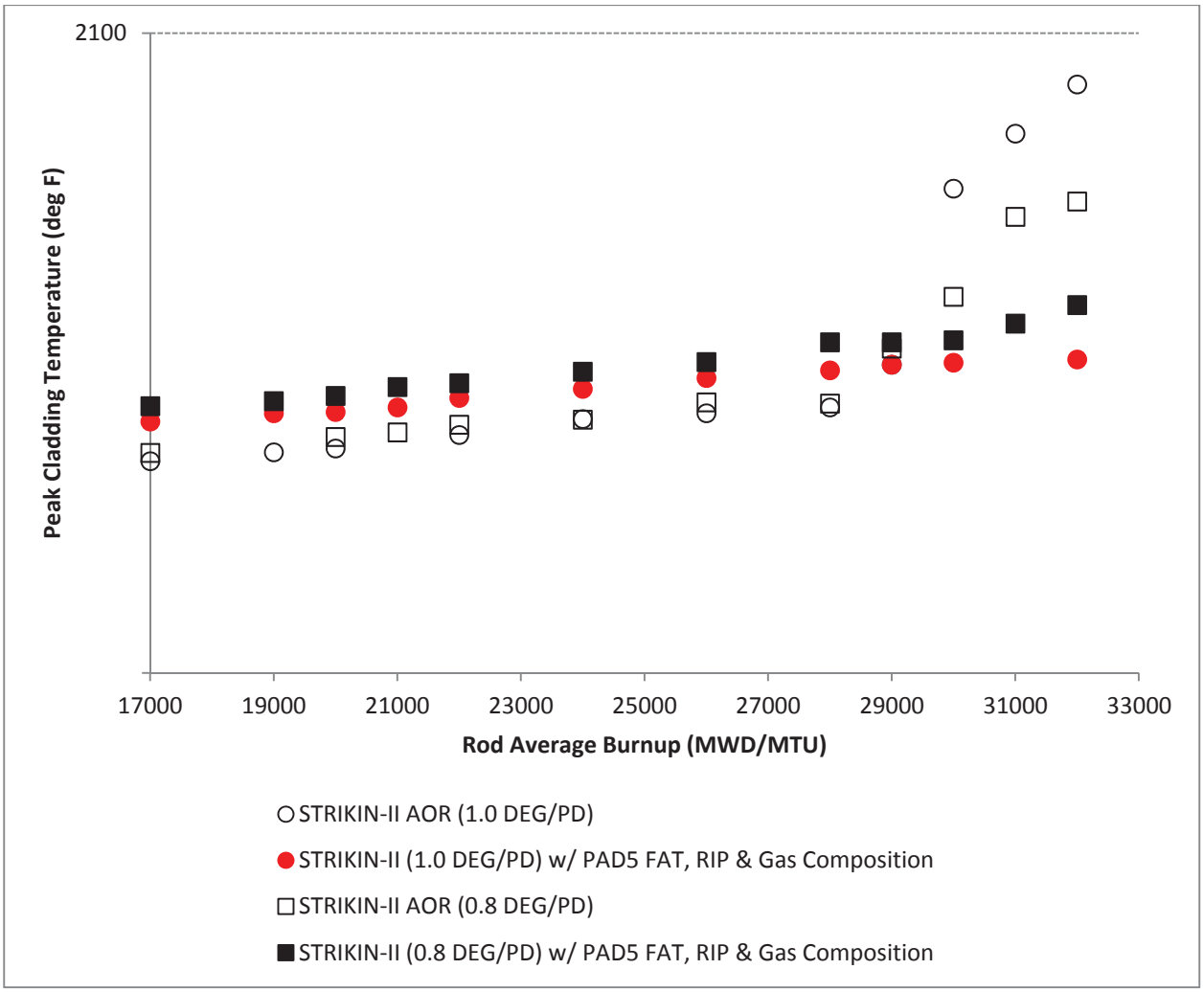
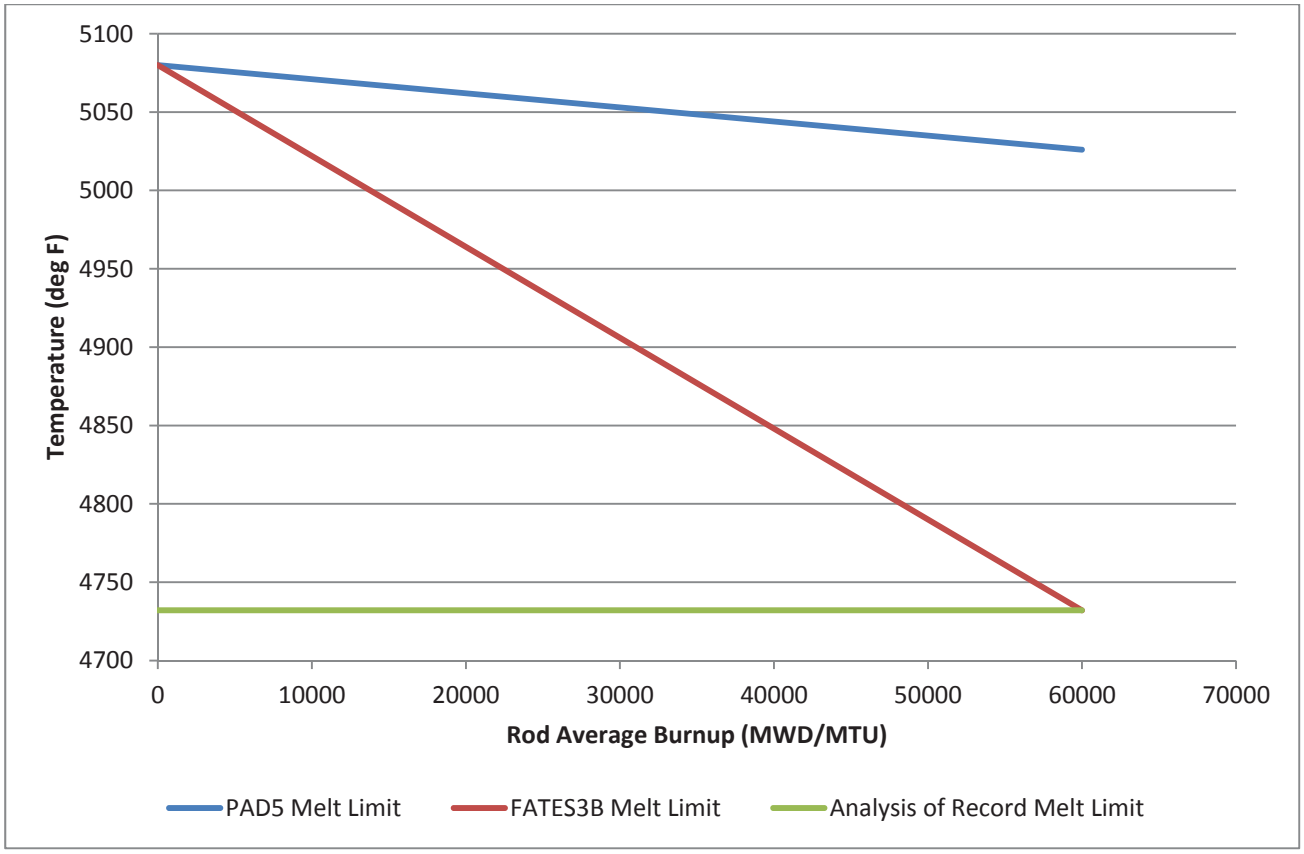


Figure B: Comparison of Fuel Melt Limit



References

1. NRC ADAMS ACCESSION NUMBER ML15289A143, WATERFORD STEAM ELECTRIC STATION, UNIT 3 – ISSUANCE OF AMENDMENT RE: CHANGES TO TECHNICAL SPECIFICATION 3.1.3.4 REGARDING CONTROL ELEMENT ASSEMBLY DROP TIMES (CAC NO. MF6459)
2. NRC ADAMS ACCESSION NUMBER ML12235A463, ST. LUCIE PLANT, UNIT 2 – ISSUANCE OF AMENDMENT REGARDING EXTENDED POWER UPRATE (TAC. NO. ME5843)
3. WCAP-16500-P-A, "CE 16x16 Next Generation Fuel Core Reference Report," August 2007.