Entergy

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

W3F1-2017-0060

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

Subject: Closure of Commitment Associated with Control Element Assembly Drop Times
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. W3F1-2015-0079, Control Element Assembly Drop Times License Condition, October 8, 2015 [ADAMS Accession Number ML15281A223].
3. NRC License Amendment 246, Control Element Assembly Drop Times, November 13, 2015 [ADAMS Accession Number ML15289A143].
4. W3F1-2016-0008, Control Element Assembly Drop Times Commitment Response, February 3, 2016 [ADAMS Accession Number ML16034A114].

Dear Sir or Madam:

This letter serves as Entergy Operations, Inc. (Entergy) completion of the commitment associated with the Control Element Assembly (CEA) drop time surveillance data.

On July 2, 2015, Entergy submitted a License Amendment Request [Reference 1] to revise the Control Element Assembly (CEA) drop times associated with Technical Specification (TS) 3.1.3.4 for Waterford Steam Electric Station Unit 3 (Waterford 3). On February 3, 2016, in letter W3F1-2016-0008 [Reference 4], the following additional commitment was made with the requirement to be completed within 60 days of the completion of Refueling Outage 21 (RF21):

> Commitment: Summary of CR-WF3-2015-09518 causal analysis will be provided to the NRC to demonstrate no further degradation to the average CEA drop time.

This commitment was needed because the original causal analysis only identified the delay in the release of the CEAs as a potential cause; therefore, additional analysis to determine the specific failure mechanism(s) causing the delay was necessary.

The results of the casual analysis performed in CR-WF3-2015-09518 are summarized in the attachment to this letter. This demonstrates that there has been no further degradation to the average CEA drop time.

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

Attachments: Waterford 3 Steam Electric Station Closure of Commitment and Summary of Causal Analysis CEA Drop Time Surveillance Data

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

Attachment

to

W3F1-2017-0060

Waterford 3 Steam Electric Station
Closure of Commitment and Summary of Causal Analysis
CEA Drop Time Surveillance Data

(3 pages)

Waterford 3 Steam Electric Station
Closure of Commitment and Summary of Causal Analysis
CEA Drop Time Surveillance Data

Introduction

On July 2, 2015, Entergy submitted a License Amendment Request [Reference 1] to revise the Control Element Assembly (CEA) drop times associated with Technical Specification (TS) 3.1.3.4 for Waterford Steam Electric Station Unit 3 (Waterford 3). In this amendment request, Attachment 7 contained regulatory commitments. One of these commitments was made to provide the Cycle 21 CEA drop time data to the NRC to confirm the conclusion of no further degradation within 60 days of the CEA Drop Time Test (CDTT). The required data was provided to the NRC on February 3, 2016 in letter W3F1-2016-0008 [Reference 4]. In this letter, the following additional commitment was made with the requirement to be completed within 60 days of the completion of Refueling Outage 21 (RF21):

> Commitment: Summary of CR-WF3-2015-09518 causal analysis will be provided to the NRC to demonstrate no further degradation to the average CEA drop time.

This commitment was needed because the original causal analysis only identified the delay in the release of the CEAs as a potential cause; therefore, additional analysis to determine the specific failure mechanism(s) causing the delay was necessary. The results of the causal analysis performed in CR-WF3-2015-09518 are summarized below.

Condition Analysis Problem Statement

The Waterford 3 arithmetic average Control Element Assembly (CEA) drop time surveillance has increased consecutively from Cycle 19 (2941 milliseconds) to Cycle 20 (3024 milliseconds 1st drop; 2967 milliseconds 2nd drop) to Cycle 21 (3063 milliseconds) with the insertion time from start of movement to fully inserted remaining constant since Cycle 11.

Evaluation Summary

The possible failure modes evaluated in this analysis and a summary of the results are provided below.

<u>Reactor Trip Switchgear Circuit Breakers</u>
The RTSG circuit breaker trip times from the last refurbishment until the present were graphed and trended. Surveillance data shows an increasing trend of 2.278 milliseconds; however, this is negligible when compared to the overall time of 3,200 milliseconds and therefore does not have a meaningful impact on the overall increasing trend in CDTT.

Control Element Drive Mechanism Control System (CEDMCS) Coil Power Switches and Automatic Control Element Drive Mechanism Timing Module (ACTM) circuit cards

The power switches provide a constant voltage to the coils. The power switch cannot fail in such a way that, on loss of power, it would maintain voltage to the coils. Additionally, there is one ACTM card per CEA and one power switch per subgroup – it is not likely that degradation would occur among all of these components to uniformly affect drop times for all the CEAs. These components are made of mostly passive components that result in immediate failure and not a degradation that would increase response time from a loss of power.

Control Element Drive Mechanism (CEDM) Latch Assemblies and Extension Shaft

Changes made to the replacement CEDMs as they relate to CEA drop time were analyzed by Westinghouse. The scope of the study included the pressure housing assembly and the coil stack and shroud assembly. The analysis concluded that changes made to construction of the motor assembly, grippers, and pressure housing would not have an effect on the release of the drive shaft. CEA Extension Shafts were reused when the CEAs were replaced.

Degradation of CEDM Coil Assemblies

Westinghouse analysis of a sample of coil traces for 10 CEAs covering a time period before and after CEDM replacement showed an average increase in upper gripper disengagement times for the ten sample CEAs of 51ms and an increase of 0.7 amps from 2012 to 2013. The average 51 ms increase was seen immediately following CEDM replacement, i.e. the dropout times have not been trending upward since then. Coil degradation is not evident for the ten sample CEAs. In addition, there have been no CEAs that failed to meet the single CEA TS criterion.

Transition to Next Generation Fuel

Next generation fuel would only effect the CEA drop time after the holding coil delay time. This time has not changed since Cycle 17; therefore, the conclusion is that there is insignificant impact on the average CEA drop positions vs. times due to the new generation fuel.

Design Differences Between Old and New CEDM Coil Assemblies

Westinghouse analyzed the changes in coil design. The replacement coils have increased wire turns with larger size wire, increasing the AC inductance approximately 4% and thus increasing magnetic flux decay time for the coil. Additionally, the gripper coil resistances have decreased.

Investigation revealed that when preparing the Engineering Change (EC) for this modification, it was identified that CEDMCS was not compatible with the recommended voltage settings of the new CEDMs, and the ACTM card's feedback logic for the UG coil voltage could not be changed to accommodate the recommended UGL voltages. In response to this concern, Westinghouse provided a letter stating that setting the voltages at the values specified in the Waterford 3 calibration procedure, which were higher than the manufacturer's recommendation, would provide reliable CEDM operation. The effect on coil decay time was not addressed in the letter. Documentation of the fact that the original EC was not reevaluated for the potential effect of these higher voltages on other design characteristics has been entered into the Corrective Action Process. This includes CEA drop time increases due to increased coil decay time.

It was concluded that the new coil design operating at the original voltage levels results in higher currents; approximately 0.7 amps. This increase in coil current results in a longer decay time thus longer rod drop times.

The lower resistances of the upper gripper coils combined with the higher voltage settings are the only design differences that can explain a longer rod drop time. Quarterly coil trace data shows that the increase was seen immediately following CEDM replacement; this was a one-time step change and the dropout times have not been trending upward since then.

Random Statistical Dispersion due to Normal CDTT Test Uncertainty
A delay time is incorporated into the CDTT software to omit the non-TS related portion of the drop time test (the time from penalty factor generation to RTSG opening). This delay time is estimated per procedure by review of past response time surveillances in a multi-step process. Analysis of the information use to estimate the delay time identified that there is uncertainty involved with past surveillance data and that error may occur when using CEAC channel response times. In addition, uncertainty is introduced due to the 50 ms update cycle of the test software. The various cycle times and execution times in the signal flow path can provide total delays of rod position from penalty factor generation to RSPT input of 83 - 406 ms.

Conclusion

Observed drop times have increased between Cycle 17 and Cycle 21 due to the design differences between the old and new CEDM coil assemblies. The new coil design operating at the original voltage levels results in higher currents; approximately 0.7 amps. This increase in coil current results in a longer decay time thus longer rod drop times. This was a one-time step change and the dropout times have not been trending upward since then.

Observed drop times have exhibited what appears to be an increasing trend from Cycle 19 to Cycle 21 due to the random statistical dispersion due to normal CDTT test uncertainty. A combination of the test methodology and uncertainties in the software explain the increase; the magnitude of the trend is within the uncertainty.

The analysis performed identified the specific causal factors for the increase in delay time in the release of the CEAs and demonstrates that there has been no further degradation to the average CEA drop time.