NRR-DMPSPEm Resource

From: Galvin, Dennis
Sent: Wednesday, October 17, 2018 5:37 PM
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Cc: Ellis, Kevin Michael; Lehning, John; Lukes, Robert; Shoop, Undine
Subject: Robinson RAIs – Duke Energy 10 CFR 50.46 Annual Report (EPID L-2018-LRO-0028)
Attachments: Robinson 50.46 Report Review - RAI 2018-10-17 L-2018-LRO-0028.pdf

Mr. Zaremba,

By letter dated May 24, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18150A705), Duke Energy (the licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) an annual report of changes to or errors discovered in an acceptable loss-of-coolant accident evaluation model application for the emergency core cooling system for Duke Energy facilities. The report for H. B. Robinson Steam Electric Plant, Unit 2 (Robinson) was provided in Enclosure 3 of the submittal.

In order for the staff to complete its review of the licensee's submittal, the NRC staff has the prepared requests for additional information (RAIs). The enclosed RAIs were e-mailed to the licensee in draft form on September 19, 2018 and October 11, 2018. Clarification calls were held on September 27, October 9, and October 17, 2018. The licensee agreed to provide responses to the RAIs by December 17, 2018. The NRC staff agreed with this date.

Respectfully,

Dennis Galvin
Project Manager
NRR/DORL/Licensing Branch II-2
US Nuclear Regulatory Commission
301-415-6256

Docket Number 50-261

Hearing Identifier: NRR_DMPS
Email Number: 627

Mail Envelope Properties (Dennis.Galvin@nrc.gov20181017173600)

Subject: Robinson RAIs – Duke Energy 10 CFR 50.46 Annual Report (EPID L-2018-LRO-0028)
Sent Date: 10/17/2018 5:36:39 PM
Received Date: 10/17/2018 5:36:00 PM
From: Galvin, Dennis

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Files	Size	Date & Time
MESSAGE	1137	10/17/2018 5:36:00 PM
Robinson 50.46 Report Review - RAI 2018-10-17 L-2018-LRO-0028.pdf	121870	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
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REQUEST FOR ADDITIONAL INFORMATION FOR

REVIEW OF ANNUAL REPORT OF CHANGES AND ERRORS

PURSUANT TO 10 CFR 50.46(a)(3)(ii)

DUKE ENERGY PROGRESS, LLC

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2

DOCKET NOS. 50-261

RAI 1

On May 24, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18150A705), Duke Energy submitted an annual report of changes and errors affecting the loss-of-coolant accident (LOCA) evaluation models for the Duke Energy licensed facilities, including H. B. Robinson Steam Electric Plant, Unit 2 (Robinson). This submittal, which is intended to address reporting requirements in 10 CFR 50.46(a)(3)(ii), stated that no changes or errors were identified during the 2017 reporting period for the large-break LOCA evaluation model applied by H.B. Robinson.

However, the U.S. Nuclear Regulatory Commission (NRC) staff has learned of an error identified in 2017 affecting the S-RELAP5 code that is associated with the neglect of cladding deformation in the calculation of cladding oxidation. The NRC staff is further aware that this S-RELAP5 code error was present in the vendor evaluation model H.B. Robinson has used to analyze the large-break LOCA event (i.e., Framatome's Realistic Large Break LOCA Methodology), which was originally approved in 2003.

Duke Energy is also aware of this error in the S-RELAP5 code and has estimated its impact for certain affected analyses, including the H.B. Robinson small-break LOCA analysis, as well as the small- and large-break LOCA analyses for the Shearon Harris Nuclear Power Plant, Unit 1. It appears that Duke Energy may have deemed reporting and estimating the impact of this S-RELAP5 error unnecessary for the H.B. Robinson large-break LOCA analysis because the Realistic Large Break LOCA evaluation model described in EMF-2103, Revision 0 (ADAMS Accession No. ML032691410)[1], was originally approved by the NRC staff without an explicit modeling of cladding swelling and rupture.

Framatome originally submitted EMF-2103, Revision 0, for NRC staff review in 2001. In support of the NRC staff's review, Framatome included information in Appendix B of this topical report concerning perceived conservatisms in the Realistic Large Break LOCA evaluation model. In particular, Framatome observed that

> Among the major assumptions stated for the FRA-ANP RLBLOCA [Framatome-ANP Realistic Large Break LOCA] methodology are declarations of adopted conservatism. Such declarations are not always physically intuitive. In these instances, sensitivity studies have been performed to arrive at the stated conclusions. In this appendix, selections of calculations are presented to support

[1] The ADAMS Accession No. is for the accepted version

> some of the statements of conservatism presented in this methodology document.

In particular, Appendix B to EMF-2103, Revision 0, cites four specific conservatisms, one of which is discussed in Section B.2, “Analysis without Clad Swelling and Rupture.” Section B.2 describes and documents the results of sensitivity studies Framatome performed using the S-RELAP-5 code to reach the conclusion that it is conservative to neglect cladding swelling and rupture.

In responses to requests for additional information (RAIs) 28, 96, and 132 on the NRC staff’s review of EMF-2103, Revision 0, Framatome provided additional context and support for its assumption that neglecting cladding swelling and rupture is conservative:

- Framatome’s response to RAI 28 states in part that

  > Swelling and rupture models were not used in the Framatome methodology because use of the swelling and rupture models based on NUREG-0630 would yield slightly reduced PCTs [peak cladding temperatures]….

- Framatome’s response to RAI 96 cites the sensitivity studies performed in Section B.2 of Appendix B to EMF-2103, Revision 0, as the basis for characterizing the general influence of fuel rod swelling and rupture as “relatively small and beneficial.”

- Framatome’s response to RAI 132 discusses an additional sensitivity study performed using the S-RELAP-5 code that appears to show that neglect of swelling and rupture is conservative even in a case where rupture of the fuel rod cladding occurs.

As noted above, however, the NRC staff has recently learned that the origin of the S-RELAP5 error associated with the calculation of cladding oxidation discovered in 2017 predates the 2001 submittal of EMF-2103, Revision 0. Hence, the sensitivity studies and derivative conclusions described by Framatome in Section B.2 of Appendix B to EMF-2103, Revision 0, and various RAI responses were, in fact, influenced by this error. Recent estimates performed for other affected pressurized-water reactors (PWRs) (e.g., Sequoyah Nuclear Plant, Units 1 and 2 (ADAMS Accession No. ML18018B158), and Shearon Harris (ADAMS Accession No. ML18150A705)) that are intended to correct for the influence of this error indicate that, contrary to the information submitted by Framatome in support of the NRC staff’s review of EMF-2103, Revision 0, the neglect of swelling and rupture in the PWR Realistic Large Break LOCA methodology is actually (1) nonconservative and (2) potentially significant in magnitude (i.e., greater than 50 °F).

As such, the NRC staff considers Framatome’s assumption that it is conservative to neglect swelling and rupture of fuel rod cladding to be an additional error affecting H.B. Robinson’s current large-break LOCA evaluation model that was not recognized and reported as such by Duke Energy in the annual report of changes and errors submitted for the 2017 reporting period. The NRC staff emphasizes that 10 CFR 50.46(c)(2) defines a LOCA evaluation model as

> the calculational framework for evaluating the behavior of the reactor system during a postulated loss-of-coolant accident (LOCA). It includes one or more computer programs and all other information necessary for application of the calculational framework to a specific LOCA, such as mathematical models used, assumptions included in the programs, procedure for treating the program input

and output information, specification of those portions of analysis not included in computer programs, values of parameters, and all other information necessary to specify the calculational procedure.

Thus, according to 10 CFR 50.46(c)(2), it is evident that the Realistic Large Break LOCA evaluation model used by H.B. Robinson to analyze the large-break LOCA event incorporates an assumption (i.e., neglecting the swelling and rupture of fuel rod cladding is conservative) that has now been demonstrated to be in error.

Considering estimated impacts for other similarly affected PWRs, the NRC staff is concerned that correction of the erroneous methods in EMF-2103, Revision 0, for modeling cladding oxidation, swelling, and rupture[2] may result in a peak cladding temperature increase of 50 °F or more for the current large-break LOCA analysis for H.B. Robinson. In light of the current large-break LOCA peak cladding temperature of 2088 °F calculated for H.B. Robinson, further information is necessary to demonstrate the continued compliance of H.B. Robinson with the regulatory limits of 10 CFR 50.46(b).

Therefore, the NRC staff requests that Duke Energy provide the following additional information in support of our review of the annual report of LOCA evaluation model changes and errors for H.B. Robinson submitted in accordance with 10 CFR 50.46(a)(3)(ii):

(a) A revision to the 2017 annual report of changes and errors submitted to address 50.46(a)(3)(ii), which acknowledges and estimates the impacts of the apparent errors in the existing large-break LOCA evaluation model applied to H.B. Robinson that are associated with (1) the incorrect computation of cladding oxidation and (2) the nonconservative neglect of cladding swelling and rupture based upon the vendor's submission of erroneous information.

(b) If the peak cladding temperature impact of these errors is significant, please further provide a 30-day error report in accordance with 10 CFR 50.46(a)(3)(ii).

(c) Confirmation that all requirements of 10 CFR 50.46(b) are satisfied once the effects of the above errors have been taken into account, or a description of the immediate steps necessary to bring plant design or operation into compliance in accordance with 10 CFR 50.46(a)(3)(ii).

(d) Adequate description of and justification for the method used to estimate the impacts of the errors described above.

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[2] For clarity, the evaluation model errors referred to in this RAI are defined according to the state of knowledge existent at the time the NRC staff reviewed Revision 0 of EMF-2103. In particular, this RAI does not define the non-incorporation of models for additional aspects of fuel rod swelling and rupture that are associated solely with Revision 3 of EMF-2103 as an error.