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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Edwin I. Hatch Nuclear Plant
Reply to a Notice of Violation; EA-09-054
1B EDG Coupling Failure

Ladies and Gentlemen:

On March 13, 2009, NRC issued an inspection report (No. 2008009) concerning the July 12, 2008 failure of the generator drive coupling on the 1B Emergency Diesel Generator (EDG) at the Edwin I. Hatch Nuclear Plant (HNP) of the Southern Nuclear Operating Company (SNC). This inspection report included a finding preliminarily determined to be of low to moderate safety significance (i.e. a White finding) when assessed using the Significance Determination Process (SDP).

In response, in a letter dated April 15, 2009, SNC largely agreed with the statement of facts related to this event as described in the inspection report. SNC had, however, calculated that the finding met the established criteria for a Green finding rather than White, with the difference due essentially to the application of common cause treatment in the SDP by the NRC. SNC accordingly supplied additional information to support treatment of the 1B EDG coupling event as an independent failure rather than as a common cause failure.

On June 4, 2009, NRC issued Enforcement Action EA-09-054, the final significance determination of a White finding and notice of violation (NOV) in this matter, having concluded that SNC did not provide sufficient basis for concluding that the July 12, 2008 failure of the 1B EDG generator drive coupling should be treated as an independent failure in performing the SDP assessment.

SNC is convinced that actual testing of components is an effective method to determine if common cause failure should be a relevant consideration. For your consideration, additional information is presented in the enclosures that addresses the five points on EDG coupling testing as related to common cause determination which were raised in the June 4, 2009 NRC letter.

SNC will use this issue as an example to work with the NRC and the Nuclear Energy Institute (NEI) to improve application of common cause factor in SDP assessments.

Also, in consideration of revisions already made to the SNC corrective action program as described in Enclosure 1, SNC respectfully requests that the cross-cutting aspect of this issue be reconsidered.

Enclosure 1 of this letter provides the SNC reply to the NOV, while Enclosure 2 provides additional discussion of the SNC position regarding the SDP assessment.

Mr. M. J. Ajluni states he is Manager, Nuclear Licensing for Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and to the best of his knowledge and belief, the facts set forth in this letter are true.

This letter contains no NRC commitments. If you have any questions, please advise.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY



M. J. Ajluni
Manager, Nuclear Licensing

Sworn to and subscribed before me this 2nd day of July, 2009.


Notary Public

My commission expires: 6/9/12

MJA/DWD/<>

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cc: Southern Nuclear Operating Company
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Mr. D. R. Madison, Vice President – Hatch
Ms. P. M. Marino, Vice President – Engineering
RType: CHA02.004

U. S. Nuclear Regulatory Commission
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State of Georgia
Mr. C. Clark, Commissioner – Department of Natural Resources

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Enclosure 1

Reply to Violation

Enclosure 1

Reply to Violation

Statement of Violation

During a U. S. Nuclear Regulatory Commission (NRC) inspection completed on March 13, 2009 for the Edwin I. Hatch Nuclear Plant (HNP), a violation of NRC requirements was identified. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," NUREG – 1600, and as stated in the NRC Final Significance Determination of White Finding and Notice of Violation (NRC Inspection Report No. 2008009), dated June 4, 2009 (Enforcement Action EA-09-054), Violation (VIO) 05000321, 366/2008009-01, 1B EDG Coupling Failure, is as follows:

10 CFR 50, Appendix B, Criterion XVI, Corrective Action, states, in part, that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected.

Contrary to the above, the licensee failed to promptly identify and correct a condition adverse to quality. Since 1988, the licensee had observed cracks in the EDG couplings, but did not identify the cracking as an indication of couplings degradation. The licensee did not document the conditions during routine maintenance inspections and no condition report was written to identify and correct this condition adverse to quality. Consequently, the 1B coupling developed higher than normal vibration on July 12, 2008, during a routine surveillance which prompted the licensee to declare the 1B EDG inoperable.

This violation is associated with a White finding for Units 1 and 2.

Reason for Violation

SNC conducted a Root Cause and Corrective Action investigation and determined the following Primary Root Causes for the coupling failure:

- In Owners Group meetings attended by both site and corporate SNC individuals, information was presented regarding degraded couplings impacting EDG operation. The information was not disseminated or evaluated by the SNC meeting attendees.
- The EDG engine-generator coupling two year preventive maintenance (PM) inspections and procedures gave no acceptance criteria to assure the coupling material condition was adequate. In spite of data package notations of degraded condition in 1988 and 2004, the couplings had not been replaced since their original installation in the 1970's.

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Corrective Actions Taken and Results Achieved

Completed Corrective Actions Addressing Primary Root Causes:

- The engine-generator coupling was replaced on July 15, 2008 and the 1B EDG was declared operable on July 16, 2008.
- Coupling replacement and operability runs for the remaining four EDGs were completed by August 9, 2008.

Corrective Actions to Prevent Recurrence

Revision of maintenance procedures to address EDG coupling gland inspection acceptance criteria and preventive maintenance was completed by October 30, 2008.

A broadness review was performed to identify similar susceptible elastomeric couplings or components in other plant equipment. Procedure revisions for this equipment were completed by October 27, 2008.

Changes to the corrective action program (CAP) to ensure proper identification, documentation and correction of conditions adverse to quality were made as a result of a fleet-wide CAP improvement effort that began subsequent to the NRC 93800 inspection performed at SNC's Farley Nuclear Plant (FNP) in September, 2007 (report issued December 19, 2007).

Conclusion

SNC does not dispute the findings as stated in Inspection Report 2008009. Corrective actions have been taken both with regard to the specific failure of an EDG coupling and also for other plant equipment as a result of a broadness review.

With regard to the cross-cutting aspect identified by NRC in the area of Problem Identification & Resolution, however, it should be noted that SNC's failure to take more appropriate action in addressing EDG coupling degradation noted in 1988 and 2004 is essentially a legacy issue not indicative of the performance of the current SNC corrective action program (CAP).

Extensive changes applicable across the SNC fleet were made to the CAP subsequent to the last pre-failure opportunity for discovery of the EDG coupling degradation problem. These changes included improvements to CAP procedures and training, increased management emphasis on safety culture development and proper use of the CAP, and assignment of personnel trained in and dedicated to root cause analysis at all plant sites and corporate headquarters.

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Problem identification, root cause evaluation, extent-of-condition and extent-of-cause determination adequacy were the focus of an NRC Region II team which performed a supplemental inspection per NRC Inspection Procedure 95002 at FNP in June 2008. The resultant inspection report, issued in July 2008, noted no violations, findings or open items.

In light of the improvements which have been made to the SNC corrective action program in the period since opportunities to identify EDG coupling degradation were missed, and in consideration of the efficacy of these improvements as confirmed through the NRC 95002 inspection last year, SNC respectfully requests that the cross-cutting aspect of this issue be reconsidered.

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Enclosure 2

Additional Discussion of Significance Determination

Enclosure 2

Additional Discussion of Significance Determination

Applicability of Common Cause Factor

In a letter dated April 15, 2009, responding to the NRC March 13, 2009 inspection report and preliminary White finding for Hatch Nuclear Plant (HNP), Southern Nuclear Operating Company (SNC) took the position that the actual condition of the remaining Emergency Diesel Generator (EDG) couplings did not warrant common cause failure treatment of the 1B EDG coupling failure in the Significance Determination Process (SDP). In support of this position, SNC provided a copy of the technical report describing coupling examination and testing performed at offsite laboratories, Altran Technical Report 08-0372-TR-001, Revision 1, January 2009, "Emergency Diesel Generator Coupling Assessments."

In Enforcement Action EA-09-054, June 4, 2009, NRC issued the final significance determination of a White finding and notice of violation (NOV) in this matter. Enclosure 2 of EA-09-054 explained the NRC basis for the final significance determination, and included five points addressing the information provided by SNC, with the conclusion that SNC did not provide sufficient basis for treatment of the failure of the 1B EDG as an independent failure in performing the SDP assessment.

The five points raised by the NRC are restated below, along with an SNC response to each.

NRC Statement:

NRC reviewed the details of the vendor testing and believes that the conclusion that the remaining couplings were not susceptible to the same failure mode is not supported by the facts and the data. Some of the concerns with the testing and conclusion are:

1. The testing does not fully model the actual in-plant conditions in that the couplings experience significant vibration when in actual service.

SNC Response:

The heavy vibration noted with the 1B coupling was not a part of normal operation but occurred only after significant de-bonding of the rubber gland to the steel hub. The variations in operating conditions of the EDG and the test were incorporated into the testing or into analysis of results. The cyclic loading as measured on the EDG at Hatch was imposed on the 2C coupling (which had flaws induced to bound all other couplings except the failed 1B) with the maximum torque applied. The torque was cycled from low to high at a high frequency and the test was run for 35 million cycles (Altran report section 4.7.1). The flaw induced coupling was then subjected to static axial torque equivalent to the rating of a new coupling, 64,000 ft-lbs (Altran report section 4.7.2). The observed crack growth was then multiplied by a factor of 2.8 to compensate for centrifugal stress from the 3-D model (Altran report section 6.0). The result showed that crack growth was slow, leaving the coupling capable of exceeding the required mission time even when applied to a coupling with flaws induced to

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bound all cracks observed on the 1A, 1C and 2C couplings. In other words, based on the conservative nature of the testing, the other EDGs would not be expected to have experienced de-bonding of the rubber coupling gland and therefore they would not be expected to have incurred abnormal vibration in service.

NRC Statement:

2. SNC concluded that run time was the dominant factor related to coupling failure and only considers run time in predicting remaining coupling life. Age-related deterioration (hardening) of the rubber was considered a shared root cause; however, it is not considered in predicting coupling life. The vendor stated that increased resonant frequency due to age-related hardening of rubber was a contributor to the failure mode of the 1B EDG generator coupling.

SNC Response:

The aging factor was built into the test program since the couplings removed from service for testing were all greater than 35 years old. The Unit 1 couplings were manufactured in 1969 while the Unit 2 couplings were manufactured before 1975. Hardness testing of all 4 couplings was performed and an analytical evaluation was performed which resulted in no definitive difference between the 4 couplings due to age. It was determined that artificial aging for testing was not necessary since one of the in-service couplings was used for the testing.

NRC Statement:

3. The failure criterion of 50% cracking based on the 51.4% cracking observed on the 1B generator coupling is not supported. No data or analysis was presented that characterized the actual cracking percentage which was on the 1B coupling before the severe vibration occurred on the 1B EDG engine.

SNC Response:

The 50% criterion was a valuation chosen to ensure that the test was successful and for use as a qualitative tool, and was based on the testing of the 2C coupling. The results of the 2C coupling test were considered to be bounding because of the induced flaws encompassing those identified in the 1C coupling, the cumulative hours of operation, the relative age and hardness readings, and the measured crack growth after the extensive testing. In addition, the 1B coupling was removed from service before any damage or operational event occurred and with some small definitive life remaining even with 51.4% of cracking.

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NRC Statement:

4. The correlation between coupling hours of operation and amount of cracking was only developed for generator-side, inner diameter (ID) cracks. No data or analysis was presented that cracks in other locations could not lead to high vibration and EDG failure to run for the required mission time. If cracking on both the generator-side and diesel-side of the coupling is used, EDG 1C is the second worst degraded coupling after the 1B coupling yet has the shortest cumulative run time at 1746 hours.

SNC Response:

All cracks, including the shallow, nearly continuous cracks near the outer rubber-to-steel interface were used to summarize the percent of cracking present. The absence of significant cracking on the diesel-side of all the couplings led to the choice of using the generator-side for the correlation. However, the test results used were obtained from the 2C coupling, which was tested after inducing additional cracks on both the diesel and generator sides bounding all those of the 1C coupling (Altran report, Kinectrics Appendix, Table 3.4). Inducing the cracks from the 1C coupling into the 2C coupling, which had more run time, produced a conservative test subject.

NRC Statement:

5. The statistical regression model developed by the vendor was based on only four data points and only considered inner diameter, generator-side cracking. Thus, there are large uncertainties in making predictions using this model. The model was used to make predictions of remaining coupling life without consideration of these uncertainties.

SNC Response:

All observed cracks were measured and induced into the 2C coupling before testing to produce a bounding case. The 3-D model was used to apply a centrifugal stress correction factor and to validate the site loading testing (Altran report section 6.0). It was also a bounding evaluation of the crack growth, but actual testing of the flaw-induced 2C coupling was the basis for determining that the 1A, 1C, 2A and 2C couplings were capable of performing for their mission time with the observed flaws present.

Overall, the following conservative measures were applied in the test protocol (Altran report, section 7.0):

“The evaluation of the subject couplings required approximations, and several noteworthy conservatisms in the approach applied are noted below:

- The full scale cyclic test applied loading equivalent to 3000kW and 1700kVAR for an equivalent of 9.5 days of equivalent operation. A

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realistic loading demand for actual 7 day operation is equivalent to 2000kW and 1000kVAR after 6 hours at 3000KW and 1700kVAR.
[Note: PRA mission time is only 24 hours.]

- The 2C coupling used in the test had the most service hours and included induced flaws intended to bound all couplings received for evaluation including 1C.
- The single crack that was found to propagate in the 2C test was artificially initiated by cutting a more severe profile than actually found in 1C.
- Only one crack out of several grew during the cyclic torsional test. This growth was considered representative.
- In the analysis performed, to consider other loadings not included in the cyclic test (such as misalignment and centrifugal stresses), very conservative approximations were applied such as assuming a homogeneously degraded material rather than the actual condition of being more degraded near the surface."

Conclusion

SNC is convinced that the program of examination and testing conducted on the remaining EDG couplings provides a conservative basis for determining the applicability of additional common cause treatment in this case. As stated in the initial response letter dated April 15, 2009, SNC calculated that the finding for the 1B EDG coupling failure met the established SDP criteria for a Green finding rather than White, with the difference due essentially to the application of common cause treatment in the SDP by the NRC.

SNC maintains that the actual condition of the other EDG couplings after the 1B EDG coupling failure, as determined through examination and testing, does not warrant application of common cause to a greater extent than common cause is already incorporated into the HNP probabilistic risk assessment (PRA) model. Given the existing data, use of a maintenance failure for the 1B EDG only, with no common cause failures of the other EDGs, would be appropriate in the NRC SPAR model.

In addition, the HNP PRA model Large Early Release Fraction (LERF) result for this issue clearly shows this case to be Green.