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U.S. Nuclear Regulatory Commission
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Hope Creek Generating Station
Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: Response to Request for Additional Information Regarding Relief Request for Examinations and Tests of Snubbers

References:
1) Letter from George P. Barnes (PSEG Nuclear LLC) to USNRC, July 30, 2008
2) U.S. Nuclear Regulatory Commission e-mail dated October 23, 2008, Hope Creek Generating Station, Draft Request for Additional Information (TAC No. MD9336), Accession No. ML082980183

In Reference 1, PSEG Nuclear LLC (PSEG) submitted relief request HC-I3R-04 and an associated license amendment request for Hope Creek Generating Station (HCGS) related to examinations and tests for snubbers. The relief request proposed an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants for snubber operational readiness testing.

In Reference 2, the NRC transmitted a draft request for additional information concerning the relief request. Attachment 1 to this letter provides PSEG's responses.

There are no commitments contained in this letter.

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NRR

Should you have any questions regarding this submittal, please contact Mr. Paul Duke at 856-339-1466.

Sincerely,

Jeffrie Keenan
Manager - Licensing
PSEG Nuclear LLC

Attachment
1. Response to Request for Additional Information

cc: S. Collins, Regional Administrator – NRC Region I
R. Ennis, Project Manager - USNRC
NRC Senior Resident Inspector - Hope Creek
P. Mulligan, Manager IV, NJBNE

ATTACHMENT 1

Hope Creek Generating Station

Facility Operating License No. NPF-57
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Response to Request for Additional Information

In Reference 1, PSEG Nuclear LLC (PSEG) submitted relief request HC-I3R-04 and an associated license amendment request for Hope Creek Generating Station (HCGS) related to examinations and tests for snubbers. The relief request proposed an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants for snubber operational readiness testing.

In Reference 2, the NRC transmitted a draft request for additional information concerning the relief request. PSEG's responses are provided below.

1) The licensee requested relief to use Code Case OMN-15, which is not yet authorized for use under Regulatory Guide 1.192. In relief request Section 9.0, "Precedents", the licensee states that extended surveillance intervals have been granted for snubbers based upon reliable performance as described in NRC Generic Letter (GL) 90-09, "Alternative Requirements for Snubbers visual examination interval," and Code Case OMN-13, "Requirements for extending snubber inservice visual examination interval." The NRC staff finds that the performance-based approach used in GL 90-09 and OMN-13 is completely different than that used in Code Case OMN-15. The initial starting point visual examination for GL 90-09 and OMN-13 is based on the entire population (100%) of snubbers, whereas in the case of OMN-15, the initial starting point testing is performed on 10% or 37 selected snubbers depending on the design test plan group (DTPG) selected. Initial visual examination of 100% snubbers, provides a much higher confidence level to extend the interval than that of functional testing of small percentage of the snubber population (10% plan or 37 snubber plan). Please explain whether and how the approach used in GL 90-09 and OMN-13 is similar to the approach used in the proposed Code Case OMN-15.

Response

In GL 90-09, the NRC staff developed "an alternate schedule for visual inspections that maintains the same confidence level as the existing schedule." The alternative inspection schedule was dependent upon good results of the previous inspection period of the snubber population. Code Case OMN-13 permits further interval extensions, again based on acceptable results in the previous interval.

Similarly, the proposed alternative in Reference 1 would permit snubber operational readiness test intervals to be extended based on demonstrated reliable performance. The minimum initial sample size proposed in Reference 1 is larger than the minimum required by Section ISTD (52 snubbers in the proposed alternative, compared to 37 snubbers in ISTD-5400). The proposed alternative would maintain the same or better confidence level in snubber operational readiness as that provided by following ASME OM Code, ISTD requirements.

The proposed alternative in Reference 1 is similar to the approach used in GL 90-09 and OMN-13 in that interval extensions would be permitted only if acceptable performance is demonstrated in the previously completed testing.

2) The visual examination and functional testing of snubbers are complementary programs that ensure operational readiness. The OM Code, Table ISTD-4252-1, allows extending the visual examination interval for good performance. By implementing Code Case OMN-15, there might be an interval when both visual examination and functional testing will not be performed. Please justify the interval extension or deferment of testing as proposed in OMN-15, when no visual examination is performed.

Response

PSEG's current practice is to perform visual examinations on a portion of the total snubber population during each refueling outage, based on the requirements in Technical Specification Table 4.7.5-1, which are based on GL 90-09. Hope Creek snubbers are separated into accessible and non-accessible groups, with visual examinations performed in alternating outages.

Upon authorization of the proposed alternative and approval of the associated license amendment request in Reference 1, visual examinations will be performed in accordance with the requirements of Table ISTD-4252-1 of Subsection ISTD. PSEG plans to continue to perform visual examinations on a portion of the total snubber population during each refueling outage. With regard to implementation of other approved Code cases relating to snubbers, PSEG will not apply the OMN-13 visual examination extended interval Code Case simultaneously with the proposed extended operational readiness testing intervals.

3) The ASME OM Code, Section ISTD, functional testing plans are based on statistical samples and mathematical equations, which already incorporate risk. The test sample plans do not require any additional testing, if the selected snubbers (sample) meet the specified functional criteria. The existing test plans are already based on risk-based and performance-based procedures and methods (see question 4 below). Therefore, please explain and justify the basis for a further extension of the testing intervals based on performance.

Response

The statistical sample plan included in the Section ISTD for inservice testing of snubbers is a Wald sequential sampling plan. A Wald sequential sampling plan requires testing to continue until an "accept" line is crossed. The "accept" line in Figure ISTD-5431-1 is defined by:

$$N \geq 36.49 + 18.18\ C$$

where

N = total number of snubbers tested that were selected from the defined test plan group (DTPG), and

C = total number of unacceptable snubbers found in the DTPG

The initial sample size using the 37 test plan (ISTD-5400) is 37. A test campaign will be concluded when the "accept" line is crossed, establishing a 95% confidence level that 90-100% of the snubbers are operationally ready. The proposed alternative in Reference 1 (Code Case OMN-15, Test Plan 1) is also a Wald sequential plan. The "accept" line in Test Plan 1 is defined by:

$$N \geq 51.60 + 21.03C$$

The initial sample size for this test plan is 52. A test campaign will be concluded when the "accept" line is crossed establishing, a 95% confidence level that 92-100% of the snubbers are operationally ready. This is a higher level of operational readiness than that established by Section ISTD.

Section ISTD requires operational readiness testing during each fuel cycle. The basis for the proposed alternative is the higher minimum level of operational readiness established by Code Case OMN-15 Test Plan 1, compared to the level established by ISTD-5400. The operational readiness testing interval may be extended without increasing the likelihood the operability level of the snubber population will fall below the 95-90 confidence produced by the existing ISTD Code.

4) The licensee has determined the service life of snubbers installed in HCGS to be 21 years. The licensee states that there are 630 snubbers, and that the 37 snubber sample test plan is being used at HCGS. Currently, only 37 snubbers out of 630 are being functionally tested during a fuel cycle. The probability of performing a functional test on a particular snubber is one in seventeen (630/37 = 17) per fuel cycle. Therefore, the functional test frequency of a particular snubber will be once in 26 years (17 fuel cycles x 18 months). Furthermore, some of the snubbers may not be tested during their service life of 21 years. Please justify further extending the functional test interval by use of Code Case OMN-15.

Response
The functional test frequency discussed in NRC Question 4 applies only as long as there are no test failures. That would be evidence of a high level of reliability.

The initial service life of 21 years for the Lisega snubbers has been established by the manufacturer. HCGS is using this as an initial service life in accordance with ISTD-6100. Section ISTD incorporates three elements in a comprehensive snubber inservice examination and testing program: examination, operational readiness testing and service life monitoring. The three elements combine to provide assurance of snubber operational readiness.

The service life monitoring program is an integral element of the HCGS snubber program, and is independent of operational readiness testing. When the service life of a snubber is expected to be exceeded before the next planned system or refuel outage, the snubber is removed from service, refurbished and reinstalled, or replaced with a pretested spare snubber from inventory.

The proposed alternative in Reference 1 is based upon the higher minimum level of operational readiness established by Test Plan 1. The service life of individual snubbers will not be exceeded, regardless of interval for operational readiness testing.

5) ISTD test sample plans use sequential statistical methods. The sequential method involves evaluation of each piece of data (testing) obtained in a sequence of observations and has an "accept line" and a "reject line." In ISTD, the sequential plan was modified to remove the "reject line," relaxing the statistically required testing. Therefore, please justify a further extension of the testing interval.

Response
The modification of the sequential plan to remove the "reject" line did not relax the statistical confidence level of the plan, which is established by the "accept" line. Removal of the rejection criterion has a negligibly small effect on the acceptance line.

The "reject" line allows the user to come to the conclusion more quickly that the entire population of snubbers must be tested. However, with the "reject" line in a sequential sampling plan, there exists a possibility of rejecting a good snubber population, consequently requiring the unnecessary 100% functional testing of snubbers with attendant ALARA and safety concerns, manpower utilization and outage extension. If the test campaign would have crossed the "reject line," it is unlikely that the "accept" line would be crossed. As noted in Appendix C to ASME/American Nuclear Standards Institute (ANSI) Code for Operation and Maintenance of Nuclear Power Plants (OM), Part 4, OMa-1988, it is not likely that populations with more than 5.4% unacceptable snubbers will cross the "accept" line. Similarly, with the alternative proposed in Reference 1, it is unlikely that populations with more than 4.8% unacceptable snubbers will cross the "accept" line. Failure to cross the "accept line" requires testing to continue until 100% of the population is tested.

The removal of the "reject" line is independent from the statistics of the OMN-15 Code Case test plan 1; and the confidence levels achieved by crossing the "accept" line, which remain higher than those achieved by the ISTD Code.

6) HCGS is using only one DTPG for the entire population of 630 snubbers. The installed snubbers might have different designs, sizes and application. Please provide details and the basis for selecting only one DTPG for the entire population of 630 snubbers at HCGS.

Response
ISTD-5252 states that "the total snubber population may be considered one DTPG." The snubber population at Hope Creek is comprised entirely of Lisega 30 series hydraulic snubbers which are of the same manufacturer, design and type. Size of snubber differs based upon the design load for a specific location in the plant. This is consistent with the grouping discussion in ISTD-5252.

7) The OMN-15 "test campaign" is a series of actions required to complete the test plan requirements as defined in ISTD-5200. The ISTD-5200 test plans are 10% sample testing, and 37 sample testing plans. Please explain with example(s) how the "test campaign" in OMN-15 using various test plans (10% sample, or 37 sample) during a number of fuel cycles provides an adequate performance basis of the entire population of snubbers to extend the test interval. The use of "successful test campaigns," as defined in the Code Case does not provide an adequate performance basis for extending the test interval based on statistical methods. Please provide all the details and show how combining a few refueling cycle results constitutes "successful test campaigns."

Response
The only test plan proposed as an alternative in Reference 1 is Code Case OMN-15 Test Plan 1, with an initial sample size of 52 snubbers.

Once the prerequisite conditions of the Code Case OMN-15 have been satisfied, the completion of a "successful" test campaign verifies that there is a 95% confidence level that 92-100% of the snubbers in the population tested are operable. The implementation and continued use of the OMN-15 sample plan 1 is based upon maintaining this confidence level of operability. Although this Code Case allows alternate testing intervals, all other requirements of ISTD would apply. All test failures would be evaluated in accordance with ISTD-1800 and ISTD-5270. If any conditions indicated that the snubber population operability performance was degrading, corrective action would be implemented as required by ISTD. If the level of operability became suspect, as evidenced by test failures, the test campaign would require continued testing until the "accept" line is crossed or until all snubbers in the FMG population are tested. If this were to require testing of the entire population the prerequisite conditions would not be met to continue with the use of the Code Case OMN-15. The requirements for successive "successful campaigns" would again have to be met before extended test intervals could be used.

8) Please provide all the details and methods including all calculations showing that Code Case OMN-15 meets the 95/90 confidence level for functional testing of snubbers.

Response

The basis for the test plans in Code Case OMN-15 is evaluated in a white paper prepared for the Electric Power Research Institute (Reference 3). The only test plan proposed as an alternative in Reference 1 is Code Case OMN-15 Test Plan 1, with an initial sample size of 52 snubbers. Note that the "accept" line for Test Plan 1 was subsequently revised in the 2006 Addenda to ASME OM Code.

The mathematical basis for Test Plan 1 is provided below and is further described in Reference 3 of the White Paper, Applied Statistics for Engineers, William Volk, 2nd edition, Chapter - Sequential Analysis, McGraw Hill Book Company.

The 37 testing sample plan and Code Case OMN-15 Test Plan 1 are Wald sequential plans in which the initial sample size is independent of the population size. Testing continues until a hypothesis regarding population quality is accepted (subject to a given probability of error), or until the entire population is tested. The sample plan establishes limits on population quality p (i.e., % bad) for good and bad populations (see White Paper, Appendix A):

p_1 = quality of a good population

p_2 = quality of a bad population

Sequential sampling tests the null hypothesis $p \leq p_1$ against the alternative hypothesis $p \geq p_2$ where $p_1 < p_2$. The error probabilities are defined by:

α = Probability of false rejection. This is the probability of concluding that $p \geq p_2$, when, in fact, $p \leq p_1$.

β = Probability of false acceptance. This is the probability of concluding that $p \leq p_1$, when, in fact, $p \geq p_2$.

The acceptance control line is defined by the equation (see White Paper, section 5.1):

$$L = h_l + mN \tag{1}$$

where

L = number of defects,

N = number of tests,

$$h_l = \frac{-\ln\frac{1-\alpha}{\beta}}{\ln\frac{p_2}{p_1}\frac{1-p_1}{1-p_2}} \tag{2}$$

and

$$m = \frac{\ln\frac{1-p_1}{1-p_2}}{\ln\frac{p_2}{p_1}\frac{1-p_1}{1-p_2}} \tag{3}$$

The equation for the "accept" line is derived by rearranging equation (1) to the form (see White Paper, section 5.4.1)

$$N = -\frac{h_l}{m} + \frac{L}{m} \tag{4}$$

and substituting "C" for "L."

The "accept" line for Code Case OMN-15 Test Plan 1 uses the following values (see White Paper, section 5.5):

$p_1 = 0.025$

$p_2 = 0.08$. Thus the minimum operability level is 92%

$\alpha = 0$

$\beta = 0.05$. Thus the acceptance confidence level is 95%.

The "accept" line is thus

$$N = 51.60 + 21.03C$$

9) Please provide the basis for the mathematical equations used for the Code Case OMN-15, Table 1, Column B acceptance limits.

Response

The only test plan proposed as an alternative in Reference 1 is Code Case OMN-15 Test Plan 1, with an initial sample size of 52 snubbers.

The basis for the Code Case OMN-15, Table 1, Column B acceptance limit is provided in the response to NRC Question 8, above.

10) Why does the Code Case linear functionality model start with 100% operability (see White Paper, Reference 2 of relief request) as opposed to 90%, if the previous test campaigns provide a 95/90 confidence level?

Response
By establishing a starting point of operability, the rate of degradation (slope) can be established by how quickly the line will fall below 90%. The lower number, 90% is the lower limit of an acceptable population established while using the ISTD 37 sample plan. The higher the assumed starting point used to establish this slope, the steeper the resulting degradation slope will be. This slope is used to establish a degradation rate over a fixed period of time and to establish the initial sample size for the test plan in OMN-15. The steeper the degradation slope, the higher the minimum acceptable operability level required to allow the skipping of a test interval. The higher the resultant operability level, the larger the initial sample size required for the OMN-15 Code Case test plan. Therefore, the starting point of 100% is a conservative measure used to establish the steepest slope and highest operability level required to skip an interval.

11) While using Code Case OMN-15, the licensee does not appear to include the cumulative effect of various performance-based and risk-informed inspection programs being used at HCGS on the safety of the plant. These risk-informed programs may include risk-informed piping inspection, and performance-based, and/or risk-informed inservice testing of pumps and valves. Please explain if other performance and risk based programs are being used at HCGS and provide details of the evaluation of their cumulative effects.

Response
The HCGS inservice inspection (ISI) program includes a risk-informed program for examination of Category B-F, B-J, and C-F-2 Pressure Retaining Piping Welds (Reference 4). The inservice testing program for valves includes provisions for check valve condition monitoring in accordance with ISTC-5222.

Section ISTD requires snubbers to be selected for operational readiness testing randomly from each DTPG, in accordance with sequential sampling requirements, and, when additional samples are required, randomly from the remaining population of the DTPG or from untested snubbers of the failure mode group (FMG), as applicable. Implementation of risk-informed piping inspection and check valve condition monitoring does not affect the selection of snubbers for operational readiness testing or the confidence levels and minimum operational readiness levels established by testing in accordance with Section ISTD.

Under the proposed alternative in Reference 1, snubbers would continue to be selected randomly for operational readiness testing. When required, additional samples would be selected in accordance with the requirements of Section ISTD. Before extended test intervals are implemented, the proposed alternative in Reference 1 would establish a higher minimum level of operational readiness than is demonstrated by testing in accordance with Section ISTD. Implementation of risk-informed piping inspection and check valve condition monitoring does not affect the selection of snubbers for operational readiness testing or the confidence levels and minimum operational readiness levels established by testing in accordance with the proposed alternative in Reference 1.

With respect to the effect of risk-informed and performance based inspection and testing programs being used at HCGS, there is no difference between Section ISTD and the alternative proposed in Reference 1.

12) On relief request page 4 of 5, the licensee states that extending the interval for functional testing allowed in Code Case OMN-15 will reduce maintenance costs. Please elaborate and explain how maintenance costs will be reduced by use of OMN-15.

Response

Activities associated with snubber testing include scaffold installation; snubber removal, testing and installation; and scaffold removal. Extended test intervals based on acceptable test performance would reduce the resources required for the performance and oversight of these activities.

13) Reference 2 of the relief request (White Paper) is based on a linear model of snubber functionality (i.e., assumes degradation to be linear in order to make predicted projection for operability). HCGS is using only one DTPG for the entire population of 630 snubbers. Therefore, while selecting the DTPG, the licensee did not use any criteria of snubber selection based on physical environment such as temperature, radiation, and humidity. The licensee also does not appear to take in to account degradation due to age of the snubber. Please provide the basis for why the linear model of snubber functionality is representative of the entire population of 630 snubbers at HCGS.

Response

The effect of snubber operating environment on age-related degradation is accounted for in the establishment of snubber service life, the period of time a snubber is expected to meet the operational readiness requirements without maintenance.

The qualification of the Lisega snubbers in use envelopes the operating environment for HCGS snubber installations. The initial HCGS service life and snubber operability assumptions are based on the worst case operating environments for the snubber locations at HCGS which would envelope the service life for any more benign environment in the plant.

Industry experience has shown hydraulic snubber failures are due overwhelmingly to fluid leakage (seal failure), with a smaller number of failures due to fluid degradation, or particulate contamination impacting performance criteria. The design of the Lisega snubber incorporates a sealed, pressurized fluid system which protects internal seals and is resistant to outside contamination. The experience at HCGS includes no test failures due to age-related degradation. Since the Lisega snubbers were installed, there have been two functional test failures. The failures involved a tandem pair of snubbers and were apparently caused by excessive vibration in the supported piping. The vibration was addressed by piping modifications and changes to system operating procedures. The affected snubbers were functionally tested satisfactorily during each of the subsequent two refueling outages.

14) On relief request page 4 of 5, the licensee states that "Based on guidance from the manufacturer (Reference 5), PSEG has determined the service life of Lisega hydraulic snubbers installed in HCGS to be 21 years." Also, on page 2 of 5, the licensee states that all snubbers were replaced with new design snubbers by Lisega and that the snubber replacements were completed in 1997. The new Lisega snubbers have been in service for about 11 years, and some of these snubbers might have been installed into harsh environment such as high-temperature, high-humidity, and radiation. Please provide details and methods used to determine the basis for 21 years of service life of snubbers, when only 11 years of service life monitoring data are available for these new snubbers.

Response

The 21 year service life is based on the manufacturer's qualification testing and recommendations for typical nuclear plant environments. For extended power uprate, HCGS location-specific analyses performed for the non-metallic components in the hydraulic snubbers indicate that the calculated doses remain below the radiation damage threshold. Therefore, there was no need to revise the existing surveillance and maintenance program to ensure functionality during their design life.

To date, HCGS has not experienced any unexplained or service related failures. The use of 21 year service life as a starting point, based upon the manufacturer's recommendation, encompasses the operating environments for Hope Creek installations. Upon authorization of the proposed alternative and approval of the associated license amendment request in Reference 1, service life monitoring will be performed in accordance with the requirements of ISTD-6000, which includes a requirement to evaluate service life at least once each fuel cycle. Hope Creek's functional testing is based on random sampling which includes all areas and all conditions.

References

1. Letter from George P. Barnes (PSEG Nuclear LLC) to USNRC, July 30, 2008

2. U.S. Nuclear Regulatory Commission e-mail dated October 23, 2008, Hope Creek Generating Station, Draft Request for Additional Information (TAC No. MD9336), Accession No. ML082980183

3. White Paper – Mathematical Basis for ASME OMN-15 Code Case Prepared for Electric Power Research Institute

4. Safety Evaluation of Relief Requests for the Third 10-Year Interval of the Inservice Inspection Program for Hope Creek Generating Station (TAC Nos. MD7503, MD7504 AND MD7505), October 16, 2008, Accession No. ML082470063