



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

April 2, 2015

Mr. Michael P. Gallagher  
Vice President, License Renewal Projects  
Exelon Generation Company, LLC  
200 Exelon Way  
Kennett Square, PA 19348

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE  
BYRON STATION, UNITS 1 AND 2, AND BRAIDWOOD STATION, UNITS 1  
AND 2, LICENSE RENEWAL APPLICATION – SET 48 (TAC NOS. MF1879,  
MF1880, MF1881, AND MF1882)

Dear Mr. Gallagher:

By letter dated May 29, 2013, Exelon Generation Company, LLC, submitted an application pursuant to Title 10 of the *Code of Federal Regulations* Part 54, to renew operating licenses NPF-37, NPF-66, NPF-72, and NPF-77 for Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2, respectively, for review by the U.S. Nuclear Regulatory Commission staff. The staff is reviewing the information contained in the license renewal application and has identified, in the enclosure, areas where additional information is needed to complete the review.

These requests for additional information were discussed with John Hufnagel, and a mutually agreeable date for the response is by April 17, 2015. If you have any questions, please contact me at 301-415-3873 or by e-mail at [john.daily@nrc.gov](mailto:john.daily@nrc.gov).

Sincerely,

/RA/

John W. Daily, Senior Project Manager  
Projects Branch 1  
Division of License Renewal  
Office of Nuclear Reactor Regulation

Docket Nos. 50-454, 50-455, 50-456, and 50-457

Enclosure:  
As stated

cc w/encl: Listserv

April 2, 2015

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200 Exelon Way  
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\*concurrence via email

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BYRON STATION, UNITS 1 AND 2  
AND BRAIDWOOD STATION, UNITS 1 AND 2  
REQUEST FOR ADDITIONAL INFORMATION – SET 48  
(TAC NOS. MF1879, MF1880, MF1881, AND MF1882)

RAI B.2.24-1c, Flux Thimble Tube Inspection follow-up

Applicability: Braidwood Station (Braidwood), Units 1 and 2

Note: This RAI is composed of three sections (1-3), each of which deals with a background, issue, and request.

Background 1:

In its response dated February 23, 2015, the applicant stated that historical flux thimble tube wear experienced at Braidwood is bounded by industry operating experience for which the GALL Report AMP was evaluated. The applicant further stated that a plant-specific AMP is not necessary, since its plant-specific condition and age-related operating experience is bounded by the conditions and operating experience for which GALL Report AMP XI.M37 was evaluated.

In its RAI response dated October 31, 2014, the applicant stated that widespread inability to obtain flux thimble tube eddy current data occurred suddenly at Braidwood Station, Units 1 and 2 and involved flux thimble tubes of various in-service times. The applicant also stated that while Byron, Units 1 and 2 and Braidwood, Units 1 and 2 have the same basic flux thimble tube design (i.e., dimensions), the Byron Units have not had significant difficulty completing eddy current examinations.

In its October 31, 2014 response, the applicant stated that causal factors which include moisture and lubricant could account for the difficulties getting eddy current data, and it would consider activities to mitigate this issue. In its response dated February 23, 2015, the applicant stated that moisture and lubricant were not likely the causal factors and that deformation of the flux thimble tubes such that the internal dimension of the tubes is affected could prevent the eddy current probe from being fully inserted. The applicant also stated that deformation could occur because of mishandling, and is unlikely to result in deformation of all 58 flux thimble tubes. The applicant concluded that the most logical scenario is that the eddy current testing equipment or testing process is the likely cause of the recent issues related to obtaining eddy current testing data.

Issue 1:

The staff noted from the applicant's responses that its program failed to obtain useful data from most of its flux thimble tubes during the recent outage inspections since 2012, due to restrictions inside the flux thimble tubes. The staff is concerned that the applicant has yet to identify the root cause and, as a result, is not able to implement effective corrective actions to resolve the problem.

The staff performed an industry operating experience search and did not note occurrences of widespread issues with inability to get eddy current data. In addition, since the 1980's when flux thimble tube wear became an issue, industry's use of chrome plated replacement tubes has greatly reduced wear rates which does not seem to be the case with the chrome plated

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replacement flux thimble tubes at Braidwood. The staff is also concerned that the increasing trend in the numbers of uninspectable flux thimble tubes, unique to Braidwood, may be due to an age-related deformation of the tubes (i.e., reduction in inside diameter).

Request 1:

- (a) Provide technical justification that the operating experience for which the GALL Report AMP was evaluated is applicable to the plant-specific operating experience at Braidwood, considering the high wear rates, and multiple issues with eddy current examinations.
- (b) Explain if higher than normal wear rates have been observed with chrome plated replacement tubes.
- (c) Provide root cause analysis and corrective actions related to the inability to obtain useful inspection data.
- (d) Explain if there is a new age-related mechanism in addition to wear that is causing obstruction of eddy current probe insertion.
- (e) If the applicant's operating experience is unique and not bounded by the operating experience for which the GALL Report AMP XI.M37 was evaluated, explain why a plant-specific AMP is not required to manage the aging effects during the period of extended operation (PEO).

Background 2:

In the LRA, the applicant described its program as an existing program which is consistent with the GALL Report AMP XI.M37, "Flux Thimble Tube Inspection." In its February 23, 2015, response to the staff's follow-up RAI, the applicant described its program elements as "will be consistent" with the GALL Report AMP XI.M37 program elements.

Issue 2:

The staff reviewed the applicant's claim of program consistency by comparing the applicant's program with the GALL program. The staff noted that several program elements in the applicant's program are not consistent with those of the GALL program. Specifically, the applicant's program failed to obtain useful data from most of its flux thimble tubes during the recent outage inspections since 2012, and proposes an enhancement to replace its tubes every three cycles if flux thimble tube inspection data cannot be obtained. Based on the applicant's existing operating experience, there is a possibility that the issues with the eddy current examinations will recur during the PEO. Based on this, the applicant will be replacing the flux thimble tubes at an acceptable frequency instead of inspecting them. In such a case, the applicant's program would have exceptions to the following elements of the GALL AMP:

Element 3. Parameters Monitored/Inspected. GALL Guidance recommends that flux thimble tube wall thickness is monitored to detect loss of material from the flux thimble tubes. The applicant's program would not be able to monitor material loss, or wear.

Element 4. Detection of Aging Effects. GALL Guidance recommends an inspection methodology (such as eddy current testing) used to detect loss of material. The applicant's program would not be able to detect the aging effect of wear.

Element 5. Monitoring and Trending. GALL Guidance recommends that flux thimble tube wall thickness measurements are trended and wear rates are calculated and projected based on plant-specific data. The applicant's program would not be able to provide trending and monitoring.

Request 2:

Identify all of the program's exceptions to GALL Report AMP XI.M37, "Flux Thimble Tube Inspection" when flux thimble tube inspection data cannot be obtained. Discuss how the proposed enhancement, to replace tubes at an acceptable frequency, will address the exceptions. Revise the program accordingly.

Background 3:

In its response dated February 23, 2015, the applicant stated multiple times that "No flux thimble tube has been replaced due to age-related degradation in less than four (4) cycles," and that "None of the 116 flux thimble tubes were required to be replaced due to age-related degradation in less than four (4) refueling cycles."

In its response, the applicant also stated multiple times that plant-specific historical wear rates were used to project tube wear and were applicable. The applicant further stated that industry operating experience indicates that flux thimble tube wear decreases over the flux thimble tube service life. In addition, the applicant provided an enhancement to its AMP to replace flux thimble tubes every three cycles when inspection data cannot be obtained.

Issue 3:

In Table 2, on Page 13 of its response, the applicant indicated that three tubes had to be replaced after only one cycle of service due to wear, which the staff considers to be age-related. This appears to contradict the applicant's statement that "No flux thimble tube has been replaced due to age-related degradation in less than four (4) cycles."

The applicant's justification for the enhancement does not consider worst case wear scenarios. For example, it had experienced higher than expected wear rates but does not consider high wear rates in consecutive cycles. The applicant cited industry operating experience that wear rates decrease following high wear in earlier cycles. The staff noted that the applicant also experienced an increase in wear rates following cycles of low wear rates.

In addition, during its review of industry operating experience, the staff noted that there is industry operating experience which indicates that high wear rates may be sustained in multiple cycles. Specifically, the staff noted that a similar plant encountered multiple tube failures prior to the completion of three cycles of operation (LER-272/1981-028). A three-cycle replacement period appears to be inadequate.

Request 3:

- a) Explain why initial wear resulting in replacement of three flux thimble tubes after one cycle is not flow related wear and will not recur.
- b) Explain why replacing flux thimble tubes every three cycles when examination data are not obtained is adequate, in light of the plant-specific high wear rates, and industry operating experience which indicates that high wear rates could continue into subsequent cycles and result in tube failures in less than three cycles.

Letter to M. Gallagher from John W. Daily dated Month April 2, 2015

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