



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION I  
2100 RENAISSANCE BLVD., SUITE 100  
KING OF PRUSSIA, PA 19406-2713

April 27, 2015

EA-14-178  
EA-14-186

Mr. Bryan C. Hanson  
Senior Vice President  
Exelon Generation Company, LLC  
President and Chief Nuclear Officer,  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

**SUBJECT: FINAL SIGNIFICANCE DETERMINATIONS FOR ONE YELLOW FINDING AND ONE WHITE FINDING WITH ASSESSMENT FOLLOW-UP AND NOTICES OF VIOLATION [NRC INSPECTION REPORT NO. 05000219/2015007] – OYSTER CREEK NUCLEAR GENERATING STATION**

Dear Mr. Hanson:

This letter provides you the final significance determinations for the preliminary findings discussed in the U.S. Nuclear Regulatory Commission (NRC) letters dated February 11, 2015, which included Inspection Report Numbers 05000219/2014009 (ML15042A231)<sup>1</sup> and 05000219/2014005 (ML15042A072). This letter also transmits the follow-up NRC assessment of Exelon Generation Company, LLC (Exelon) performance at the Oyster Creek Nuclear Generating Station (Oyster Creek), which supplements the NRC annual assessment letter issued on March 4, 2015 (ML15062A273).

The first finding, preliminarily determined to be of Yellow significance, involved the failure by Exelon to establish adequate measures for selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the electromechanical relief valves (EMRVs). Specifically, the original design of the EMRV solenoid actuators was determined to be inadequate because, when they were placed in an environment where the actuators were subject to vibration associated with plant operation, the mechanical tolerance between posts and guides created a condition where the springs could wedge between the guides and posts, jamming the actuator plunger assembly. Additionally, the maintenance refurbishing process for the EMRV actuators was not adequate to prevent this condition. On June 20, 2014, during refurbishment of EMRVs that were removed from the plant during the October 2012, refueling outage, the licensee identified that this condition had occurred in the B and D EMRV actuators. The NRC determined that, based on the as-found

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<sup>1</sup> Designation in parentheses refers to an Agency-wide Documents Access and Management System (ADAMS) accession number. Documents referenced in this letter are publicly-available using the accession number in ADAMS.

condition of the valves and the last successful actuation of the D EMRV on July 27, 2012, the B and D EMRV had been inoperable for a period greater than the Technical Specification allowed outage time of 24 hours.

The second finding, preliminarily determined to be of White significance, involved Exelon's failure to review the suitability of application of a new emergency diesel generator (EDG) belt maintenance process that was essential to a safety-related function of the EDGs and to verify the acceptance criteria of that process. Specifically, Exelon changed the method for tensioning the cooling fan belt on the EDG from measuring belt deflection to measuring belt frequency, and did not verify the adequacy of the acceptance criteria stated for the new method. As a result, Exelon did not identify that the specified belt frequency imposed a stress above the fatigue endurance limit of the shaft material, making the upper fan shaft susceptible to fatigue and failure. This design control issue resulted in the failure of the Oyster Creek EDG No. 2 upper fan shaft on July 28, 2014, and in the EDG No. 2 being inoperable for a period greater than the Technical Specification allowed outage time of seven days.

The February 11, 2015, NRC letters each included a choice for Exelon to attend a regulatory conference or reply in writing to provide its position on the facts and assumptions the NRC used to arrive at the findings and their safety significance. In separate letters dated March 13, 2015 (ML15084A107 and ML15084A103), Exelon provided written responses to the NRC's preliminary determinations.

In the response to the first finding, Exelon stated that the methodology used to calculate the risk significance of the EMRV failures overestimated the common cause failure probabilities, therefore overestimating the risk significance of the finding. The NRC considered the information developed during the inspection and the information provided by Exelon in its March 13, 2015, response, and concluded that the finding is appropriately characterized as Yellow. A summary of the information provided by Exelon in its March 13, 2015, letter, and the NRC response, is provided in Enclosure 1.

As described in Inspection Report Number 05000219/2014009, the NRC determined this issue meets the criteria specified in Section 11.05a of Inspection Manual Chapter (IMC) 0305, "Operating Reactor Assessment Program," for treatment as an old design issue. Specifically, the issue: (1) was licensee-identified during as-found testing which is not required by NRC regulations; (2) was immediately corrected by the licensee; (3) was not likely to be previously identified during normal operations, routine testing, or maintenance; and (4) is not reflective of current performance. Therefore, this finding will not be used as an input in the assessment process or NRC Action Matrix. However, in accordance with IMC 0305, the NRC will conduct a supplemental inspection using Inspection Procedure (IP) 95002, "Supplemental Inspection for One Degraded Cornerstone or Any Three White Inputs in a Strategic Performance Area," when Exelon staff notify us of their readiness for this inspection. This inspection is conducted to provide assurance that the root cause and contributing causes of any performance issues are understood, the extent of condition is identified, and the corrective actions are sufficient to prevent recurrence.

The NRC has also determined that the finding involved a violation of Title 10 of the *Code of Federal Regulations* (10 CFR) 50, Appendix B, Criterion III, "Design Control," as cited in the Notice of Violation (Notice) included as Enclosure 2. The circumstances surrounding the

violation were described in detail in the subject inspection report. In accordance with the NRC Enforcement Policy, the Notice is considered an escalated enforcement action because it is associated with a Yellow finding. The NRC has concluded that the information regarding: (1) the reason for the violation; (2) the interim and long term corrective actions already taken and planned to correct the violation and prevent recurrence; and, (3) the date when full compliance was achieved, is already adequately addressed on the docket in NRC Inspection Report 05000219/2014009, in your letter dated March 13, 2015, and in this letter. Therefore, you are not required to respond to this letter unless the description therein does not accurately reflect your corrective actions or your position.

In the response to the second finding, Exelon did not contest the finding nor the characterization of its risk significance. The NRC concluded that the finding is appropriately characterized as White. As a result of this White finding in the Mitigating Systems Cornerstone, the NRC has assessed Oyster Creek to be in the Regulatory Response column of the NRC Action Matrix, retroactive to the fourth calendar quarter of 2014. The NRC plans to conduct a separate supplemental inspection for this finding in accordance with IP 95001, "Supplemental Inspection for One or Two White Inputs in a Strategic Performance Area," when Exelon staff notify us of their readiness for this inspection. This inspection is conducted to provide assurance that the root causes and contributing causes of any performance issues are understood, the extent of condition is identified, and the corrective actions are sufficient to prevent recurrence.

The NRC determined that the second finding involved a violation of 10 CFR 50, Appendix B, Criterion III, "Design Control," as cited in the Notice included as Enclosure 3. The circumstances surrounding the violation were described in detail in the subject inspection report. In accordance with the NRC Enforcement Policy, the Notice is considered an escalated enforcement action because it is associated with a White finding. The NRC has concluded that the information regarding: (1) the reason for the violation; (2) the interim and long term corrective actions already taken and planned to correct the violation and prevent recurrence; and, (3) the date when full compliance was achieved, is already adequately addressed on the docket in NRC Inspection Report 05000219/2014005, in your letter dated March 13, 2015, and in this letter. Therefore, you are not required to respond to this letter unless the description therein does not accurately reflect your corrective actions or your position.

You have 30 calendar days from the date of this letter to appeal the staff's determination of significance for the identified Yellow and White findings. Such appeals will be considered to have merit only if they meet the criteria given in the NRC IMC 0609, "Significance Determination Process," Attachment 2. An appeal must be sent in writing to the Regional Administrator, Region I, 2100 Renaissance Boulevard, King of Prussia, PA 19406.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response, if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room located at NRC Headquarters in Rockville, MD, and from the NRC's Agency-wide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response, if you choose to provide one, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction.

B. Hanson

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Should you have any questions regarding this matter, please contact Mr. Silas Kennedy, Chief, Projects Branch 6, Division of Reactor Projects in Region I, at (610) 337-5046.

Sincerely,

A handwritten signature in cursive script, appearing to read "Daniel H. Dorman".

Daniel H. Dorman  
Regional Administrator

Docket No. 50-219  
License No. DPR-16

Enclosures: As stated

cc w/encl: Distribution via ListServ

B. Hanson

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Should you have any questions regarding this matter, please contact Mr. Silas Kennedy, Chief, Projects Branch 6, Division of Reactor Projects in Region I, at (610) 337-5046.

Sincerely,

*/RA/*

Daniel H. Dorman  
Regional Administrator

Docket No. 50-219  
License No. DPR-16

Enclosures: As stated

cc w/encl: Distribution via ListServ

**ML15112A147**

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OFFICE	RI/ORA	RI/ORA	RI/DRS	RI/DRP	RI/DRS	RI/DRP
NAME	M McLaughlin/*	N Warnek/*	M Gray/*	S Kennedy/*	R Lorson/*	H Nieh/ *
DATE	3/25/15	3/25/15	3/20/15	3/31/15	4/16/15	4/14/15
OFFICE	RI/ORA	RI/ORA				RI/DRA
NAME	B Klukan/ *	B Bickett/*	J Wray*	R Carpenter*	L Casey*	D Dorman
DATE	4/14/15	4/14/15	4/20/15	4/20/15	4/20/15	4/22/15

\* See previous concurrence page

## ENCLOSURE 1

### NRC RESPONSE TO INFORMATION PROVIDED IN THE EXELON GENERATION COMPANY, LLC (EXELON) LETTER DATED MARCH 13, 2015 REGARDING THE EMRV FINDING

#### SUMMARY OF INFORMATION PROVIDED BY EXELON

In its March 13, 2015 letter (ML15084A107), Exelon stated that the NRC did not apply realistic assumptions in the calculation of common cause failure (CCF) probabilities, leading to an overestimated risk significance for the EMRV finding. Exelon provided four points, which are described verbatim, below.

- The Risk Assessment Standardization Project (RASP) methodology requires that an observed equipment failure or degradation to be classified as having either the potential for CCF or not as applied to the associated CCF group. If it is qualitatively determined that the potential for CCF exists, the Standardized Plant Analysis Risk (SPAR) model quantitative methodology assumes with 100% certainty that CCF exists for the observed issue. This methodology therefore represents a binary input (i.e., assume either no CCF or complete CCF due to the observed issue), with no clear process for evaluating CCF in a potential “middle ground” based on available information related to the cause and extent of condition of the failure.
- The full conditional CCF probability is applied to all components in the group with the failed component, regardless of the details or cause associated with the failure. This approach for determining the conditional CCF probabilities (i.e., alpha factors) used in Probabilistic Risk Assessment and SPAR models includes all inter-component dependencies not captured explicitly in the models. Applying the full conditional CCF probability calculated in the SPAR model in this manner is likely to overestimate the risk impact of a failure in an SDP evaluation.
- Using the Alpha methodology (as was applied in this case) for determining the conditional CCF probabilities is not in the spirit of achieving realistic results. Key investigative facts provided by Exelon are not addressed in the inspection report and do not appear to have been incorporated into the SPAR CCF calculation including 1) no history for similar failure in more than 40 years of plant operation; 2) no evidence of abnormally high vibration in the operating cycle leading up to the failure of the two EMRVs; 3) the time-dependent nature of the failure mechanism and 4) the fact that the remaining three EMRVs exhibited significantly less degradation, passed their operability test, and were *known* to not be in a failed state.
- Lastly, following plant shutdown on July 7, 2014 to support extent of condition inspection, all five EMRV actuators stroked satisfactorily during as-found testing.

#### NRC RESPONSE

Overall, the NRC agrees with several of the points raised by Exelon regarding the methodology used to calculate CCF. Namely, that the methodology for calculating CCF requires a failure mode to be considered a CCF or not a CCF, with no middle ground. However, the NRC

believes that the methodology that was used represents the best peer-reviewed methodology available for CCF analysis, and accurately depicts risk associated with CCF events. None of the information provided caused NRC to question the validity of the original methodology or results described in inspection report 05000219/2014009 (ML15042A231). Additional details are provided below.

A CCF is defined as a condition when two or more components fail within the probabilistic risk assessment (PRA) mission time window as a result of a shared cause. The NRC agrees that the risk assessment standardization project (RASP) methodology used to calculate the risk requires that the failure mode be classified as a CCF or not a CCF. In other words, either the failure mode has the potential to affect the other components in the common cause group, or it is an independent failure. (As Exelon stated, it is a "binary input" with no "middle ground.") In the case of the EMRV failures, the NRC determined that the cause of the observed degradation of the B and D EMRVs had the potential to affect the remaining EMRVs and, therefore, constituted a CCF. It is important to note that, in order for an equipment failure to be considered a CCF, the exact failure mechanism does not have to be shared. In other words, the subcomponent or part that fails does not have to be the same; it is the cause of failure that is shared. In this case both the parts that failed and the cause of failure were the same, namely a valve design not suited for a high vibration environment.

As described in NUREG/CR-6268, Rev. 1, Section 7.4, the available models for calculating CCF include the Basic Parameter model, the Beta model, the Multiple Greek Letter model, and the Alpha Factor model. All of these models provide estimates of the probability of a common cause event occurring, given a specific number of failed components within a specific common cause grouping. In the case of Oyster Creek, the finding represents the observed failure of two valves within a group size of five valves. The NRC used the Alpha Factor model to calculate CCF because it is (1) a multi-parameter model that can handle any redundancy level, (2) based on ratios of failure rates that make the assessment of its parameters easier when no statistical data are available, and (3) a simpler statistical model and produces more accurate point estimates as well as uncertainty distributions compared to other parametric models that have the above two properties. The NRC believes the Alpha Factor model is the best peer reviewed methodology available for calculating CCF, and it appropriately characterizes risk impact of a failure in a significance determination process (SDP) evaluation. The NRC does not agree with Exelon's contention that applying the full conditional CCF probability calculated in the SPAR model overestimated the risk impact of the EMRV failure.

The NRC considered the key investigative facts provided by Exelon, and concluded that the new information would not alter the original significance determination. Specifically, the NRC continues to conclude that the cause of the failure of the B and D EMRVs had the potential to affect the remaining EMRVs, and the time-dependent nature was appropriately accounted for. Although there were no previously identified failures of EMRVs at Oyster Creek, it was determined that cause of the valve failures was an inadequate design. This design has essentially been unchanged over the life of the plant. Past work orders documenting the refurbishment of these valves identified excessive wear of the springs and/or guide post that required their replacement. Although only two of the five EMRVs failed, all showed signs of abnormal wear. Lastly, the NRC notes that a successful operability test of redundant or similar components in the common cause component group does not reduce the conditional CCF probability of the remaining components to zero. The time dependent failure of the valves was accounted for in accordance with the guidance provided in RASP Volume 1, Section 2.4.

Specifically, for a failure that could have occurred at any time since the component was last operated (e.g., the time of actual failure cannot be determined due to the nature of the failure mechanism), the exposure time (T) is equal to one-half of the time period since the last successful functional operation of the component (T/2) plus repair time. This exposure time determination approach is appropriate for standby or periodically operated components that fail due to a degradation mechanism that gradually affects the component during the standby time period and is considered appropriate for this evaluation.

In summary, the NRC carefully reviewed the response provided by Exelon in the March 13, 2015 letter, and determined that the new information provided did not alter our original risk assessment as described in inspection report 05000219/2014009 (ML15042A231).



ENCLOSURE 2  
NOTICE OF VIOLATION

Exelon Generation Company, LLC.  
Oyster Creek Nuclear Generating Station

Docket No. 50-219  
License No. DPR-16  
EA-14-178

During an NRC inspection conducted on June 20, 2014 – December 16, 2014, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

10 CFR 50, Appendix B, Criterion III, "Design Control," states in part, that "Measures shall be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components."

Technical Specification 3.4.B states, in part, five electromatic relief valves (EMRVs) shall be operable and if more than one are inoperable, then reactor pressure shall be reduced to 110 psig or less, within 24 hours.

Contrary to the above, since original installation of the EMRVs in 1969, until the valves were redesigned and reinstalled during the 2014 refueling outage, Exelon did not establish adequate measures for the suitability of applications of materials and processes (maintenance) for the EMRV solenoid-operated actuators. Specifically, the original design of the EMRV actuators was inadequate because when they were placed in an environment where the actuator was subject to vibration associated with plant operation, the mechanical tolerance between posts and guides created a condition where the springs could wedge between the guides and the posts, jamming the actuator plunger assembly. In addition, given the original design of the valve, the maintenance refurbishing processes were not adequate to maintain the required internal tolerances to prevent excessive fretting and wear of the internal components. As a consequence of this design control issue, Exelon also violated Technical Specification 3.4.B, because two EMRVs were inoperable for greater than the allowed outage time of 24 hours.

This violation is associated with a Yellow Significance Determination Process finding, dispositioned as an Old Design Issue per Inspection Manual Chapter 0305.

The NRC has concluded that information regarding: (1) the reason for the violation; (2) the corrective actions taken and planned to correct the violation and prevent recurrence; and (3) the date when full compliance was achieved is already adequately addressed on the docket in Inspection Report 05000219/2014009, dated February 11, 2015, in the letter from Exelon to the NRC, dated March 13, 2015, and in the letter transmitting this Notice of Violation (Notice). Therefore, you are not required to respond to this Notice. However, if the description therein does not accurately reflect your corrective actions or your position you are required to submit a written statement or explanation pursuant to 10 CFR 2.201. In that case, or if you choose to respond, clearly mark your response as a "Reply to a Notice of Violation – EA-14-178," and send it to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Regional Administrator, Region I, and a copy to

the NRC Resident Inspector at Oyster Creek Nuclear Generating Station, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

If you choose to respond, your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. Therefore, to the extent possible, the response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction.

Dated this 27<sup>th</sup> day of April 2015.

ENCLOSURE 3  
NOTICE OF VIOLATION

Exelon Generation Company, LLC.  
Oyster Creek Nuclear Generating Station

Docket No. 50-219  
License No. DPR-16  
EA-14-186

During an NRC inspection conducted from October 1, 2014 – December 31, 2014, a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

10 CFR 50, Appendix B, Criterion III, "Design Control," requires, in part, that measures shall be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems, and components, and that measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.

Technical Specification 3.7.C.2.b requires that if one diesel generator becomes inoperable during power operation, the reactor may remain in operation for a period not to exceed 7 days.

Contrary to the above, from May 13, 2005, to September 9, 2014, Exelon did not review the suitability of the application of a different maintenance process at Oyster Creek that was essential to a safety-related function of the Emergency Diesel Generators (EDGs). Specifically, Exelon changed the method for tensioning the cooling fan belt on the EDG from measuring belt deflection to belt frequency and did not verify the adequacy of the acceptance criteria stated for the new method. As a result, Exelon did not identify that the specified belt frequency imposed a stress above the fatigue endurance limit of the shaft material, making the EDG cooling fan shaft susceptible to fatigue and failure on July 28, 2014. As a consequence of this design control issue, Exelon also violated Technical Specification 3.7.C, because Exelon operated Oyster Creek with EDG No. 2 inoperable for greater than 7 days.

This violation is associated with a White Significance Determination Process finding.

The NRC has concluded that the information regarding: (1) the reason for the violation; (2) the corrective actions taken and planned to correct the violation and prevent recurrence; and, (3) the date when full compliance was achieved, is already adequately addressed on the docket in NRC Inspection Report 05000244/2014005, in your letter dated March 13, 2015, and in the letter transmitting this Notice of Violation (Notice). Therefore, you are not required to respond to this Notice. However, if the description therein does not accurately reflect your corrective actions or your position you are required to submit a written statement or explanation pursuant to 10 CFR 2.201. In that case, or if you choose to respond, clearly mark your response as a "Reply to a Notice of Violation – EA-14-186," and send it to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Regional Administrator, Region I, 2100 Renaissance Boulevard, Suite 100, King of Prussia, PA 19406, and a copy to the NRC Resident Inspector at Oyster Creek Nuclear Generating Station, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

If you choose to respond, your response will be made available electronically for public inspection in the NRC Public Document Room and from the NRC's Agency-wide Documents Access and Management System (ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. Therefore, to the extent possible, the response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction. If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

In accordance with 10 CFR 19.11, Exelon may be required to post this Notice within two working days of receipt.

Dated this 27<sup>th</sup> day of April 2015.