



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

February 22, 2016

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

**SUBJECT: BYRON STATION, UNIT NOS. 1 AND 2 - RELIEF FROM THE REQUIREMENTS
OF THE ASME CODE (CAC NOS. MF6434 AND MF6435)**

Dear Mr. Hanson:

By letter dated June 22, 2015 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML15173A209), as supplemented by letter dated November 30, 2015 (ADAMS) Accession No. ML15335A387), Exelon Generation Company, LLC (the licensee), submitted alternative request RP-1 to the U.S. Nuclear Regulatory Commission (NRC). The licensee proposed an alternative to certain inservice testing (IST) requirements of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code), for the fourth 10-year IST program at Byron Station (Byron), Unit Nos. 1 and 2. The licensee also proposed alternative requests RG-1, RP-2, and RP-3, which will be addressed by separate NRC staff correspondence and RV-1, which was withdrawn.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the proposed alternative RP-1 on the basis that complying with the specified requirement would result in hardship or unusual difficulty.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the proposed alternative RP-1 provides reasonable assurance that the affected components, pumps 0SX02PA and 0SX02PB, are operationally ready. The NRC staff also determined that not allowing the alternative results in a hardship without a corresponding increase in quality or safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

Therefore, the NRC staff authorizes the alternative request RP-1 for Byron Unit Nos. 1 and 2 for the forth 10-year IST program interval, which begins on July 1, 2016, and is scheduled to end on June 30, 2026.

B. Hanson

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If you have any questions, please contact the Project Manager, Joel S. Wiebe at 301-415-6606 or via e-mail at Joel.Wiebe@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read 'JP', with a long horizontal flourish extending to the right.

Justin C. Poole, Acting Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No(s). STN 50-454 and STN 50-455

Enclosure:
Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATIVE REQUEST RP-1

FOR THE FOURTH 10-YEAR INTERVAL INSERVICE TESTING PROGRAM

EXELON GENERATION COMPANY, LLC

BYRON STATION, UNIT NOS. 1 AND 2

DOCKET NUMBERS 50-454 AND 50-455

1.0 INTRODUCTION

By letter dated June 22, 2015 (Agencywide Document Access and Management System (ADAMS) Accession No. ML15173A209), as supplemented by letter dated November 30, 2015 (ADAMS Accession No. ML15335A387), Exelon Generation Company, LLC (the licensee), submitted alternative request RP-1 for Byron Station (Byron), Unit Nos. 1 and 2. The licensee proposed an alternative to certain inservice testing (IST) requirements of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code), for the fourth 10-year IST program at Byron Station (Byron), Unit Nos. 1 and 2. The licensee also proposed alternative requests RG-1, RP-2, and RP-3, which will be addressed by separate NRC staff correspondence and RV-1, which was withdrawn.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.55a(z)(2), the licensee requested to use the proposed alternative in RP-1 on the basis that compliance with the ASME OM Code requirements present an undue hardship without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Section 50.55a(f) of 10 CFR, "Inservice Testing Requirements," requires, in part, that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed in accordance with the specified ASME OM Code and applicable addenda incorporated by reference in the regulations. Exceptions are allowed where alternatives have been authorized or relief has been requested by the licensee and granted by the U.S. Nuclear Regulatory Commission (NRC or Commission) pursuant to paragraphs (z)(1), (z)(2), or (f)(6)(i) of 10 CFR 50.55a.

In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety (10 CFR 50.55a(z)(1)); (2) compliance would result in hardship or unusual difficulty without a compensating increase in

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the level of quality and safety (10 CFR 50.55a(z)(2)); or (3) conformance is impractical for the facility (10 CFR 50.55a(f)(6)(i)). Section 50.55a allows the NRC to authorize alternatives and to grant relief from ASME Code requirements upon making the necessary findings.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

The applicable ASME OM Code edition and addenda for Byron, Unit Nos. 1 and 2, fourth 10-year IST program interval is the 2004 Edition through the 2006 Addenda. The fourth 10-year IST program interval at Byron, Unit Nos. 1 and 2, is scheduled to begin July 1, 2016, and end on June 30, 2026.

The licensee stated that the proposed alternative has been authorized for Byron, Unit Nos. 1 and 2, third 10-year program interval by an NRC letter dated September 7, 2006 (ADAMS No. ML062230351).

3.1 Licensee's Alternative Request RP-1

Applicable Code Requirements

ASME OM Code, Integrated Subsystem Test Bed (ISTB)-5223, "Comprehensive Test Procedure," (e), states, "All deviations from the reference values shall be compared with the ranges of Table ISTB-5221-1 and corrective action taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5221-1. For example, if vibration exceeds either $6V_r$ or 0.7 inches per second (ips), the pump is in the required action range."

Table ISTB-5221-1, "Vertical Line Shaft and Centrifugal Pumps Test Acceptance Criteria," specifies the pumps' vibration alert range from >0.325 ips to 0.700 ips and required action range >0.700 ips for the comprehensive pump test.

Component for which Relief is Requested

Essential Service Water (SX) Makeup Pumps A and B (0SX02PA and 0SX02PB).

Licensee's Reason for Alternative Request

The figures and trends referenced in the reason for relief, proposed alternative, and basis sections were submitted as part of the original package dated June 22, 2015, and supplement dated November 30, 2015, are not repeated below.

The SX makeup pumps are a unique design. For each pump, a horizontal diesel drives a right angle gearbox located approximately 39 feet above the pump. The drive shaft from the gearbox to the pump consists of five coupled sections and is located in the pump discharge piping column. Pump thrust is carried by bearings physically located within the gearbox. The pump

is submerged in river water. The licensee states that due to the unique design of these pumps, normal vibration values have been as high as approximately 0.5 ips at the gearbox locations. As a result, the normal vibration values consistently exceed the lower alert range limit of 0.325 ips, and, therefore, require that SX makeup pumps be tested on an increased frequency (as required by ISTB-6200). The licensee proposes an alternative to the requirements of Table ISTB-5221-1 so as to not have to test the pump on an increased frequency.

Licensee's Proposed Alternative

The licensee proposes to increase the lower limit of the alert range as specified in Table ISTB-5221-1 from 0.325 ips to 0.550 ips. The licensee does not propose any change to the lower limit of the required action range (0.700 ips).

Licensee's Basis for Use

In support of its proposed alternative the licensee has submitted information about the pump vibrations and the licensee's actions to understand and reduce those vibrations in accordance with NUREG/CP-0152. These key requirements of the NUREG and the licensee's assessment of the subject pumps are in accordance with those requirements are briefly summarized below.

Vibration History

"The licensee should have sufficient vibration history from IST which verifies that the pump has operated at this vibration level for a significant amount of time, with any "spikes" in data justified."

The licensee states that vibration analysis has indicated that the readings obtained are the result of vibrations induced by the diesel engine and gearbox, along with a resonant condition of the gearbox and its foundation. Additionally, the overall vibration levels have remained steady over the past 20 years.

Maintenance and inspection activities have indicated that the angle gearboxes have been operating properly and have not degraded due to vibration. Maintenance and inspection activities on the pumps have indicated that there has not been any pump degradation due to the vibration observed on the gearboxes. Likewise, the pump units have not caused vibration degradation of the gearboxes.

Consultation with Pump Manufacturer/Vibration Expert

"The licensee should have consulted with the pump manufacturer or vibration expert about the level of vibration the pump is experiencing to determine if pump operation is acceptable."

The licensee identified that in 2001, Byron Jackson, the pump manufacturer, had consulted an industry vibration expert and the vendor representative from the gearbox company, in an effort to ensure vibration levels are as low as achievable with this particular design, and to ensure the existing vibration levels are not indicative of pump degradation. These efforts included the following activities:

- Field service representatives from the gearbox company supervised the refurbishment of the two gearboxes. Both refurbished units were then installed on the pumps. The units that were refurbished had seen a significant amount of service at vibration levels in excess of the lower alert limit. When inspected, the gearboxes did not show any vibration-related degradation.
- Bi-directional support braces were installed on the gearboxes to address the vibration resonance problem.
- The gearboxes were precision aligned and the couplings were balance checked upon installation.

Attempts to Lower Vibration

"The licensee should describe attempts to lower the vibration below the defined code absolute levels through modifications to the pump."

The licensee states that due to the adverse quality of the river water in which the pumps operate, the pump impellers have been replaced with stainless steel units and the wear rings replaced with a wear resistant alloy. The new pump assemblies were tested at the vendor's facility and exhibited very low vibration levels.

These collective efforts resulted in some reduction in the vibration levels, however, not enough to remove the pumps from the ASME OM Code alert range. Both pumps have experienced vibration levels at the gearbox locations of up to 0.55 ips during the third 10-year IST interval. The licensee concluded those vibration levels recorded at the gearbox locations are normal for the configuration of the subject pumps and do not indicate an unusual condition of the gearbox or the pump. The proposed alternative limits will ensure that required action is taken if vibration levels increase while ensuring the pump is not prematurely declared inoperable.

Spectral Analysis

"The licensee should perform a spectral analysis of the pump-driver system to identify all contributors to the vibration levels."

The licensee submitted spectrum trend data that validate the analysis performed by an independent consultant, i.e., vibrations are induced by the diesel engine, gearbox, and resonance associated with the gearbox and its foundation. The vibrations experienced to date are not indicative of degraded pump performance.

Since the gearbox normally exhibits relatively high vibration levels which are not indicative of degradation, the use of the Table ISTB-5221-1 would result in pumps unnecessarily being placed in double test frequency. Increasing the lower alert range limit for these pumps would ensure the pumps are placed in double test frequency at a vibration level that would be abnormal for the SX makeup pumps' design configuration.

Hardship

The licensee states that placing the SX makeup pumps in double test frequency is a hardship because it results in additional man hours, increased pump run time/pump component degradation, confined space entry hazards and work during inclement weather. There is not a compensating increase in quality and safety because the pumps have run with this vibration level for the past 20 years.

3.2 NRC Staff Evaluation of Relief Request RP-1

ASME OM Code, ISTB-5223, requires that when overall pump vibration measurement in any one measured direction falls in the range of >0.325 ips to 0.700 ips, the pump shall be declared in the alert range and testing doubled until the cause of the deviation is determined and condition is corrected. Although a pump is considered operable while in the alert range, increased vibration to this level may be an indicative of degradation which would warrant further investigation. Therefore, the ASME OM Code requires that frequency be doubled until the cause of the increased vibration is determined and corrected.

For 0SX02PA and 0SX02PB pumps, the vibration measurements are frequently about 0.55 ips which exceeds the lower alert range limit of 0.325 ips. In lieu of doubling the test frequency, the licensee proposes to raise the vibration alert range limit from >0.325 to 0.55 ips. The licensee does not propose to change the action limit, which will remain at 0.700 ips. The proposed alternative is a resubmittal of NRC-approved alternative request RP-1 for the Byron, Unit Nos. 1 and 2, third 10-year IST program. The proposed alternative was authorized by NRC staff in a letter dated September 7, 2006, on the basis that:

1. Vibration History: Documentation of vibration history verifies that the pump has operated satisfactory at this vibration level measured at the pump gearbox for a significant period of time without degradation.
2. Consultation with Pump Manufacturer/Vibration Expert: The licensee has consulted with the pump vendor and vibration experts. The pump's gearbox vendor provided documentation states that 0.55 ips is an acceptable vibration alert range limit. The pump vendor has verified that, when tested at the vendor's facility, the replacement stainless steel impellers had "very low" vibration levels. The material condition of the gearbox was examined and no degradation due to vibration was noted.
3. Attempt to Lower Vibration: The licensee has attempted to reduce the vibration level by adding restraints to stiffen the right angle gearbox and by improved alignment of the gearboxes and couplings.
4. Spectral Analysis: The licensee stated that spectral analysis is performed as part of the IST vibration data collection. Any pump vibration concerns are going to be met with more comprehensive special testing and appropriate corrective maintenance will be performed.

In the current alternative request, the licensee has readdressed all four issues and states that the overall vibration levels have remained steady at approximately 0.55 ips over the past

20 years and that doubling the test frequency under current conditions does not provide additional assurance as to the condition of the pump and its ability to perform its safety function. Furthermore, the licensee submitted additional vibration history from the last 10-year IST interval including spectral analysis and maintenance activities. The licensee states that during the fourth 10-year IST interval, advance analysis techniques, equivalent to spectral analysis, may be performed in lieu of the spectral analysis.

The NRC staff finds that this additional data and information continue to demonstrate that vibrations in excess of the Code-required lower end of the alert range have not adversely affected the pump performance and therefore, increasing the lower end of the alert range from 0.325 ips to 0.55 ips is, in this case, justified. Additionally NRC staff notes that the licensee proposed alert range (>0.55 to 0.700 ips) remains sufficiently wide so as to be able to identify and assess pump degradation, prior to entering the required action range (>0.700 ips). The NRC staff finds that not allowing the alternative results in hardship without a compensating increase in quality and safety. Therefore, the NRC staff concludes that the proposed alternative provides reasonable assurance of operational readiness of the of the 0SX02PA and 0SX02PB pumps.

4.0 CONCLUSION

As set forth above, the NRC staff determined that for alternative request RP-1, the proposed alternative provides reasonable assurance that the affected components, pumps 0SX02PA and 0SX02PB, are operationally ready. The NRC staff also determined that not allowing the alternative results in hardship without a corresponding increase in quality or safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the alternative request RP-1 for Byron Unit Nos. 1 and 2 for the forth 10-year IST program interval, which begins on July 1, 2016, and is scheduled to end on June 30, 2026.

All other ASME OM Code requirements for which relief was not specifically requested and approved in the subject requests for relief remain applicable.

Principle Contributor: Gurjendra S. Bedi, NRR/DE

Date:

B. Hanson

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If you have any questions, please contact the Project Manager, Joel S. Wiebe at 301-415-6606 or via e-mail at Joel.Wiebe@nrc.gov.

Sincerely,

/RA/

Justin C. Poole, Acting Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454 and STN 50-455

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Safety Evaluation

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