August 12, 2003

Mr. Ronald A. Jones
Vice President, Oconee Site
Duke Energy Corporation
P.O. Box 1439
Seneca, SC 29679

SUBJECT: RELIEF REQUEST ASSOCIATED WITH PUMP GENERIC RELIEF REQUEST NUMBER ON-GRP-01 FOR OCONEE NUCLEAR STATION, UNITS 1, 2 AND 3 (TAC NOS. MB6602, MB6603 AND MB6604)

Dear Mr. Jones:

By letter dated October 23, 2002, you submitted two requests for relief, ON-GRP-01 and ON-GRP-02, for Oconee Nuclear Station, Units 1, 2 and 3. They request relief from the American Society of Mechanical Engineers "Code for the Operation and Maintenance of Nuclear Power Plants" (OM Code). In your letter dated June 24, 2003, you withdrew Relief Request ON-GRP-02 and resubmitted Relief Request ON-GRP-01.

The NRC staff concludes that your proposed alternative to the OM Code requirements in Table ISTB 5.2.1-1 provides an acceptable level of quality and safety, and is authorized for use at the Oconee Nuclear Station, Units 1, 2 and 3, pursuant to Title 10 *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i). The alternative is authorized for the fourth 10-year interval inservice testing program. Enclosed is the NRC staff's Safety Evaluation.

Sincerely,

/RA/

John A. Nakoski, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270 and 50-287

Enclosure: As stated

cc w/encl: See next page

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DATE	7/22/2003	7/22/2003	8/5/2003	8/11/2003

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUEST NO. ON-GRP-01

DUKE ENERGY CORPORATION

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NUMBERS 50-269, 50-270 AND 50-287

1.0 INTRODUCTION

In its letter dated October 23, 2002, Duke Energy Corporation (the licensee) submitted two requests for relief for Oconee Nuclear Station (ONS), Units 1, 2, and 3. These two requests, ON-GRP-01 and ON-GRP-2, request relief from the requirements of the American Society of Mechanical Engineers (ASME) "Code for Operation and Maintenance of Nuclear Power Plants" (OM Code). In its letter dated June 24, 2003, the licensee withdrew Relief Request ON-GRP-02 and resubmitted Relief Request ON-GRP-01.

2.0 REGULATORY EVALUATION

The *Code of Federal Regulations* (10 CFR) Section 50.55a, requires that inservice testing (IST) of certain ASME Code Class 1, 2 and 3 pumps and valves be performed at 120-month (10-year) IST program intervals in accordance with the ASME OM Code and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to paragraphs (a)(3)(i), (a)(3)(ii),or (f)(6)(i) of 10 CFR 50.55a. In accordance with 10 CFR 50.55a(f)(4)(ii), licensees are required to comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in the regulations 12 months prior to the start of each 120-month IST program interval. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making necessary findings. NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provides alternatives to Code requirements that are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, "Guidance for Inservice Testing at Nuclear Power Plants."

By letter dated October 23, 2002, the licensee proposed an alternative to the requirements of the ASME OM Code for fourth 10-year IST interval of ONS. The ONS fourth 10-year IST interval for all 3 units commenced July 1, 2002. The program was developed in accordance with the 1995 Edition, up to and including the 1996 Addenda to the ASME OM Code.

3.0 TECHNICAL EVALUATION

3.1 Code Requirements

The licensee requested relief from the alert and required action range requirements of Table ISTB 5.2.1-1 for pumps that are considered smooth-running. Table ISTB 5.2.1-1 states that, if during an inservice test, a bearing vibration measurement exceeds 2.5 times the reference value previously established as required by paragraph ISTB 4.3, the pump is considered in the alert range. The frequency of testing is then doubled in accordance with paragraph ISTB 6.2 until the condition is corrected and the vibration level returns below the alert range. Pumps whose vibration is recorded to be six times the reference value are considered in the required action range and must be declared inoperable until the cause of the deviation has been determined and the condition is corrected, or an analysis of the pump is performed and new reference values are established in accordance with paragraph ISTB 4.6.

3.2 Licensee's Basis for Requesting Relief

The repeatability of pump vibration readings at ONS is in the range of 0.05 inches per second (ips) due to hydraulic flow noise in this amplitude range and the repeatability of the vibration instruments. When vibration velocities are less than 0.05 ips, changes have been shown to be insignificant.

At vibration velocities less than 0.05 ips, flow noise and instrument repeatability can significantly affect reference values. Candidates for smooth-running status will be analyzed per ISTB paragraph 4.3 to verify that use of this relief request will not prevent the detection of significant pump degradation.

For displacement reference values less than 0.5 mils, it is noted that Section XI of the ASME Boiler and Pressure Vessel Code (in effect for the third interval IST Program) set the alert range at greater than 1.0 mil and the required action range at greater than 1.5 mil. This implies a minimum reference value of 0.5 mils, which is equivalent to 0.047 ips for 1800 revolutions-per-minute (rpm) pumps and 0.094 ips for 3600 rpm pumps, is required. The effective reference values proposed for smooth-running pumps are roughly equal to the implied Section XI reference values for 1800 rpm pumps and more conservative than the implied reference values for 3600 rpm pumps. Without authorization of this alternative, the alert ranges for some smooth-running pumps will be reduced by a factor of 10.

The ONS Predictive Maintenance (PdM) program is part of the Preventive Maintenance (PM) program. The PM program was developed using industry guidelines as well as factoring in ONS site-specific experience and regulatory requirements. The PM program and PdM activities are controlled by plant procedures. Each of these pumps has regularly scheduled PM and PdM activities performed on that pump as described in the model work orders. The performance of the system associated with each of these pumps is monitored and compared to performance criteria under the ONS maintenance rule program. This ensures the continued effectiveness of the PM program to minimize component failures and maintain or improve system performance (balance availability and reliability). The ONS PdM program uses vibration analysis, lubricant analysis, and, as appropriate, infrared thermographic analysis to predict the need for maintenance so that equipment can be reworked prior to failure. The components included in this program include those considered important to safe and reliable plant operation, including

all the pumps in the IST program. The intervals for monitoring are based on the manufacturer's recommendations, maintenance history, cost effectiveness, and experience. Although the monitoring, analysis, database, and software used in the PdM program do not fall under the ONS quality program, the PdM program still provides valuable information for assuring the operational readiness of smooth-running pumps.

The vibration analysis program monitors the vibration of rotating machinery. In addition to the vibration at pump bearings, the vibration of the driver (turbine or motor) bearings is also collected and trended. Analyzed parameters and methods include vibration velocity, bearing acceleration, bearing high frequency detection, and spectral analysis.

The lubricant analysis program samples lubricants and analyzes them to identify degradation or negative trends. Capabilities include wear debris, lubrication cleanliness, and limited chemical composition analysis.

In both the vibration monitoring and lubricant analysis programs, recently acquired data is compared with previous data to detect any indicated degradation in equipment condition. If degradation indicates the reliability of operating equipment may be negatively affected, or if acceptance criteria are no longer being met, appropriate corrective action is taken. Corrective action may include: continued trending of the degraded condition, if the condition is not considered to be immediately threatening to the equipment and can be corrected during a time window convenient to plant operation; additional testing or monitoring to confirm the suspected degraded condition; inspection and repair of the equipment as necessary; changes to preventive maintenance procedures or schedules; or design changes.

ONS expends considerable resources on preventive and predictive maintenance. One result of these efforts is that pumps run very smoothly. To continue to impose Code-mandated alert and required action values on smooth-running pumps unnecessarily penalizes ONS for achieving this high level of performance.

3.3 Licensee's Proposed Alternative to Code Testing Requirements

Vibration parameters that have reference values less than or equal to 0.05 ips may be considered "smooth-running." The alert and required action values for these parameters will be determined as if their reference value is 0.05 ips; that is, the alert range will be greater than 0.125 ips to 0.3 ips, and the required action range will be greater than 0.3 ips.

In addition to the Code-mandated parameter monitoring (developed head, flow, overall vibration, etc), additional pump performance parameters are monitored under the predictive maintenance program. This program includes the following:

Spectrum band monitoring
Bearing acceleration monitoring (on ball and roller bearings only)
Bearing oil analysis (for oil lubricated bearings)

If any parameters are outside normally expected ranges, an evaluation will be performed and appropriate corrective actions will be taken.

Before being treated as smooth-running under this relief request, each candidate pump parameter will be reviewed to verify that testing performed under the provisions of this relief request will not prevent the detection of significant pump degradation.

3.4 Evaluation

The ASME OM Code, ISTB 4.7.4 requires that vibration of safety-related pumps be measured at specific locations on the pump. For centrifugal pumps, the measurements are taken in a plane approximately perpendicular to the rotating shaft in two orthogonal directions on each accessible pump-bearing housing. For vertical line shaft pumps, the vibration measurements are taken on the upper motor-bearing housing in three orthogonal directions, including the axial direction. The measurement is also taken in the axial direction on each accessible pump thrust-bearing housing. These measurements are to be compared with the Code vibration-acceptance criteria to determine if the measured values are acceptable.

Table ISTB 5.2.1-1 of the ASME OM Code states that, if during an inservice test, a bearing vibration measurement exceeds 2.5 times the reference value previously established as required by paragraph ISTB 4.3, the pump is considered in the alert range. The frequency is then doubled in accordance with paragraph ISTB 6.2 until the condition is corrected and the vibration level returns below the alert range. Pumps whose vibration exceeds six times the reference value are considered in the required action range and must be declared inoperable until the cause of the deviation has been determined and the condition is corrected, or an analysis of the pump is performed and new reference values are established in accordance with paragraph ISTB 4.6. The vibration reference values are required by paragraph ISTB 4.3 to be established when the pump is in good condition.

For pumps whose absolute magnitude of vibration is an order of magnitude below the absolute vibration limits in Table ISTB 5.2.1-1, a relatively small increase in vibration magnitude may cause the pump to enter the alert or required action range. These instances may be attributed to variation in flow, instrument accuracy, or other noise sources that would not be associated with degradation of the pump. Pumps that operate in this region are typically referred to as smooth-running. Based on a small acceptable range, a smooth-running pump could be subject to unnecessary corrective action.

The ASME OM Code has tried numerous times to develop a Code change to establish test requirements for a class of pumps defined as smooth-running. These requirements focused on selecting a minimum vibration to be specified in the proposed Code change that would be assigned as the minimum reference values. The Code committees have not reached a consensus on the appropriate minimum reference value and on whether this approach would be adequate to identify degradation in safety pumps during testing. In addition, the Code committees have had significant discussion on what other types of pump-monitoring activities should be included as compensatory requirements for testing of smooth-running pumps.

At least one plant has previously been authorized to use the smooth-running pump methodology as described above. The minimum reference value was 0.1 ips. However, a pump bearing at this plant experienced significant degradation even though the vibration was below the minimum reference value in the proposed alternative. Had the current Code requirements been in place, the bearing vibration level for this pump would have exceeded the alert range. The degradation was discovered during vibration monitoring for a predictive

maintenance program. After this finding, it was clear to the NRC staff that a simple minimum reference value method alone would not be sufficient to determine pump degradation.

The licensee's proposal combines the minimum reference value method with a commitment to perform additional pump monitoring. The licensee will assign a vibration reference value of 0.05 ips to any pump bearing vibration direction where, in the course of determining its reference value, the measured value is below 0.05 ips. Therefore, the acceptable range as defined in Table ISTB 5.2.1-1 will be less than or equal to 0.125 ips, the alert range will be greater than 0.125 ips to 0.3 ips, and the required action range will be greater than 0.3 ips for pumps that are considered smooth-running. The licensee has a PdM program as part of the PM program. The PM program was developed using industry guidelines as well as factoring in site-specific experience and regulatory requirements. The PM program and PdM activities are controlled by plant procedures. Each pump has regularly scheduled PM and PdM activities performed as described in the PM model work orders. The performance of the system associated with the pump is monitored and compared to performance criteria under the maintenance rule program. This ensures the continued effectiveness of the PM program to minimize component failures and maintain or improve system performance.

The PdM program routinely uses vibration analysis, lubricant analysis, and, as appropriate, infrared thermographic analysis. The components included in this program include those considered important to safe and reliable plant operation, including all the pumps in the IST program. In both the vibration monitoring and lubricant analysis programs, recently acquired data is compared with previous data to detect any indicated degradation of equipment condition. If any of the parameters are outside normally expected ranges, the condition is evaluated and appropriate corrective actions are taken.

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The lubricant analysis program samples lubricants and analyzes them to identify degradation or negative trends. Capabilities include wear debris, lubrication cleanliness, and limited chemical composition analysis.

As described above, the NRC staff finds that the alert and required action limits specified in the relief request sufficiently address the previously undetected acute pump problems. The 0.05 ips minimum reference value is consistent with previous NRC staff safety evaluations of similar issues. The NRC staff acknowledges that the objective of the licensee's predictive maintenance program is to detect problems involving the mechanical condition, even well in advance of when the pump reaches its overall vibration alert limit. Therefore, the licensee's proposed alternative will provide an acceptable level of quality and safety.

3.5 Conclusion

Based on a review of the information provided by the licensee, the NRC staff concludes that the licensee's proposed alternative with respect to pump vibration alert and required action values for smooth-running pumps is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the remainder of

the fourth 10-year interval, based on the alternative providing an acceptable level of quality and safety.

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Date: August 12, 2003

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