March 31, 2000

Mr. Craig G. Anderson
Vice President, Operations ANO
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2, RE: RELIEF REQUESTS ASSOCIATED WITH THE THIRD INTERVAL INSERVICE TESTING PROGRAM SUBMITTAL (TAC NOS. MA7302 AND MA7305)

Dear Mr. Anderson:

By letter dated November 12, 1999, Entergy Operations, Inc. (Entergy) submitted its third ten-year interval Inservice Testing (IST) program, which would become effective on March 26, 2000, for Arkansas Nuclear One, Unit 2 (ANO-2). Entergy submitted four pump relief requests and seven valve relief requests. The Nuclear Regulatory Commission (NRC) has evaluated these relief requests in the enclosed safety evaluation, and the results are summarized as follows.

Pursuant to 10 CFR 50.55a(f)(4)(iv), relief request IST 2-99-11 is approved on the basis that the proposed alternative is contained in the 1995 Edition of the American Society of Mechanical Engineers Code for Operation and Maintenance of Nuclear Power Plants (OM Code), which has been incorporated by reference in 10 CFR 50.55a (64 FR 51370). Pursuant to 10 CFR 50.55a(a)(3)(ii), relief requests IST 2-99-3, 2-99-4, 2-99-5, 2-99-6, 2-99-7, 2-99-8, 2-99-9, and 2-99-10, are authorized for use in the third IST interval on the basis that imposition of Code requirements would result in hardship without a compensating increase in the level of quality or safety, and the proposed testing provides reasonable assurance of pump and valve operability. However, the proposed use of a sampling plan associated with relief request 2-99-9 is denied, because Entergy has not adequately addressed the specific hardship of testing the two affected valves in the group.

Pursuant to 10 CFR 50.55a(f)(6)(i), relief request IST 2-99-1 is granted on the basis that compliance with the Code requirements is impractical, and the proposed alternative meets the guidance of NUREG-1482 and provides reasonable assurance of pump operability. The NRC has determined that the granting of relief request IST 2-99-1 is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon Entergy that could result if the requirements were imposed on the facility. Relief request IST 2-99-2 to use existing instruments is authorized, in accordance with 10 CFR 50.55a(a)(3)(ii), for an interim period of one year to allow Entergy to either procure new equipment that meets the Code requirements or revise and resubmit the relief request. The NRC has determined that imposition of the Code requirements for this one-year period would result in hardship without a compensating increase in the level of quality or safety, and the proposed testing provides reasonable assurance of pump operability.

The scope of IST program, cold shutdown justifications, refueling outage justification, and IST program commitments have not been reviewed in detail and are subject to NRC inspection.

Sincerely,

***/RA/***

Robert A. Gramm, Chief, Section 1
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure: Safety Evaluation

cc w/encl: See next page

The scope of IST program, cold shutdown justifications, refueling outage justification, and IST program commitments have not been reviewed in detail and are subject to NRC inspection.

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Robert A. Gramm, Chief, Section 1
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cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUESTS ASSOCIATED WITH THE

THIRD INTERVAL INSERVICE TESTING PROGRAM

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NUMBER 50-368

## 1.0 INTRODUCTION

Title 10 of the *Code of Federal Regulations*, Part 50.55a (10 CFR 50.55a), requires that inservice testing (IST) of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 pumps and valves are performed in accordance with Section XI of the ASME *Boiler and Pressure Vessel Code* (the 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 Sections (a)(3)(i), (a)(3)(ii), 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, (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 its facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making the necessary findings. Guidance related to the development and implementation of IST programs is given in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," issued April 3, 1989, and its Supplement 1 issued April 4, 1995, NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," and NUREG/CR-6396, "Examples, Clarifications, and Guidance on Preparing Requests for Relief from Pump and Valve Inservice Testing Requirements."

The 1989 Edition of the ASME Code is the latest edition incorporated by reference in Paragraph (b) of Section 50.55a. Subsection IWV of the 1989 Edition, which gives the requirements for IST of valves, references Part 10 of the American National Standards Institute (ANSI)/ASME *Operations and Maintenance Standards* (OM-10) as the rules for IST of valves. OM-10 replaces specific requirements in previous editions of Section XI, Subsection IWV, of the ASME Code. Subsection IWP of the 1989 Edition, which gives the requirements for IST of pumps, references Part 6 of the ANSI/ASME *Operations and Maintenance Standards* (OM-6) as the rules for IST of pumps. OM-6 replaces specific requirements in previous editions of Section XI, Subsection IWP, of the ASME Code.

Arkansas Nuclear One, Unit 2 (ANO-2) began commercial operation on March 26, 1980. The licensee's IST program submitted in the letter dated November 12, 1999, covers the third 10-year IST interval for ANO-2, which begins on March 26, 2000. The updated program was developed in accordance with the 1989 Edition of ASME Code Section XI. In the updated program, Entergy submitted four pump relief requests and seven valve relief requests. The staff has completed its review of all relief requests and is providing the following evaluation.

The scope of IST program, cold shutdown justifications, refueling outage justification, and IST program commitments have not been reviewed in detail and are subject to NRC inspection.

## 2.0 PUMP RELIEF REQUEST

### 2.1.0 Relief Request IST 2-99-1

IST 2-99-1 requests relief for service water pumps (2P-4A, 2P-4B, and 2P-4C) of ANO-2 from the requirements of Section 5.2 of OM-6, i.e., an inservice test will be conducted with the pump operating at specified test reference conditions.

### 2.1.1 Licensee's Basis for Relief Request

The licensee states:

"During normal plant operation, either two or three service water pumps are required to be in operation. The pumps provide cooling water flow to the two safety grade service water loops and to the non-safety grade auxiliary cooling water loop. Interrupting the cooling water flow to certain components would result in an immediate plant transient or a plant trip. The system flow requirements are defined by the service loads of the supplied components. After system operation reaches a degree of stability, perturbation of flow to any of the on-line heat exchangers could have a severe adverse impact on plant operation with the potential for unacceptable flow and temperature transients. This situation precludes flow adjustments on specific heat loads and certainly throttling of pump or header isolation valves. As such, returning the system operating parameters to a prescribed unique reference value (either flow or differential pressure) is impractical and could result in an unreasonable and unwarranted risk to plant operation with little or no apparent gain in plant safety or reliability. Historical test data indicates that over the operating range of interest there is little or no variation in pump vibration characteristics (e.g., vibration levels are independent of flow rate over the allowed range of flows)."

### 2.1.2 Alternative Testing

The licensee states:

"These pumps will be tested on a quarterly basis with the specific unique test reference values, as defined in Section 1.3 [of OM-6] and discussed in Section 4.3 [of OM-6], replaced by a set of variable reference values in the form of a representative curve denoting reference differential pressure as a function of pump indicated flow rate for each pump. The reference flow versus differential pressure ($\Delta P$) curve represents hydraulic performance over the entire flow range of the pump. The reference curve will be determined for each pump as follows:

1. Each reference pump curve will be determined when the pump is known to be operating acceptably.

2. Measurements used to obtain reference points for the curve will use instruments that meet the accuracy and range requirements of OM-6, Section 4.6.

3. The reference curve will be constructed from at least five measured points over the operating range of pump flow rates. Corresponding differential pressure and flow rate measurements will be recorded after flow stability is achieved at each point.

4. Only those points of the reference curve beyond the flat, low flow region and within the design flow rate of the pump will be used to establish acceptance criteria for quarterly testing. This range will include pump design basis flow rates.

5. Acceptance criteria will be established that do not conflict with operability criteria for flow rate and differential pressure in technical specifications or the safety analysis report.

6. The acceptance criteria for pump/motor vibration will be those specified in OM-6, Table 3a based on reference values measured during typical pump operation at or near the pump's design basis flow rate. Vibration levels have been demonstrated to remain essentially the same over the entire range of flow rates used.

7. After any maintenance or repair to a pump that may have affected or significantly altered the previous pump performance curve, a new reference pump curve will be developed or the previous curve revalidated by an appropriate inservice test.

The Service Water pumps are centrifugal vertical line shaft pumps. The limits for acceptable pump differential pressure at operating flow will be derived from Table 3b of OM-6. Individual acceptance criteria for each pump will be developed as follows:

1. The "required action range" will be where pump differential pressure, at the operating flow rate, indicates less than 93% of the value taken from the reference curve and greater than 110% of the reference value.

2. An "alert range" will be established where pump differential pressure, at the operating flow rate, indicates between 95% and 93% of the value taken from the reference curve.

3. Each of the pump's acceptance criteria curves shall be compared to the applicable and corresponding requirements for these pumps as set forth in ANO-2 Technical Specifications, Safety Evaluation Report, and Safety Analysis Report. If necessary, adjustments to the required action range limits will be made to ensure that the acceptance criteria are conservative with respect to the requirements of license basis documents.

4. In the event that a pump's operational parameters fall outside of the acceptance criteria, appropriate corrective actions will be implemented in accordance with Section 6.1 [of OM-6].

The proposed alternate testing for these pumps meets or exceeds the requirements as set forth in NUREG-1482, Section 5.2.

The proposed alternate testing will provide adequate test information and assurance equivalent to that of the Code requirement needed to assess the operational readiness of the subject pumps and adequately detect significant pump degradation."

2.1.3 Evaluation

Section 5.2 of OM-6 requires that pump flow rate and differential pressure be evaluated against reference values to monitor pump condition and to allow detection of hydraulic degradation. When it is impractical to perform a quarterly test of a pump at a reference value of flow and differential pressure, testing in the "as-found" condition and comparing values to an established reference curve provide a suitable alternative. Pump curves represent a set of infinite reference points of flow rate and differential pressure. Establishing a reference curve for a pump when it is known to be operating acceptably, and basing the acceptance criteria on this curve, can permit evaluation of pump condition and detection of degradation, though not in accordance with OM-6. There is, however, a higher degree of uncertainty associated with using a curve to assess operational readiness. Therefore, the development of the reference curve should be as accurate as possible. Section 5.2 of NUREG-1482 allows the use of pump curves as an acceptable alternative to IWP-3100 requirements, provided that certain guidance is followed in preparing the pump curves.

The service water pumps, 2P-4A, -4B, and -4C, operate under a variety of flow rate and differential pressure conditions. Varying the flow rate of these pumps is impractical during normal plant operating conditions because of a potential for loss of adequate flow to heat exchangers. Therefore, it is impractical to perform the quarterly pump test during plant operation, because interruption of cooling water flow could cause a reactor transient or a trip. As a result, the licensee proposes to use the reference flow versus differential pressure curve for testing the pumps. The reference curves are developed in accordance with the guidance of NUREG-1482, Section 5.2, and the acceptance criteria are consistent with ASME Section XI requirements. As such, the staff finds that the proposed alternative provides reasonable assurance of pump operability.

2.1.4 Conclusion

Based on the determination that compliance with the Code requirements is impractical, and the proposed alternative meets the guidance of NUREG-1482 and provides reasonable assurance of pump operability, relief is granted from the Code requirements pursuant to 10 CFR 50.55a(f)(6)(i). A similar relief request for the affected pumps was granted by the NRC on February 16, 1996, for use during the second IST interval for ANO-2.

2.2.0 Relief Request IST 2-99-2

IST 2-99-2 requests relief for charging pumps 2P-36A, 2P-36B, and 2P-36C from the frequency response range requirements of Section 4.6.1.6 of OM-6. The Code requires that the frequency response range of the vibration measuring transducers and their readout system will be from one-third minimum pump shaft rotational speed to at least 1000 Hz. The licensee proposes to use instrumentation which they currently possess.

2.2.1 Licensee's Basis for Relief Request

The licensee states:

"The vibration requirements of OM-6, with the exception of the accuracy requirement of the vibration transducer/readout system in the frequency response range below 5 Hz, are complied

with by Entergy Operations. This frequency response range is necessary to monitor one-third pump shaft rotational speed for the charging pumps. The ANO-2 charging pumps have a shaft rotational speed of 197 RPM (3.2 Hz). The OM-6 code specifies a vibration monitoring system capable of collecting data down to 1/3 pump rotational speed, which in this case would be 1.1 Hz. In order to meet this specification, special equipment would have to be purchased and a vendor capable of calibration down to that frequency would have to be located at a significant cost. Equipment calibrated for readings down to such a low frequency would not be capable of meeting high frequency response calibration requirements for all other IST components, making specialized data collection equipment useful only for these three pumps. Entergy Operations does not believe that there is sufficient benefit to be gained by obtaining this low frequency transducer/readout system for this limited number of pumps.

The charging pumps are three-piston reciprocating pumps, which causes a six times running speed frequency due to piston slap (each of the three pistons travels back and forth once for each crankshaft revolution). This frequency (6 times running speed) is within the calibrated range of currently available equipment. Looseness in the crankshaft journals creates impacting that is detected at harmonics of running speed. These harmonic frequencies are also within the calibrated range of the available equipment which means that normal reciprocating pump problems are detectable with the current equipment. Time-waveform data allows the evaluation of individual piston slap impacts, as well as once-per-revolution rubs or impacts associated with worn or loose crankshaft bearings. This type of analysis, on these pumps, is more beneficial than the peak amplitude value of the velocity measurement specified by OM-6. Calibration to 5% accuracy at very low frequencies is not necessary for this type of qualitative analysis.

The charging pump bearings are sleeve type (wide babbit, full bronze) on the eccentric crank, sleeve bearings on the connection rods, and ball-and-socket style bearings at the plunger. The only bearings accessible for vibration analysis are the eccentric crank bearings. Impacts inside the pump due to looseness or bearing problems, etc., excite the natural frequencies of the pump casing and parts creating a high frequency vibration, as well as the low frequency of the impacts themselves. The low impact frequencies are readily detected by human senses and the high frequency resonance vibration is detected by the current vibration monitoring system used on the pumps.

Entergy Operations performs more extensive vibration monitoring, both in the number of points monitored and in the type of monitoring performed, on the charging pump equipment train than is required by OM-6. This vibration monitoring, in conjunction with the hydraulic testing and normal operator observations, provide adequate assurance of the operational readiness of these pumps and early detection of any significant degradation."

2.2.2 Alternative Testing

The licensee states:

"For reciprocating pumps, the OM-6 Code requires one location for vibration measurement. That location is on the bearing housing of the crankshaft, approximately perpendicular to both the crankshaft and the line of plunger travel. That location and orientation will be monitored for peak vibration amplitude using the existing vibration instrumentation calibrated from 5 Hz (1.6 times running speed) to at least 1000 Hz. The charging pumps are three-piston reciprocating pumps. The charging pump equipment train consists of a motor, a speed

reducing gearbox, and the pump. Entergy Operations will continue to collect vibration data in three orthogonal directions on each motor bearing, four locations on the gearbox, two radial directions on the pump inboard bearing, and three orthogonal directions on the pump outboard bearings. The vibration data collected includes spectrum and filter-out data. The filter-out data is used for limit comparison and trending purposes. The spectrum data can be used for trending purposes and to diagnose the mechanical condition of equipment. Time waveform data will also be collected and analyzed for evidence of worn or loose crankshaft bearings."

2.2.3 Evaluation

Section 4.6.1.6 of OM-6 requires that the frequency response range of the vibration measuring transducers and their readout system be from one-third minimum pump speed to at least 1000 Hz. Section XI previously required that the frequency response range of the readout system be from one-half minimum speed to at least maximum pump shaft rotational speed (IWP-4520(b)). This change was made specifically by the ASME OM Code Committee in order to more adequately envelop all potential noise contributors that could indicate degradation.

The ANO-2 charging pumps operate at a very low frequency (i.e., at 3.2 Hz). The licensee proposes to use existing vibration instrumentation with a lower frequency limit of 5.0 Hz. The licensee indicates that in order to meet the Code requirements, special equipment with a low end limit of 1.1 Hz would have to be purchased and an instrument capable of calibration down to that frequency would have to be located at a significant cost.

The existing instrumentation cannot measure sub-harmonic vibration or vibration at the running speed for the charging pumps. Vibrations at one-third of running speed may indicate looseness of bearing or "oil whips" in journal bearings. Rotor or seal rub is another type of problem found at sub-harmonic vibration levels. Additionally, loose seals and bearings, bearing and coupling damage, poor shrink fit, and bearing support resonance are indicated in sub-harmonic levels. Problems such as misalignment, unbalance, loose impeller, bent shaft, bearings eccentric, case distortion, and shaft out of round may be detected at pump running speed. Therefore, the intent of the Code changes is clear, i.e., to adequately assess the condition of pump at the low end of frequency range.

The licensee has addressed qualitatively individual piston slap impacts, and rubs or impacts associated with worn or loose crankshaft bearings. The licensee also states that impacts inside the pump due to looseness or bearing problems, excites the natural frequencies of the pump casing and parts creating a high frequency vibration, as well as the low frequency of the impacts themselves, and that the low impact frequencies are readily detected by human senses. Additionally, the high frequency resonance vibration is detected by the current vibration monitoring system used on the pumps. However, the current instrumentation could not provide the data to assess the pump conditions, which are specifically required by the revised Code requirements.

The staff understands that it may be burdensome for the licensee to purchase new equipment each time Code requirements are revised or more advanced equipment becomes available. However, the cost of purchasing new instruments might not sufficiently outweigh the ability to adequately assess the condition of safety-related pumps. In addition, other than the cost of new instruments, the licensee has not provided sufficient information on the hardship or unusual difficulty associated with complying with the Code, or at least obtaining equipment that

could measure the running speed of the pumps. The majority of pump problems are identified at 60% running speed, and this is often where the peak vibration levels are found. Numerous utilities have procured and utilize vibration measurement equipment that have frequency response ranges down to 1.5-2 Hz (e.g., Monticello).

Because of the significance of the revised Code requirements, the licensee should continue its efforts to procure new instruments that meet the Code requirements or revise and resubmit the relief request to address the specific hardship in addition to equipment cost.

2.2.4 Conclusion

The staff concludes that immediate compliance with the new Code requirements would result in a hardship because of the time required to procure new instrumentation. Therefore, the proposed alternative to use existing instruments is authorized, in accordance with 10 CFR 50.55a(a)(3)(ii), for an interim period of one year to allow the licensee to either procure new equipment that meets the Code requirements or revise and resubmit the relief request to address the specific hardship other than cost. The proposed testing meets the requirements in the previous IST interval and provides reasonable assurance of operational readiness of the charging pumps in the interim period because these normally-operating pumps are tested quarterly and the majority of the modes of pump degradation could be detected with existing vibration instrumentation, except for the sub harmonic and first harmonic modes.

2.3.0 Relief Request IST 2-99-3

IST 2-99-3 requests relief for low pressure safety injection (LPSI) pumps 2P-60A and 2P-60B from the test procedure of Section 5.2 of OM-6. The Code requires that an inservice test be conducted with the pump operating at specified test reference conditions.

2.3.1 Licensee's Basis for Relief Request

The licensee states:

"During power operation, minimum recirculation is the only available flow path for testing LPSI pumps that does not violate train separation requirements. On recirculation, flow is from the refueling water tank, through an orificed line back to the refueling water tank. The flow resistance of the loop is therefore, fixed and consistent for each inservice test. Although the test flow rate is set by a fixed system resistance, no means are available to measure flow each quarter as required by OM-6. All of the piping in the flow test loop is stainless steel. Little likelihood exists of an unexpected increase in system resistance due to corrosion product build-up or fouling. Any gradual reduction in system resistance would produce lower than normal pump differential pressure which would result in an evaluation, if results indicate a degrading condition."

2.3.2 Alternative Testing

The licensee states:

"These pumps will be tested on recirculation flow each quarter. Vibration and pump differential pressure data will be taken and analyzed. These pumps will also be full flow tested during cold

shutdowns (in accordance with NUREG-1482, Section 3.1.1.1 guidance) through a fully instrumented flow path to the reactor coolant system. Full-flow pump differential pressure and vibration data will be taken and analyzed. This alternative testing is in accordance with Generic Letter 89-04, Position 9."

2.3.3 Evaluation and Conclusion

There are two flow paths that can be used to test LPSI pumps. One flow path is a recirculation loop from the pump discharge to the refueling water tank, and another is a normal flow path from the pump discharge to the RCS. During power operation, minimum recirculation is the only available flow path for testing LPSI pumps that does not violate train separation requirements. As such, only the recirculation flow path can be used to perform the quarterly pump tests. However, flow rate cannot be measured due to lack of flow instrumentation in the recirculation loop. Imposing the Code requirements would require system modifications and installation of on-line flow instrumentation, and therefore, compliance with the Code requirements would result in hardship for Entergy. In lieu of the Code-required test, Entergy proposes testing the pumps quarterly without flow measurements, but performing additional tests at cold shutdown with flow measurements. The staff finds that this alternative described above provides reasonable assurance of operational readiness for the affected pumps. Pursuant to 10 CFR 50.55a(a)(3)(ii), Entergy's proposed alternative is authorized on the basis that it provides reasonable assurance of pump operability and that imposing the Code requirements would result in hardship without a compensating increase in the level of quality and safety.

2.4.0 Relief Request IST 2-99-4

IST 2-99-4 requests relief for high pressure safety injection (HPSI) pumps 2P-89A, 2P-89B, and 2P-89C from the test procedure of Section 5.2 of OM-6. The Code requires that an IST be conducted with the pump operating at specified test reference conditions.

2.4.1 Licensee's Basis for Relief Request

The licensee states:

"During power operation, minimum recirculation is the only practical flow path for testing HPSI pumps. On recirculation, flow is from the refueling water tank, through an orificed line back to the refueling water tank. The flow resistance of the loop is therefore fixed and consistent for each inservice test. Although the test flow rate is set by a fixed system resistance, no means are available to measure flow each quarter as required by OM-6. All of the piping in the flow test loop is stainless steel. Little likelihood exists of an unexpected increase in system resistance due to corrosion product build-up or fouling. Any gradual reduction in system resistance would produce lower than normal pump differential pressure which would result in an evaluation, if results indicate a degrading condition."

2.4.2 Alternative Testing

The licensee states:

"These pumps will be tested on recirculation flow each quarter. Vibration and pump differential pressure data will be taken and analyzed. These pumps will also be full flow tested during cold shutdowns (in accordance with NUREG-1482, Section 3.1.1.1 guidance) through a fully instrumented flow path to the reactor coolant system. Full-flow pump differential pressure and vibration data will be taken and analyzed. This alternative testing is allowed by Generic Letter 89-04, Position 9."

2.4.3 Evaluation and Conclusion

There are two flow paths that can be used to test HPSI pumps. One flow path is a recirculation loop from the pump discharge to the refueling water tank, and another is a normal flow path from the pump discharge to the RCS. During power operation, minimum recirculation is the only available flow path for testing HPSI pumps. As such, only the recirculation flow path can be used to perform the quarterly pump tests. However, the flow rate cannot be measured due to lack of flow instrumentation in the recirculation loop. Imposing the Code requirements would require system modifications and installation of on-line flow instrumentation, and therefore, compliance with the Code requirements would result in hardship for Entergy. In lieu of the Code-required test, Entergy proposes testing the pumps quarterly without flow measurements but performing additional tests at cold shutdown with flow measurements. The staff finds that this alternative described above provides reasonable assurance of operational readiness for the affected pumps. Pursuant to 10 CFR 50.55a(a)(3)(ii), Entergy's proposed alternative is authorized on the basis that it provides reasonable assurance of pump operability and that imposing the Code requirements would result in hardship without a compensating increase in the level of quality and safety.

3.0 VALVE RELIEF REQUEST

3.1.0 Relief Request IST 2-99-5

IST 2-99-5 requests relief for check valves 2MS-39A and 2MS-39B from the requirements of Section 4.3.2 of OM-10, i.e., check valves shall be exercised nominally every 3 months, except as provided by Sections 4.3.2.2, 4.3.2.3, 4.3.2.4, and 4.3.2.5. These check valves open to supply steam to the emergency feedwater pump turbine and close to prevent reverse flow to a ruptured steam generator.

3.1.1 Licensee's Basis for Relief Request

The licensee states:

"The design of the emergency feedwater pump turbine steam supply does not include any means to verify that the disc in these valves travels to the closed position on cessation or reversal of flow. The ability of these valves to close can, however, be confirmed by non-intrusive monitoring techniques. This monitoring cannot be performed during cold shutdowns or refueling outages [because the] steam flow necessary to open and close these valve[s] is not available during outages.

Although non-intrusive testing could be performed quarterly during pump testing to confirm the ability of the valves to close, the following provides justification for deferring non-intrusive testing to once per refueling cycle during plant operation:

a. System pressures and flow conditions have been verified to cause the valves to close during emergency feedwater pump testing.

b. NUREG-1482, Section 4.1.4 and the Summary of Public Workshops Held in NRC Regions on Inspection Procedure 73759 "Inservice Testing of Pumps and Valves" and Answers to Panel Questions on Inservice Testing Issues, reference question 2.3.19, state that the need to setup special test equipment is adequate justification to defer close testing of check valves. This guidance is applicable at ANO-2 pertaining to closure testing of these valves.

c. Quarterly testing using non-intrusive testing methods could provide indeterminate results caused by unrelated system dynamic conditions which could, in turn, result in unnecessary additional testing or disassembly or possibly an unnecessary plant shutdown.

d. Each of these valves has been disassembled several times with no unexpected service-related deterioration identified during these inspections."

3.1.2 Alternative Testing

The licensee states:

"These valves will be exercised open with flow each quarter. Non-intrusive monitoring techniques, in conjunction with a quarterly emergency feedwater pump test, will be performed once per refueling cycle during power operations. If nonintrusive testing does not confirm that the valve closes or reveals a failure mechanism that could impact the valve's safety function, then the valve will be opened and inspected."

3.1.3 Evaluation and Conclusion

These check valves are in the steam supply line to the emergency feedwater pump turbine. They open to admit steam to the turbine and close to prevent reverse flow to a postulated ruptured steam generator. These valves meet the Code requirements of full-stroke open during testing of the turbine emergency feedwater pump, but they could not be verified to close on cessation or reversal of flow during the quarterly test. Disassembly/inspection, leak testing, and non-intrusive techniques are acceptable means to verify closure of check valves as discussed in Position 2 of GL 89-04 and Section 4.1.2 of NUREG-1482. The licensee proposes to use the non-intrusive technique to verify the closure of the affected valves during plant operation once per refueling cycle in lieu of every quarter. The licensee requests the relief from the quarterly closure test on the basis of the need to set up special test equipment and that the test may result in hardship for unnecessary additional testing, disassembly, or possibly unnecessary plant shutdown.

With regard to the extended test frequency, the staff has determined (see Section 4.1.4 of NUREG-1482) that the need to set up test equipment provides sufficient justification to defer closure testing of a check valve until the next refueling outage. Use of the non-intrusive techniques requires additional equipment, setup of the equipment, and the use of qualified personnel to operate the equipment. Therefore, the licensee's proposal meets the guidance of NUREG-1482, and more frequent testing would result in a hardship for the licensee. Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee's proposed alternative is authorized on the basis that compliance with the Code requirements would result in hardship without a compensating increase in the level of quality and safety. In addition, the proposal meets the guidance of NUREG-1482.

3.2.0 Relief Request IST 2-99-6

IST 2-99-6 requests relief for valves 2SI-27A, 2SI-27B, 2SI-28A, and 2SI-28B from the valve seat leakage testing requirements of Section 4.2.2.3(c) of OM-10. These valves open to allow safety injection flow to RCS hot leg piping during long-term core cooling to prevent boron precipitation. They have a closed safety function to act as pressure isolation valves.

3.2.1 Licensee's Basis for Relief Request

The licensee states:

"The absence of isolation valves on the downstream side does not allow individual leak rate testing of these valves. The low pressure side of these valves is monitored for back leakage through high pressure alarms in the control room. In addition, 2SI-26A and 2SI-26B, a third valve in series on each injection path, are individually leak rate tested. [Valves] 2SI-26A and 2SI-26B provide a second, leak-tested, pressure isolation between high design pressure and low design pressure piping."

3.2.2 Alternative Testing

The licensee states:

"[Valves] 2SI-27A and 2SI-28A will be treated as one valve. [Valves] 2SI-27B and 2SI-28B will also be treated as one valve. These valve pairs are demonstrated to be leak tight during power operation. Per OM-10, Section 4.2.2.1, these valves do not require a leak test. The low pressure side of these valve pairs is instrumented, 2PI-5105 and 2PI-5106, and will alarm in the control room in the event of high pressure, hence demonstrating that these valves, as a pair, are leak tight. If one or both of these valve pairs were leaking and if other valves were leaking such that no pressure buildup is observed on 2PI-5105 and[/]or 2PI-5106, then leakage through these valve pairs would still be detected as an increase in unknown leakage when the daily reactor coolant system leakage test is performed. In the event the RCS unknown leakage becomes significant (greater than one gpm) then additional steps will be performed to determine if the leakage is through 2SI-27A/28A or 2SI-27B/28B. Leak testing only one of the two valves in each identified pair does not create a conflict with any ANO-2 regulatory or license requirements."

3.2.3 Evaluation and Conclusion

These valves open to allow safety injection flow to RCS hot leg piping during long-term core cooling to prevent boron precipitation. They have a closed safety function to act as pressure isolation valves. It is not practical to individually leak test the affected check valves because they are in series and necessary test taps are not installed. Imposing the Code requirements would require system modifications and installation of test taps. The licensee proposes to treat (2SI-27A/28A) and (2SI-27B/28B) as two valve pairs and to demonstrate the leak tightness of each pair during power operation. In lieu of testing the affected valves individually, the licensee proposes to test the affected valves in pairs, and additional valves 2SI-26A/26B in accordance with OM-10 to provide the second leak tested barrier in the lines on the high pressure side. The staff finds that the proposal of two leak tested barriers provides reasonable assurance of valve isolation reliability for the affected system. Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee's proposed alternative is authorized on the basis that compliance with the Code would result in hardship without a compensating increase of level of quality and safety.

3.3.0 Relief Request IST 2-99-7

IST 2-99-7 requests relief for piston check valves 2CVC-22A, 2CVC-22B, 2CVC-22C, 2CVC-69A, 2CVC-69B, and 2CVC-69C from the requirements of Section 4.3.2 of OM-10, i.e., check valves shall be exercised nominally every 3 months, except as provided by Sections 4.3.2.2, 4.3.2.3, 4.3.2.4, and 4.3.2.5. These valves open to supply normal charging and emergency boration to the RCS and prevent reverse flow through an idle charging pump.

3.3.1 Licensee's Basis for Relief Request

The licensee states:

"The discharge of each charging pump (ANO-2 has three charging pumps) has two 1-1/2 inch piston check valves installed in series. The piston check valves both have an open and closed safety function. Insufficient space (approximately 1[-]1/2 inches) exists between the two piston check valves to allow for pressure taps that would be required to perform individual valve closure testing. Only one valve is needed to meet design requirements for this application."

3.3.2 Alternative Testing

The licensee states:

"The piston check valves will be full flow tested each quarter. The piston check valves that are in series will be treated as one valve and will be reverse flow tested each quarter. Should a valve pair fail a reverse flow closure test, both valves will be disassembled, repaired, and re-tested."

3.3.3 Evaluation and Conclusion

These valves open to supply normal charging and emergency boration to the RCS and prevent reverse flow through an idle charging pump. In order to meet the Code requirements, each installed valve must have the capability of being tested individually to verify its safety functions.

This would require the licensee to install test taps between the two valves in series. The licensee states that insufficient space (approximately 1-1/2 inches) exists between the two piston check valves to allow for pressure taps that would be required to perform individual valve closure testing. Imposing the Code requirements would cause the licensee to extensively modify the system and install test taps. The licensee proposes to test the valves in pair and states that only one valve is needed to meet design requirements for this application. In addition, should a valve pair fail a reverse flow closure test, both valves will be disassembled, repaired, and re-tested. The staff finds the proposal to test the affected valves in pairs provides reasonable assurance of valve closure reliability for the charging system. Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee's proposed alternative is authorized on the basis that compliance with the Code would result in hardship without a compensating increase of level of quality and safety.

3.4.0 Relief Request IST 2-99-8

IST 2-99-8 requests relief for valves 2SI-16A, 2SI-16B, 2SI-16C, and 2SI-16D from exercise requirements of Section 4.3.2 of OM-10. These valves have an open safety function to provide safety injection flow from safety injection tanks to the RCS. These valves also have a closed safety function to act as pressure isolation valves between low pressure safety injection tanks and the RCS.

3.4.1 Licensee's Basis For Relief Request

The licensee states:

"These valves cannot be full-stroke tested during power operation because the safety injection tanks pressure is less than the reactor coolant system pressure during normal operation. Due to the time it takes the safety injection tank motor-operated valves to open, there is no way to establish maximum accident flow through these valves during cold shutdown or refueling outages."

3.4.2 Alternative Testing

The licensee states:

"These valves will be disassembled and stroke tested during refueling outages in accordance with the requirements of GL 89-04, Position 2. One valve will be opened and inspected each refueling outage. The check valve inspected will be alternated each refueling outage until all of the check valves have been inspected. When all of the valves have been inspected, the inspection schedule will be repeated. If a common failure mode that could affect a valve's safety function is discovered during an inspection, all of the other potentially affected valves will be inspected. If a valve is disassembled, then the valve will receive a partial flow and leak test prior to returning it to service. [Valves] 2SI-16A, 2SI-16B, 2SI-16C, and 2SI-16D are quarterly partial stroke tested.

In lieu of disassembling these check valves, non-intrusive testing may be performed to confirm the ability of these valves to full stroke open. If non-intrusive testing is performed, the guidance in NUREG-1482, Section 4.1.2 will be followed. If non-intrusive testing cannot confirm that the valve strokes full open or reveals a failure mechanism that could impact the valve's safety

function, the valve will be opened and inspected. If non-intrusive testing is not performed or provides inconclusive results, disassembly of the check valves as outlined in the previous paragraph will be resumed."

3.4.3 Evaluation and Conclusion

These valves have an open safety function to provide safety injection flow from safety injection tanks to the RCS. These valves also have a closed safety function to act as pressure isolation valves between low pressure safety injection tanks and the RCS. These valves cannot be full-stroke tested during power operation because the safety injection tanks pressure is less than the RCS pressure during normal operation.

Section 4.3.2.2 of OM-10 allows that if valve exercising is not practicable during plant operation or cold shutdowns, full-stroke exercising is to be performed during refueling outages. Section 4.3.2.4(c) allows disassembly every refueling outage to verify operability of check valves. However, the licensee proposes to test these valves on a sampling basis, and to disassemble one valve each refueling outage in accordance with the requirements of GL 89-04, Position 2. In lieu of disassembling these check valves, non-intrusive testing may be performed to confirm the ability of these valves to full stroke open. A similar relief request SI-2 for using disassembly/inspection was authorized by NRC on February 16, 1996, for use during the second IST interval.

Because these valves cannot be full-stroke tested during power operation, disassembling these check valves on a sampling plan was authorized for use during the second IST interval. However, in addition to disassembly/inspection, the licensee also proposes an option to use non-intrusive testing to confirm the ability of these valves to full-stroke open. The licensee states that if non-intrusive testing cannot confirm that the valve strokes full open or reveals a failure mechanism that could impact the valve's safety function, the valve will be opened and inspected, and if non-intrusive testing is not performed or provides inconclusive results, disassembly of the check valves as outlined in the previous paragraph will be resumed. Because the non-intrusive testing is performed in accordance with the guidance in NUREG-1482, Section 4.1.2, the staff finds it to be an acceptable means of verifying valve operability.

The staff concludes that the proposed alternative of using either disassembly associated with a sampling plan or qualified non-intrusive techniques meets the guidance of GL 89-04 and NUREG-1482, and therefore, provides reasonable assurance of valve operability. Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee's proposed alternative is authorized on the basis that compliance with the Code would result in hardship without a compensating increase of level of quality and safety.

3.5.0 Relief Request IST 2-99-9

IST 2-99-9 requests relief for check valves 2BS-IA and 2BS-IB from the requirements of Section 4.3.2 of OM-10, i.e., check valves shall be exercised nominally every three months, except as provided by Sections 4.3.2.2, 4.3.2.3, 4.3.2.4, and 4.3.2.5. These valves open to provide a flow path from refueling water tank to containment spray and safety injection pumps. They have a closed function to prevent reverse flow to the refueling water tank.

3.5.1 Licensee's Basis For Relief Request

The licensee states:

"Full-stroke exercising these valves during power operation or cold shutdown would require the simultaneous operation of one high pressure safety injection pump, one low pressure safety injection pump, and one containment spray pump at design accident flow rates. During power operation, the discharge pressure of the high pressure safety injection pump and low pressure safety injection pump is less than RCS pressure. During cold shutdowns, there is insufficient RCS volume to allow concurrent operation of the high pressure and low pressure safety injection pumps.

The ability of these valves to fully open can be confirmed by non-intrusive monitoring techniques. Although non-intrusive testing can be performed quarterly during pump testing to confirm the ability of the valves to open, the following provides justification for deferring non-intrusive testing to once per refueling cycle during plant operation:

a. These valves are exercised (partial-stroked open and verified closed) on a quarterly frequency.

b. NUREG-1482, Section 4.1.4 and the Summary of Public Workshops Held in NRC Regions on Inspection Procedure 73759 "Inservice Testing of Pumps and Valves" and Answers to Panel Questions on Inservice Testing Issues, reference question 2.3.19 state that the need to setup special test equipment is adequate justification to defer flow testing of check valves. This guidance is applicable to ANO-2 pertaining to open stroke testing of these valves.

c. System pressures and flow conditions have been verified to cause the valves to fully stroke during containment spray pump testing.

d. Quarterly testing using non-intrusive testing methods could provide indeterminate results caused by unrelated system dynamic conditions which could, in turn, result in unnecessary additional testing or disassembly or possibly an unnecessary plant shutdown.

e. Each of these valves has been disassembled several times with no unexpected service related deterioration identified during these inspections."

3.5.2 Alternative Testing

The licensee states:

"These valves will be part-stroke exercised open and verified closed quarterly. Non-intrusive monitoring techniques in conjunction with a quarterly containment spray pump test will be performed once per refueling cycle, during plant operation. The guidance in NUREG-1482, Section 4.1.2 for a sampling plan will be followed with these two valves in a group. One of these valves will be non-intrusively tested each refueling cycle, alternating the tested valve each refueling cycle. If non-intrusive testing does not confirm that the valve strokes full open or reveals a failure mechanism that could impact the valve's safety function, the valve will be

opened and inspected. If problems are found with the sample valve that are determined to affect the operational readiness of the valve, all valves in the group will be tested using non-intrusive techniques."

3.5.3 Evaluation and Conclusion

These valves open to provide a flow path from refueling water tank to containment spray and safety injection pumps. They have a closed function to prevent reverse flow to the refueling water tank. These valves meet the Code requirements of closure testing quarterly, but they could only be part-stroke open during the quarterly tests. Disassembly/inspection and non-intrusive techniques are acceptable means to verify closure of check valves, as discussed in Position 2 of GL 89-04 and Section 4.1.2 of NUREG-1482. The licensee proposes to use the non-intrusive technique to verify the full open position of the affected valves during plant operation, once per refueling cycle in lieu of every quarter. The licensee requests the relief from the quarterly full-open stroke test based on the need to set up special test equipment, and that the test may result in hardship for unnecessary additional testing, disassembly, or possibly unnecessary plant shutdown.

With regard to the extended test frequency, the staff has determined (see Section 4.1.4 of NUREG-1482) that the need to set up test equipment provides sufficient justification to defer full open testing of a check valve until the next refueling outage. Use of the non-intrusive techniques requires additional equipment, setup of the equipment, and the use of qualified personnel to operate these equipment. Therefore, the licensee's proposal meets the guidance of NUREG-1482, and more frequent testing would result in a hardship for the licensee.

The licensee also proposes to use a sampling plan in conjunction with non-intrusive testing methods, i.e., one of the two valves will be non-intrusively tested each refueling cycle. Although the need to set up test equipment is adequate justification to defer full open testing of a check valve until the next refueling outage, it is not sufficient to justify the use of a sampling plan. Unless additional hardship and burden associated with non-intrusive method is provided, the use of a sampling plan is denied. It should be noted that Relief Request IST 2-99-5 (see Section 3.1.0 of this evaluation) is similar to this relief request, yet a sampling plan was not proposed.

Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee's proposed alternative is authorized on the basis that the proposal meets the guidance of NUREG-1482, and that compliance with the Code would result in hardship without a compensating increase of level of quality and safety. However, the use of a sampling plan is denied and the interval between two tests shall not exceed 25% of the length of the refueling cycle.

3.6.0 Relief Request IST 2-99-10

IST 2-99-10 requests relief for check valves 2BS-5A and 2BS-5B from the requirements of Section 4.3.2 of OM-10, i.e., check valves shall be exercised nominally every three months, except as provided by Sections 4.3.2.2, 4.3.2.3, 4.3.2.4, and 4.3.2.5. These containment spray discharge header check valves remain closed to maintain the spray headers full of spray water, and open to provide containment spray flow to the reactor building.

3.6.1 Licensee's Basis For Relief Request

The licensee states:

"Full-stroke or partial-stroke exercising these valves with flow during power operation or cold shutdown would result in spraying the containment, with possible damage to plant equipment."

3.6.2 Alternative Testing

The licensee states:

"These valves will be disassembled and stroke tested during refueling outages in accordance with the requirements of GL 89-04, Position 2. One of these valves will be inspected each refueling outage, alternating between the valves. Valves 2BS-5A and 2BS-5B have been disassembled and manually exercised with no discernible degradation to date. When the valve is disassembled, the valve internals are visually inspected by quality control personnel for worn or corroded parts. If problems are found, repairs will be made and the remaining valve shall be inspected unless a common-mode failure mechanism can be dismissed. Following re-assembly, a small amount of water is passed through these valves while re-filling the spray header."

3.6.3 Evaluation and Conclusion

These containment spray discharge header check valves remain closed to maintain the spray headers full of spray water, and open to provide containment spray flow to the reactor building. Full-stroke or partial-stroke exercising these valves with flow during power operation or cold shutdown would result in spraying the containment, with possible damage to plant equipment. Therefore, the licensee proposes to disassemble and inspect the affected valves each refueling outage.

Section 4.3.2.2 of OM-10 allows that if valve exercising is not practicable during plant operation or cold shutdowns, full-stroke exercising is to be performed during refueling outages. Section 4.3.2.4(c) allows disassembly every refueling outage to verify operability of check valves. However, the licensee proposes to test these valves on a sampling basis, i.e., to disassemble and inspect one valve each refueling outage in accordance with the guidance of GL 89-04, Position 2.

The staff concludes that the proposed alternative meets the guidance of GL 89-04 and NUREG-1482, and provides reasonable assurance of valve operability. Pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee's proposed alternative is authorized on the basis that compliance with the Code would result in hardship without a compensating increase of level of quality and safety.

3.7.0 Relief Request IST 2-99-11

IST 2-99-11 requests relief from the accumulator requirements of Paragraph 8.1.2.2 of OM-1987, Part 1 (OM-1987) for 2PSV-2803, 2PSV-2805, 2PSV-2806, 2PSV-2808, 2PSV-2823, 2PSV-2825, 2PSV-2826, 2PSV-2828, 2PSV-5007, 2PSV-5027, 2PSV-5047, 2PSV-5067.

These are safety and relief valves used for compressible fluid service other than steam. They are associated with emergency diesel generator starting air, safety injection tank nitrogen.

3.7.1 Licensee's Basis for Relief Request

The licensee states:

"The specified accumulator volume requirement is not needed for simple determination of the valve set pressure. This was recognized by the Code working group and committees and is corrected in more recent versions of the OM Code. (Ref[erence] ASME OM Code-1990, OMc-1994 Addenda, Paragraph I 8.1.2, and OMa Code 1996, Paragraph I 8.1.2(b).)"

3.7.2 Alternative Testing

The licensee states:

"The volume of the accumulator drum and the pressure source flow rate will be sufficient to determine the valve set-pressure. (Ref ASME OM Code-1990, OMc-1994 Addenda, Paragraph I 8.1.2 and OMa Code 1996, Paragraph I 8.1.2(b).)"

3.7.3 Evaluation and Conclusion

Paragraph 8.1.2.2 of OM-1987 requires the setpoint test accumulator have a minimum volume equal to the valve capacity (cubic feet/second) multiplied by the time open (seconds), divided by 10. Unlike OM-1987, the later versions of OM Code and Appendix I on testing of safety and relief valves do not require the verification of valve capacity, only the set pressure. The OM Part 1 Code Committee reviewed the requirements of Paragraph 8.1.2.2 of OM-1987 and its basis, concluded that the requirements were overly conservative and unnecessarily prescriptive. The Code requirement was revised in the1994 Addenda (OMc) to delete the prescriptive requirements, and requires only that the volume and pressure source flow be sufficient to determine the valve set-pressure. Compliance with the OM-1987 requirements would require a calculation for each valve and possibly requiring resizing the accumulator drum, which would result in hardship for the licensee. The use of later versions of OM Code and OMc-1994 provide an acceptable means of performing set pressure tests. The revision to the OM Code is also contained in Appendix I, Section I 4.1.1(b) of the 1995 Edition of the OM Code which has been incorporated by reference in 10 CFR 50.55a (64 FR 51370). Therefore, the licensee's proposed alternative is approved pursuant to 10 CFR 50.55a(f)(4)(iv).

4.0 CONCLUSION

Pursuant to 10 CFR 50.55a(f)(4)(iv), relief request IST 2-99-11 is approved on the basis that the proposed alternative is contained in the 1995 Edition of the OM Code, which has been incorporated by reference in 10 CFR 50.55a (64 FR 51370). Pursuant to 10 CFR 50.55a(a)(3)(ii), relief requests IST 2-99-3, 2-99-4, 2-99-5, 2-99-6, 2-99-7, 2-99-8, 2-99-9, and 2-99-10, are authorized for use in the third IST interval on the basis that imposition of Code requirements would result in hardship without a compensating increase in the level of quality or safety, and the proposed testing provides reasonable assurance of pump and valve operability. However, the proposed use of a sampling plan associated with relief request 2-99-9

is denied, because the licensee has not adequately addressed the specific hardship of testing the two affected valves in the group.

Pursuant to 10 CFR 50.55a(f)(6)(i), relief request IST 2-99-1 is granted on the basis that compliance with the Code requirements is impractical, and the proposed alternative meets the guidance of NUREG-1482, and provides reasonable assurance of pump operability. The NRC has determined that the granting of relief request IST 2-99-1 is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The relief request IST 2-99-2 to use existing instruments is authorized, in accordance with 10 CFR 50.55a(a)(3)(ii), for an interim period of one year to allow the licensee to either procure new equipment that meets the Code requirements or revise and resubmit the relief request. The NRC has determined that imposition of the Code requirements for this one-year period would result in hardship without a compensating increase in the level of quality or safety, and the proposed testing provides reasonable assurance of pump operability.

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